



## Factors associated with leisure time physical activity among ELSA-Brasil participants: Ecological model



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### ABSTRACT

The main objective of the study was identify the prevalence and factors associated with leisure time physical activity (LTPA) in adult participants of the Longitudinal Study of Adult Health (ELSA-Brasil). The LTPA was measured using the International Physical Activity Questionnaire (IPAQ), long version. A hierarchical ecological model was built with the possible factors associated with LTPA distributed across blocks. We estimated crude and adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) using logistic regression. In men, being more educated, having a high family income, living in environments with conditions and opportunities for PA, being retired and being overweight were positively associated, while current smoking, obesity and abdominal obesity were associated negatively with the LTPA. Among women, being over 60 years old, being more educated, having a high family income, living in an environment with conditions and opportunities for PA practice and being retired were positively associated, while being overweight, obese and having abdominal obesity were associated negatively with the LTPA. The proposed ecological model explains the LTPA through the social, physical and personal environment and highlights gender differences in physical activity.

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### 1. Introduction

Physical activity (PA) is considered an important protective factor for metabolic and cardiovascular diseases (Kokkinos, 2008; Pitanga and Lessa, 2010; Pitanga et al., 2014a). It is defined as any body movement that results in energy expenditure above the resting metabolism (Caspersen et al., 1985). Moreover, it is classified into four domains: leisure time, commuting, work and household activities.

Researchers seek to identify the determinants of PA, which include components of social, environmental, behavioral and biological factors, especially with regard to leisure time because there is extensive evidence of its benefits for promoting and maintaining health (Pitanga et al., 2010; Wagmacker and Pitanga, 2009).

While socioeconomic status, education and age are reported in the literature as associated with physical activity (Marshall et al., 2007; Ahmed et al., 2005; Marquez et al., 2009; Pitanga and Lessa, 2015a; Pitanga et al., 2012), variables such as racial discrimination, perceptions

of security in the neighborhood and living in a suitable environment for being active are considered possible determinants of disparities in health and may also be related to physical activity (Shelton et al., 2009; Roman et al., 2009; Piro et al., 2006; Gustat et al., 2012).

Stress and the hours devoted to work are also associated with physical activity (Kirk and Rhodes, 2011) and smoking is related to sedentary behavior, as seen by evidence showing that, after quitting, time for PA increases significantly among subjects who attend antismoking clinics (Hassandra et al., 2012).

On the other hand, longitudinal population-based studies have shown that PA has an inverse association with obesity (Fogelholm and Kukkonen-Harjula, 2000; Saris et al., 2003), although because individuals who are overweight or obese may be less likely to be physically active, it is not entirely clear whether obesity is a cause or consequence of physical inactivity (Ekelund et al., 2008; Bauman et al., 2012).

Different and sophisticated techniques have been used to try to identify the main determinants of PA in several studies. The hierarchical analysis has been proposed to analyze possible determinants of health or disease conditions (Victoria et al., 1997). In Brazil, researchers have used this model to explain the PA behavior of different populations (Florindo et al., 2009; Fonseca et al., 2008).

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Physical activity identification in adults using an ecological model to summarize the different levels of the socio-economic and cultural environment, the physical environment and the individual environment can provide important information for the planning and implementation of public policies to promote physical activities, as it can be used as a means to prevent various cardiovascular and metabolic diseases with consequent cost reductions for the health system (Pitanga and Lessa, 2008), especially considering that the prevalence of LTPA observed in Brazilian studies (Pitanga et al., 2014a; Florindo et al., 2009; Del Duca et al., 2013; Da Silva et al., 2014) are smaller than in other international studies (Martinez-Gonzalez et al., 2001; Redondo et al., 2011). In addition, this study will add information about LTPA in active and retired civil servants in higher education institutions of six Brazilian cities.

The aim of this study was to evaluate factors associated with leisure time physical activity in adult participants of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil).

## 2. Methods

### 2.1. Population and sample

The ELSA-Brasil is a cohort study of 15,105 active and retired civil servants aged 35–74 years in six higher education institutions located in the cities of Salvador, Vitoria, Belo Horizonte, Rio de Janeiro, São Paulo and Porto Alegre, whose methodological details have been previously described (Aquino et al., 2012; Schmidt et al., 2015). In the present study, all participants who participated in the baseline (2008–2010) assessment about physical activity and provided full details of their social, physical and individual environments were included in the analysis, with a total of 14,876 participants (1.5% loss).

The ELSA-Brasil was approved by Ethics Committees in Research of the six centers involved in the study. All participants signed an informed consent form and were guaranteed that their data would be maintained secretly and confidentially.

### 2.2. Data production

Data were collected by a team of trained interviewers and assessors and were certified by a quality control board able to perform the study protocol in any ELSA-Brasil research center (Schmidt et al., 2015). The study included face-to-face interviews to administer the questionnaire blocks and anthropometric measurements of weight, height and waist circumference. Body weight without shoes and while wearing standardized dress of negligible weight was obtained in the morning after the participants fasted for 8 to 12. We used an electronic scale, Toledo®, with a capacity of up to 200 Kg. To measure the standing height we used a SECA® brand stadiometer with the participant positioned standing straight with his back to the stadiometer, barefoot (at an angle of 45°) and with his head in the Frankfurt plane. Waist circumference was obtained by placing an inelastic tape over the mid-point between the lower rib and the iliac crest on the right side, or at the umbilicus if it was impossible to mark points. Standards and recommended technical criteria were observed at all stages of the anthropometric evaluation (Lohman et al., 1988). The equipment was installed and calibrated following standard procedures in all research centers (RC).

#### 2.2.1. Measurement of Physical Activity

For the identification and quantification of PA, we used the International Physical Activity Questionnaire (IPAQ), which consists of questions about the frequency and duration of physical activity (walking, moderate and vigorous) at work, in transportation, in household activities and during leisure time (Matsudo et al., 2001). Physical activity was measured in minutes/week by multiplying the weekly rate for the duration of each of the activities. For the purposes of this study, we used only the domain of physical activity during leisure time, which was categorized as 0 = insufficiently active (<150 min per week of moderate physical activity or

walking and/or <60 min per week in vigorous physical activity or <150 min per week of any combination of walking, moderate and vigorous physical activity) and 1 = physically active (≥150 min per week of moderate physical activity or walking and/or ≥60 min per week in vigorous physical activity or ≥150 min per week of any combination of walking, moderate and vigorous physical activity).

#### 2.2.2. Measurement of independents variables

The perception of safety in the neighborhood was obtained by following question: Do you feel safe walking day or night in your neighborhood? The answer “no” was categorized as = 0, and “yes” was categorized as = 1. The care for patients/dependents in the home was dichotomized into: 0 = no and 1 = yes. Discrimination in public places was obtained through the following question: ever in life you felt discriminated against in public places such as banks, commercial establishments, hospitals, among others, and was categorized as 0 = no and 1 = yes. The variables of the physical environment were classified by the following questions: your neighborhood offers conditions for people to be physically active (walking, bike?); and, there are many opportunities to practice physical activities or sports in clubs, gyms or other spaces in

### DISTAL BLOCK - SOCIAL ENVIRONMENT

DEMOGRAPHIC VARIABLE  
Age, Education.

ECONOMIC VARIABLES  
Family income, Salaried maid's  
presence in the home.

CULTURAL VARIABLE  
Perception of security in the neighborhood,  
Discrimination in public environments, Care of  
patients / dependents in the home.

### INTERMEDIATE BLOCK - PHYSICAL ENVIRONMENT

ENVIRONMENT VARIABLES  
Environment in the neighborhood with conditions (walking,  
biking) and opportunities (sports clubs, gyms or other  
spaces) for physical activity.

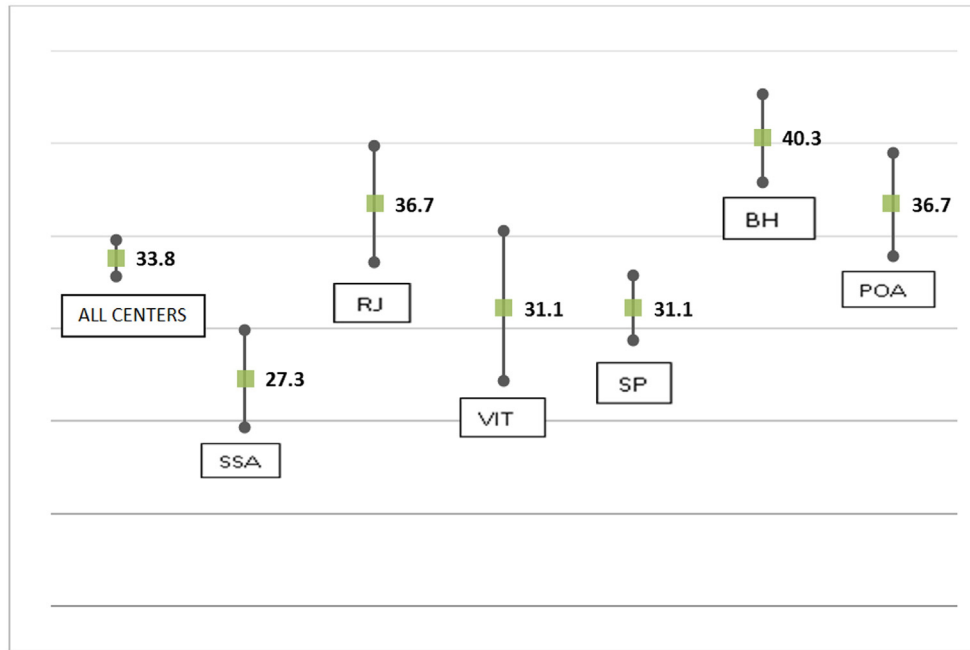
### PROXIMAL BLOCK – INDIVIDUAL ENVIRONMENT

BEHAVIORAL /  
OCCUPATIONAL VARIABLE  
Current Smoking, Functional  
Status and Hours Work Week

BIOLOGICAL VARIABLES  
Overweight, Obesity, Abdominal Obesity

LEISURE TIME  
PHYSICAL  
ACTIVITY

Fig. 1. A hierarchical ecological model for the analysis of factors associated with leisure time physical activity in adults from the ELSA-Brasil.



**Graph 1.** Prevalence and 95% CI of leisure time physical activity for centers after adjusting for age (Female). Longitudinal Study of Adult Health (ELSA-Brasil), 2008–2010. SSA, Salvador; RJ, Rio de Janeiro; VIT, Vitória; SP, São Paulo; BH, Belo Horizonte; POA, Porto Alegre.

your neighborhood? The answer “no” was categorized as = 0, and “yes” was categorized as = 1.

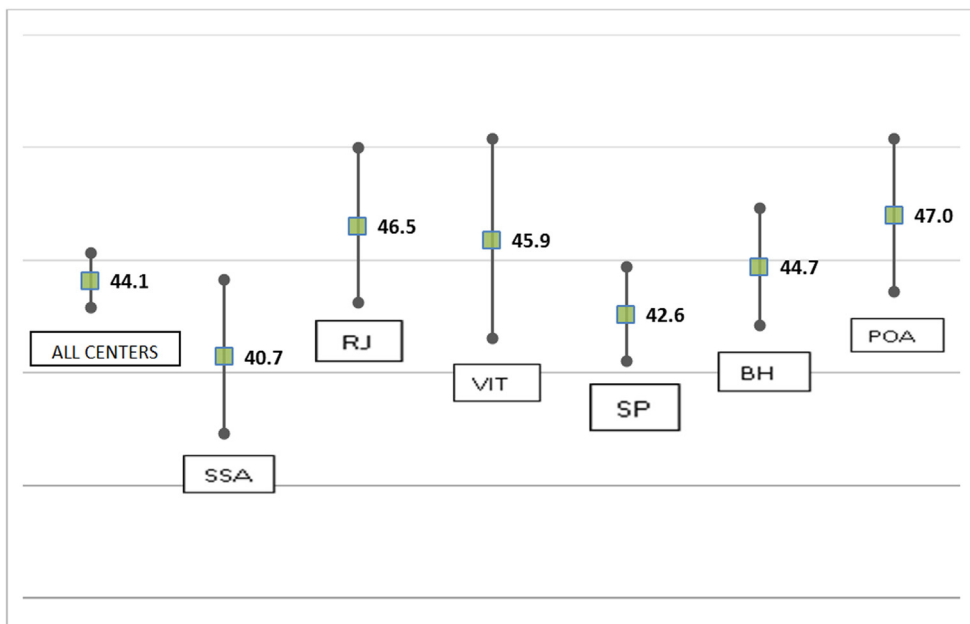
Overweight and obese participants were identified by the body mass index (BMI) measurement with the equation  $BMI = \text{weight (kg)} / \text{height (m)}^2$  (Amin et al., 2012). The following cutoffs were adopted: overweight = 0 if  $BMI < 25.0$  and overweight = 1 if  $BMI \geq 25.0$ ; and obesity = 0 if  $BMI < 30.0$  and obesity = 1 if  $BMI \geq 30.0$ . Abdominal obesity was determined by the conicity index (CI) applying the formula:

$$C\text{-index} = \frac{\text{Waistcircumference(m)}}{0.109 \sqrt{\text{BodyMass(kg)}} \cdot \text{Height(m)}}$$

The following cut-off points for conicity index were used: for men, abdominal obesity = 0 if the  $CI < 1.25$ , and abdominal obesity = 1 if the  $CI \geq 1.25$ . For women, abdominal obesity = 0 if the  $CI < 1.18$ , and abdominal obesity = 1 if the  $CI \geq 1.18$  (Pitanga and Lessa, 2015b).

### 2.3. Analysis procedures

Leisure time physical activity (LTPA) was the dependent variable, while the independent variables were grouped into blocks from an adapted theoretical ecological model (Matsudo et al., 2004): the social environment (demographic: age and level of education; economic: family income and the presence of a salaried maid in the home; cultural: perceptions of safety in the neighborhood, discrimination in public



**Graph 2.** Prevalence and 95% CI of leisure time physical activity for centers after adjusting for age (Male). Longitudinal Study of Adult Health (ELSA-Brasil), 2008–2010. SSA, Salvador; RJ, Rio de Janeiro; VIT, Vitória; SP, São Paulo; BH, Belo Horizonte; POA, Porto Alegre.

places and the care of patients/dependents in the home); the physical environment (conditions and opportunities for physical activity); and individual factors (behavioral/occupational: current smoking, functional status and weekly working hours); and biological factors (overweight, obesity and abdominal obesity).

All analyzes were stratified by gender. The prevalence of LTPA by RC and the strata of each independent variable were analyzed after adjusting for age and presented as frequencies with their respective 95% confidence intervals. We estimated crude and adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) using logistic regression from the adapted theoretical model (Matsudo et al., 2004) to discriminate against potential associated factors of hierarchical levels (Fig. 1). The strategy used for the entry of variable blocks was the forward method in the following order: distal blocks (socio-demographic, socio-economic and socio-cultural), intermediate blocks (physical environment: conditions and opportunities for physical activity) and proximal block (behavioral/occupational and biological). During the steps of hierarchical analysis remained in the model variables with  $p < 0.1$ . We used the statistical software STATA, version 12.0.

### 3. Results

A total of 6788 men and 8088 women were included in the analysis. The prevalence for each RC stratified by sex and the age-adjusted LTPA global prevalence rates are shown in Graph 1 and 2. The prevalence and confidence intervals of LTPA per stratum of each variable analyzed in the study are shown in Table 1. Both men and women were more active in older age than at 60 years or younger. Greater degrees of education and family income were associated with increased LTPA in both sexes. Higher proportions of LTPA were observed in men and women who reported having housemaids in the home. Regarding the care of patients/dependents at home, women had lower LTPA scores when they were responsible for this activity. Both men and women had higher LTPA scores when they reported more conditions and opportunities for physical activity. The LTPA frequency was lower in current smokers and higher in retired men and women. The proportion of LTPA was lower in men and women who were overweight, obese and had abdominal obesity.

The social, physical and personal environment variables included in the hierarchical model were associated with physical activity in leisure time after stratifying by sex (Tables 2 and 3). Among men, being better educated, having a high family income, living in environments with conditions and opportunities for physical activity, being retired and being overweight were positively associated with the LTPA, while being a current smoker, being obese and having abdominal obesity were negatively associated with the LTPA (Table 2). Among women, being over 60 years old, being better educated, having a high family income, living in environments with conditions and opportunities for physical activity and being retired were positively associated with the LTPA, while being overweight, obese and having abdominal obesity were negatively associated with the LTPA (Table 3).

### 4. Discussion

The prevalence of LTPA among participants of the ELSA-Brasil were higher than those observed in other studies conducted in Brazil. A recent study conducted in the city of Alagoinhas in Bahia, Brazil (Pitanga et al., 2014a), found an LTPA prevalence of 20.4%. Another study conducted in the city of Salvador, Bahia, Brazil (Pitanga et al., 2012), among black adults found an LTPA prevalence of only 9.6%. In São Paulo, Brasil (Florindo et al., 2009), the LTPA prevalence was observed to be 22.5%. In another recent study conducted in the city of Pelotas, Rio Grande do Sul, Brazil (Da Silva et al., 2014), which reported a temporal trend in LTPA during the period from 2003–2010, the LTPA varied from 26.8% to 24.6%, respectively. On the other hand, in a study conducted among adults in the city of Florianópolis, Santa Catarina, Brazil (Del

Duca et al., 2013), the LTPA prevalence was 47.5%, which is much larger than the prevalence reported in this study.

**Table 1**

The prevalence of LTPA by strata of the variables analyzed in the study. Longitudinal Study of Adult Health (ELSA-Brasil), 2008–2010.

Variables	Men		Women	
		(95%CI)		(95%CI)
Prevalence of LTPA	6788	44.1 (32.8–34.8)	8088	33.8 (42.9–45.3)
Social environment				
demographic				
Age (years)				
34–50	3168	44.9 (42.3–47.6)	3750	31.4 (28.7–34.1)
51–59	2102	40.2 (37.1–43.8)	2619	33.5 (30.4–36.7)
≥60	1518	47.6 (43.8–51.2)	1719	39.7 (36.0–43.5)
Education				
Incomplete elementar	564	27.8 (21.2–35.7)	326	19.0 (10.4–31.4)
Complete elementar	569	34.4 (28.5–41.8)	444	20.7 (12.9–30.4)
High-school	2221	39.8 (36.6–43.1)	2918	25.8 (22.7–29.1)
College	3434	51.2 (48.8–53.6)	4400	41.6 (39.3–43.9)
Economic				
Family income				
Up to 2 MW	79	32.9 (17.2–55.7)	112	19.6 (5.2–40.3)
2 MW to 8 MW	2654	35.8 (32.8–38.9)	3217	24.9 (21.9–28.0)
8 MW to 18 MW	2238	46.0 (42.9–49.1)	3069	34.7 (31.8–37.6)
Above 18 MW	1791	54.8 (51.6–57.9)	1654	50.9 (47.5–54.4)
Maid salaried presence in the home				
No	5171	41.3 (39.2–43.4)	5998	30.6 (28.5–32.7)
Yes	1616	53.2 (49.9–56.6)	2090	43.2 (39.9–46.4)
Cultural				
Perception of security in the neighborhood				
No	2154	41.0 (37.8–44.4)	2678	32.1 (29.0–35.4)
Yes	4133	45.4 (43.1–47.7)	4893	34.7 (32.4–37.3)
Discrimination in public environments				
No	5585	44.6 (42.6–46.5)	6497	34.3 (32.3–36.3)
Yes	1190	42.1 (37.8–46.6)	1570	31.9 (27.9–36.2)
Care of patients/dependents in the home				
No	6203	44.2 (42.3–46.0)	7218	34.2 (32.4–36.2)
Yes	579	43.7 (37.7–50.2)	863	30.6 (25.2–36.6)
Physical environment				
Conditions for physical activity				
No	1706	36.1 (31.3–39.0)	2281	26.0 (22.5–29.7)
Yes	4703	47.5 (45.4–49.5)	5390	37.6 (35.5–39.8)
Opportunities for physical activity				
No	1659	35.5 (31.6–39.5)	1971	22.9 (19.2–27.2)
Yes	4911	47.7 (45.7–49.8)	5903	37.8 (35.8–39.9)
Individual environment				
Behavioral				
Current smoking				
No	3408	48.0 (45.5–50.4)	5050	34.7 (32.5–36.9)
Yes	3379	40.2 (37.6–42.9)	3038	32.4 (29.5–35.4)
Occupational				
Functional status				
Active	5698	43.0 (41.0–45.0)	6239	31.7 (29.6–33.4)
Retired	1087	49.9 (45.6–54.2)	1844	41.3 (37.7–44.9)
Hours of work weekly				
≤40	4130	42.6 (40.1–44.8)	5852	32.6 (30.5–34.7)
>40	2658	46.7 (43.9–49.5)	2236	37.2 (33.8–40.5)
Biological				
Overweight				
No	2219	46.8 (43.3–49.6)	3041	40.1 (37.3–42.9)
Yes	4569	43.0 (40.8–45.3)	5047	30.1 (27.8–32.4)
obesity				
No	5311	46.5 (44.5–48.5)	6023	37.0 (34.9–39.0)
Yes	1477	35.6 (31.5–39.9)	2065	24.7 (21.0–28.7)
Abdominal obesity				
No	2249	52.4 (49.5–55.3)	2556	40.6 (37.6–43.7)
Yes	4539	40.0 (37.8–42.3)	5532	30.7 (28.5–33.0)

MW; Minimum wage.

**Table 2**

The association between leisure time physical activity and selected variables among men 35–74 years. Longitudinal Study of Adult Health (ELSA-Brasil), 2008–2010.

Variables	OR (95%CI)						
	Crude	Women (n = 8088)					
		Block 1 #	Block 2 §	Block 3 *	Block 4 †	Block 5 ♦	Block 6 Ω
<b>1. Social environment</b>							
<b>1.1 Demographic</b>							
Age							
34–50	1	1	1	1	1	1	1
51–59	0.83 (0.74–0.93)	0.88 (0.78–0.98)	0.84 (0.75–0.94)	0.83 (0.74–0.94)	0.83 (0.74–0.93)	0.85 (0.75–0.96)	0.93 (0.83–1.05)
≥60	1.11 (0.98–1.26)	1.12 (0.99–1.27)	1.03 (0.90–1.17)	1.02 (0.89–1.16)	1.02 (0.89–1.16)	0.87 (0.73–1.04)	0.99 (0.83–1.19)
Education							
Incomplete elementar	1	1	1	1	1	1	1
Complete elementar	1.36 (1.05–1.77)	1.37 (1.07–1.77)	1.32 (1.02–1.70)	1.33 (1.03–1.72)	1.35 (1.05–1.75)	1.37 (1.06–1.78)	1.40 (1.08–1.82)
High-school	1.71 (1.39–2.11)	1.74 (1.41–2.14)	1.57 (1.27–1.93)	1.58 (1.28–1.95)	1.59 (1.29–1.97)	1.61 (1.30–1.99)	1.63 (1.31–2.02)
College	2.72 (2.23–3.33)	2.70(2.22–3.29)	1.88 (1.50–2.36)	1.91 (1.52–2.41)	1.85 (1.47–2.34)	1.85 (1.47–2.34)	1.87 (1.48–2.37)
<b>1.2. Economic</b>							
Maid salaried presence in the home							
No	1	1	1	1	1		
	1.62 (1.44–1.81)	1.13 (0.99–1.29)	1.13 (0.99–1.29)	1.12 (0.98–1.28)			
Yes	1	1	1	1	1		
	1.62 (1.44–1.81)	1.13 (0.99–1.29)	1.13 (0.99–1.29)	1.12 (0.98–1.28)			
Family income							
Up to 2 MW	1	1	1	1	1	1	1
2 MW to 8 MW	1.14 (0.69–1.91)	1.05 (0.65–1.69)	1.05 (0.65–1.69)	1.05 (0.65–1.69)	1.04 (0.64–1.69)	1.05 (0.65–1.71)	1.06 (0.65–1.73)
8 MW to 18 MW	1.74 (1.06–2.92)	1.32 (0.81–2.15)	1.31 (0.80–2.14)	1.31 (0.80–2.14)	1.27 (0.78–2.08)	1.30 (0.79–2.12)	1.35 (0.82–2.21)
Above 18 MW	2.47 (1.50–4.15)	1.64 (0.99–2.72)	1.62 (0.98–2.68)	1.62 (0.98–2.68)	1.54 (0.92–2.55)	1.64 (0.99–2.71)	1.75 (1.05–1.91)
<b>1.3. Cultural</b>							
Perception of security							
No	1	1	1	1	1	1	1
Yes	1.19 (1.07–1.33)	1.18 (1.06–1.32)	1.18 (1.06–1.32)	1.11 (0.99–1.24)	1.11 (0.99–1.24)	1.11 (1.00–1.24)	1.12 (1.00–1.25)
Care of patients/dependents in the home							
No	1	1	1	1	1	1	1
Yes	0.98 (0.82–1.17)	1.02 (0.85–1.22)	1.02 (0.85–1.22)	1.02 (0.85–1.22)			
Discrimination in public environments							
No	1	1	1	1	1	1	1
Yes	0.90 (0.80–1.03)	0.97 (0.85–1.11)	0.97 (0.85–1.11)	0.97 (0.85–1.11)			
<b>2. Physical environment</b>							
<b>2.1 Conditions for physical activity</b>							
No	1	1	1	1	1	1	1
Yes	1.60 (1.43–1.80)	1.37 (1.21–1.56)	1.37 (1.21–1.56)	1.37 (1.21–1.56)	1.37 (1.21–1.56)	1.37 (1.21–1.55)	1.39 (1.22–1.57)
<b>2.2 Opportunities for physical activity</b>							
No	1	1	1	1	1	1	1
Yes	1.66 (1.47–1.86)	1.27 (1.11–1.44)	1.27 (1.11–1.44)	1.27 (1.11–1.44)	1.27 (1.11–1.44)	1.28 (1.12–1.45)	1.26 (1.11–1.43)
<b>3. Individual environment</b>							
<b>3.1. Behavioral</b>							
Current Smoking							
No	1	1	1	1	1	1	1
Yes	0.73 (0.66–0.80)	0.81 (0.73–0.89)	0.81 (0.73–0.89)	0.81 (0.73–0.89)	0.81 (0.73–0.89)	0.81 (0.73–0.89)	0.83 (0.75–0.93)
<b>3.2 Occupational</b>							
Functional status							
Active	1	1	1	1	1	1	1
Retired	1.32	1.41 (1.17–1.69)	1.41 (1.17–1.69)	1.41 (1.17–1.69)	1.41 (1.17–1.69)	1.41 (1.17–1.69)	1.46 (1.21–1.76)

(continued on next page)



Table 2 (continued)

Variables	OR (95%CI)						
	Crude	Women (n = 8088)					
		Block 1 #	Block 2 §	Block 3 *	Block 4 †	Block 5 ♦	Block 6 Ω
	(1.16–1.51)						
Hours of work							
≤40 h per week	1				1		
>40 h per week	1.19 (1.07–1.31)				0.96 (0.86–1.06)		
3.3. Biological							
Overweight							
No	1						1
Yes	0.87 (0.79–0.97)						1.22 (1.08–1.38)
Obesity							
No	1						1
Yes	0.63 (0.56–0.72)						0.71 (0.62–0.81)
Abdominal obesity							
No	1						1
Yes	0.61 (0.55–0.67)						0.54 (0.48–0.61)

MW, Minimum Wage; # Adjusted for demographic variables.

§ Adjusted for demographic and economic variables.

\* Adjusted for demographic, economic and cultural variables.

† Adjusted for demographic and economic variables, physical environment and perception of security.

♦ Adjusted for demographic, economic, behavioral and occupational variables, physical environments and perception of security.

Ω Adjusted for demographic, economic, behavioral, occupational and biological variables, physical environments and perception of security.

Variable withdrawn analysis:  $p > 0.10$ .

In international studies, the prevalence of LTPA is higher and ranges from 71.1% for women and 75.8% for men in the EU countries, including a variation of 91.9% in Finland and 40.7% in Portugal (Martinez-Gonzalez et al., 2001). More recently, a study found that only 21% of the population had sufficient levels of LTPA in Saudi Arabia (Amin et al., 2012). Finally, another study conducted in the city of Girona, Spain (Redondo et al., 2011), described an increasing trend in the prevalence of LTPA from 1995–2005 (46.2% to 77.45%).

In comparison with international studies the prevalence of LTPA found in Brazil are low, indicating the need to implement more policies to promote physical activity in this region of South America.

The Block 1 (social environment) variables that were positively associated with the LTPA scores included the level of education and family income among men and age, education levels and family income among women.

The study from Salvador, Bahia, Brazil (Pitanga et al., 2012) among black adults found associations between the LTPA and schooling and socioeconomic status. This study found no association between the LTPA and perceptions of violence and security in the neighborhood, which is consistent with the results found in our study. In contrast to our results, in the study conducted in the city of Alagoinhas, Bahia, Brazil (Pitanga et al., 2010) observed an inverse association between the LTPA scores and perceived insecurity/violence in the neighborhood. The same study found a positive association between middle and high school education levels and middle socioeconomic status.

There is a higher possibility of people with higher levels of education and higher income participating in physical activity in their leisure time because these activities are developed mainly in gyms, clinics and clubs requiring financial resources. The study conducted in Florianopolis, Brazil (Del Duca et al., 2013) also showed that LTPA levels were higher in those with more education and higher incomes.

We observed an increasing trend of physical activity with increasing age among women. Similar results were reported by a study conducted in the city of Salvador, Brazil, that observed more activity in women aged 60 years and older relative to younger women. The explanation for this phenomenon might be the fact that this age group, including women who have raised their children, are retired and are often widowed or separated, which reduces their load of household chores

and provides more opportunities to participate in physical activities in their leisure time.

We did not observe significant associations between positive perceptions of safety and LTPA levels. It is possible that both men and women perform physical activities locally and during safer times, as this variable did not influence physical activity. We imagined that perceptions of safety could be positively associated with LTPA, but in our study could not demonstrate this result, probably because other variables of the social and physical environment weaken its effect.

With regard to the block 2 variables (physical environment), LTPA was associated with both conditions and opportunities for physical activity among women and men. According to our results, at a workplace in the city of Alagoinhas, Bahia, Brazil (Pitanga et al., 2014b), it was found that the mere perception of the possibility of using public space for physical activity increased the likelihood of the adoption of physically active during leisure time by nine-fold. It is noteworthy that with the growth of cities there is a reduction in the space available for physical activity and recreation. This, linked to social problems such as urban violence and technological facilities, favors the adoption of sedentary habits (Rocha et al., 2011).

The findings of our study on the influence of the physical environment in LTPA is a strong point of our results and should be used to convince policy makers of the importance of urbanization of cities appropriately for physical activity, i.e. investment the construction of walking trails, bike paths, sports courts, public fitness centers, among others.

As for block 3 (individual environment), we found that retired men and women were more likely to be active in their leisure time. After retirement, people probably have more time available to engage in physical activity programs. We also found an inverse association between tobacco use only in men, which reinforces the finding that physical activity increases significantly after quitting (Hassandra et al., 2012). Similar results regarding smoking were observed in the study performed in the city São Paulo, Brazil (Florindo et al., 2009), but the associations were observed in both sexes.

There were also positive associations between LTPA levels and being overweight in men and inverse associations between LTPA and being overweight in women, overall obesity and abdominal obesity both

**Table 3**

The association between leisure time physical activity and selected variables among women 35–74 years. Longitudinal Study of Adult Health (ELSA-Brasil), 2008–2010.

Variables	OR (95%CI)						
	Crude	Women (n = 8088)					
		Block 1 #	Block 2 §	Block 3 *	Block 4 †	Block 5 ◆	Block 6 Ω
<b>1. Social environment</b>							
<b>1.1 Demographic</b>							
Age							
34–50	1	1	1	1	1	1	1
51–59	1.10 (0.99–1.23)	1.17 (1.06–1.31)	1.12 (1.00–1.24)	1.12 (1.00–1.25)	1.11 (0.99–1.24)	1.03 (0.92–1.16)	1.11 (0.99–1.25)
≥60	1.44 (1.28–1.63)	1.63 (1.44–1.84)	1.47 (1.29–1.67)	1.46 (1.29–1.66)	1.48 (1.30–1.68)	1.11 (0.94–1.31)	1.24 (1.04–1.47)
Education							
Incomplete elementar	1	1	1	1	1	1	1
Complete elementar	1.11 (0.77–1.62)	1.20 (0.83–1.72)	1.17 (0.81–1.68)	1.16 (0.81–1.67)	1.15 (0.80–1.66)	1.15 (0.80–1.66)	1.12 (0.77–1.61)
High-school	1.49 (1.10–2.00)	1.78 (1.33–2.39)	1.58 (1.17–2.12)	1.56 (1.16–2.11)	1.58 (1.17–2.13)	1.57 (1.16–2.13)	1.50 (1.11–2.04)
College	3.04 (2.28–4.09)	3.63 (2.72–4.84)	2.38 (1.75–3.24)	2.39 (1.76–3.26)	2.28 (1.68–3.11)	2.30 (1.69–3.13)	2.12 (1.55–2.89)
<b>1.2. Economic</b>							
Maid Salaried presence in the home							
No	1		1				
	1.72 (1.55–1.91)		1.07 (0.95–1.20)				
Yes	1		1				
	1.72 (1.55–1.91)		1.07 (0.95–1.20)				
Family income							
Up to 2 MW	1		1		1	1	1
2 MW to 8 MW	1.37 (0.84–2.87)		1.14 (0.71–1.84)	1.13 (0.70–1.82)	1.07 (0.66–1.74)	1.06 (0.65–1.72)	1.08 (0.66–1.75)
8 MW to 18 MW	2.17 (1.34–3.66)		1.43 (0.88–2.33)	1.43 (0.88–2.31)	1.30 (0.80–2.13)	1.27 (0.78–2.07)	1.26 (0.77–2.06)
Above 18 MW	4.24 (2.61–7.17)		2.33 (1.41–3.84)	2.37 (1.44–3.88)	2.08 (1.27–3.43)	2.06 (1.25–3.39)	2.00 (1.21–3.31)
<b>1.3. Cultural</b>							
Perception of security							
No	1			1			
Yes	1.12 (1.02–1.24)			1.09 (0.98–1.21)			
Care of patients/dependents in the home							
No	1			1		1	1
Yes	0.85 (0.72–0.99)			0.83 (0.71–0.98)	0.84 (0.72–0.99)	0.84 (0.72–0.99)	0.86 (0.73–1.01)
Discrimination in public environments							
No	1			1			
Yes	0.90 (0.80–1.01)			0.97 (0.86–1.10)			
<b>2. Physical environment</b>							
<b>2.1 Conditions for physical activity</b>							
No	1				1	1	1
Yes	1.72 (1.54–1.92)				1.34 (1.19–1.51)	1.35 (1.20–1.53)	1.37 (1.21–1.54)
<b>2.2 Opportunities for physical activity</b>							
No	1				1	1	1
Yes	2.04 (1.81–2.30)				1.45 (1.27–1.66)	1.46 (1.28–1.66)	1.41 (1.23–1.61)
<b>3. Individual environment</b>							
<b>3.1. Behavioral</b>							
Current smoking							
No	1					1	
Yes	0.90 (0.82–0.99)					0.93 (0.84–1.03)	
<b>3.2 Occupational</b>							
Functional status							

(continued on next page)

Table 3 (continued)

Variables	OR (95%CI)					
	Crude	Women (n = 8088)				
		Block 1 #	Block 2 §	Block 3 *	Block 4 †	Block 5 ♦
Active	1				1	1
Retired	1.52 (1.36–1.69)				1.49 (1.28–1.73)	1.51 (1.30–1.75)
Hours of work						
≤40 h per week	1				1	
>40 h per week	1.22 (1.10–1.35)				0.99 (0.89–1.11)	
3.3. Biological						
Overweight						
No	1					1
Yes	0.64 (0.53–0.71)					0.86 (0.77–0.97)
Obesity						
No	1					1
Yes	0.56 (0.50–0.63)					0.74 (0.65–0.85)
Abdominal obesity						
No	1					1
Yes	0.65 (0.59–0.72)					0.73 (0.65–0.81)

MW, Minimum Wage; # Adjusted for demographic variables.

§ Adjusted for demographic and economic variables.

\* Adjusted for demographic, economic and cultural variables.

† Adjusted for demographic, economic, physical environment and care for patient/dependent at home.

♦ Adjusted for demographic, economic, behavioral and occupational variables, physical environment and care for patient/dependent at home.

Ω Adjusted for demographic, economic and biological variables, physical environment, care for patient/dependent at home and functional status.

Variable withdrawn analysis:  $p > 0.10$ .

among men and women. Overweight and obesity can reduce physical activity in population groups, although it is not entirely clear whether obesity is a cause or consequence of physical inactivity (reverse causality) (Ekelund et al., 2008). In the present study we observed an inverse association between LTPA and overall obesity and abdominal obesity in both sexes. Overweight status reduced the likelihood of LTPA only in women. In men, being overweight increased likelihood LTPA, probably because the anthropometric parameter reflects not only an increase in body fat but also muscle mass.

Similar results were shown in the very ELSA-Brazil in a recent study published by Coelho et al. (2015) when it was observed that men and women with central obesity were less prone to practice physical activity of high or moderate intensity. Moreover, overweight men were more likely to report vigorous physical activity while obese women were less likely to report this level of physical activity.

A possible limitation of the study is that the information on physical activity was obtained by self-reported questionnaires, which nevertheless are a widely used instrument in national and international studies. It is important to mention that the ELSA-Brasil is a longitudinal study and is expected to incorporate more objective measures, such as accelerometry, which may increase the validity of information on physical activity.

It is noteworthy that while the study population is not representative of the general population, the prevalence of LTPA among the six centers located in different regions provides important information.

## 5. Conclusions

The proposed ecological model explains the LTPA through the social, physical and personal environment and highlights gender differences in physical activity. These results can make important contributions to public policies to promote physical activity by acting on factors associated with this human behavior. The information that the social, physical and individual environments of the proposed ecological model are associated with LTPA should be used by public

health managers to encourage physical activity in the most vulnerable groups, such as men and women with lower education levels, lower family income and/or that are not retired, and women of younger age. In addition, managers must request the construction of appropriate public spaces for physical activity as well as provide adequate physical structure with qualified professionals to guide the practice of physical activity. Our findings should also encourage programs to reduce obesity and smoking, as all of these actions together can influence the population to increase physical activity during leisure time.

## Informed consent

Informed consent was obtained from all individual participants included in the study.

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Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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