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Factors associated with sedentary behavior among ELSA-Brasil participants: ecological model

Fatores associados ao comportamento sedentário entre participantes do ELSA-Brasil: modelo ecológico

AUTHOR'S

Francisco José Gondim Pitanga[1]
Sheila Maria Alvim Matos[2]
Maria da Conceição Almeida[3]
Rosane Härter Griep[4]
Maria Carmen Viana[5]
Enirtes Caetano Prates Melo[3,6]
Estela M.L. Aquino[2]

1 Department of Physical Education. Federal University of Bahia, Salvador, Bahia, Brazil.

2 Institute for Collective Health. Federal University of Bahia Salvador, Bahia, Brazil.

3 Institute Gonçalo Moniz - Fundação Oswaldo Cruz, Brazil.

4 Laboratory of Education in Environment and Health, Fundação Oswaldo Cruz. Brazil.

5 Section of Psychiatric Epidemiology, Department of Social Medicine, Postgraduate Program in Public Health, Federal University of Espírito Santo, Vitória, Espírito Santo, Brazil.

6 Department of Epidemiology, National School of Public Health, Fundação Oswaldo Cruz. Brazil.

CORRESPONDING

Francisco José Gondim Pitanga
pitanga@lognet.com.br
Universidade Federal da Bahia. Faculdade de Educação. Av. Reitor Miguel Calmon, s/n, Vale do Canela. Salvador, Bahia, Brazil.
CEP: 40000-000.

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ABSTRACT

The main objective was to identify the prevalence and factors associated with sedentary behavior (SB). The study comprising a total of 13,765 individuals of both sexes participating in the Longitudinal Study of Adult Health (ELSA-Brasil) assessed in the second wave (2012-2014). The SB was measured using questions related to sitting time during the week and weekend. The associated factors were assessed by face-to-face interviews, with blocks of questionnaires and anthropometric measurements. A hierarchical ecological model was built with all possible factors associated with SB: sociodemographic environment (age and level of education; economic status); behavioral environment (leisure time physical activity, commuting physical activity, beer consumption, current smoking); and biological environment (overweight, obesity and abdominal obesity). Crude and adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) were estimated using logistic regression. Among men and women, higher education, current smoking and abdominal obesity were positively associated with SB, while being over 51 years old and being physically active were negatively associated with SB. The proposed ecological model explains the SB through the sociodemographic, behavioral and biological environment.

Keywords: Sedentary lifestyle; Adult; Epidemiology.

RESUMO

O objetivo principal do estudo foi identificar a prevalência e fatores associados ao comportamento sedentário (CS). O estudo compreendeu um total de 13.765 indivíduos de ambos os sexos participantes do Estudo Longitudinal de Saúde do Adulto (ELSA-Brasil) avaliados na segunda onda (2012-2014). O CS foi medido usando questões relacionadas ao tempo sentado durante a semana e o final de semana. Os fatores associados foram avaliados por meio de entrevistas face a face com blocos de questionários e medidas antropométricas. Um modelo ecológico hierárquico foi construído com todos os possíveis fatores associados ao CS: ambiente sociodemográfico (idade e nível de instrução; situação econômica); ambiente comportamental (atividade física no tempo livre, atividade física de deslocamento, consumo de cerveja, tabagismo atual); e ambiente biológico (sobrepeso, obesidade e obesidade abdominal). Odds ratios (OR) brutos e ajustados e intervalos de confiança de 95% (95% ICs) foram estimados usando regressão logística. Entre homens e mulheres, a maior escolaridade, o tabagismo atual e a obesidade abdominal foram positivamente associados ao CS, enquanto que ter mais de 51 anos e ser fisicamente ativo estavam associados negativamente ao CS. O modelo ecológico proposto explica o CS por meio do ambiente sociodemográfico, comportamental e biológico.

Palavras-chave: *Comportamento sedentário; Adulto; Epidemiologia.*

Introduction

Sedentary behavior (SB) refers to any activity characterized by low energy expenditure, not exceeding 1.5 metabolic equivalents, and includes specific behaviors such as sitting for reading, studying, watching television, etc. Generally, these habits are considered diffe-

rent from practicing small amounts of physical activity, a behavior in which the individual also fails to engage in moderate or vigorous physical activity that would require an energy expenditure above 3 metabolic equivalents[1].

Various studies have shown an association between time spent in SB and a greater incidence of cardiovascular disease[2], type 2 diabetes[3], obesity[4] and metabolic syndrome[5], as well as a greater risk of death from cardiovascular disorders[6,7]. Moreover there is evidence that excess SB such as television viewing and computer use represents relevant risk factors and merits as much investigation as that conducted on physical activity levels. Sitting for prolonged periods of time constitutes an important risk factor for all causes of mortality irrespective of the regular practice of physical activity[8].

Although research on the mechanisms involved in the influence of SB on cardio-metabolic disorders is in the early stages, it is speculated that during sedentary activity there is a significant reduction in muscle liproprotein lipase (LPL) activity, the key enzyme that regulates lipid metabolism. Low LPL activity levels were associated with a substantial decrease in plasma triglyceride absorption by skeletal muscles, and, thus, fat is deposited in the vessels or adipose tissue[9].

To successfully develop interventions to reduce this unhealthy behavior the factors associated with SB need to be identified. Recent research in Canada has shown that there are different determinants of SB, including marital status, presence of children in the household and social support[10]. Another study conducted in Japan showed that SB is more prevalent among the elderly, single and unemployed[11]. In a study carried out in Brazil it was observed that older workers with higher income and more schooling had a higher chance of having sedentary behaviors[12], but new studies are needed to identify other factors associated with this type of behavior.

SB identification in adults using an ecological model to summarize the different levels of the socio demographic, behavioral and biological environment can provide important information for planning and implementing public policies to reduce sedentary behavior in specific population groups. Within the scope of ELSA-Brasil, in which the study population is composed of individuals with predominantly sedentary activities, and only 33.8% of women and 44.1% of men reported leisure time physical activity at baseline[13], the investigation of this topic may add knowledge to the theme that has not yet been explored.

The aim of this study was to evaluate the prevalence and factors associated with sedentary behavior in men and women participating in the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil).

Methods

The ELSA-Brasil is a cohort study involving 15,105 active or retired civil servants aged 35-74 years, from five different universities and one research institution located in the cities of Salvador, Vitória, Belo Horizonte, Rio de Janeiro, São Paulo and Porto Alegre. Methodological procedures of the study have been described in detail elsewhere[14,15]. All participants assessed in the second wave (2012-2014) with complete data on sedentary behavior were included in the present analysis, comprising a total of 13,765 participants of both sexes.

The ELSA-Brasil was approved by internal review boards from all research centers involved. Data was collected after all participants signed an informed consent form, and confidentiality was assured to all participants.

The data were produced by a team of interviewers and then verified by trained personnel and certified by a quality control committee[15].The supervisory personnel were authorized to apply the study protocol in any of the ELSA-Brasil study centers. The interviews were conducted face-to-face, with blocks of questionnaires and anthropometric measurements of weight, height and waist circumference were applied. Body weight without shoes and while wearing standardized dress of negligible weight was obtained in the morning, after participants fasted for 8 to 12 hours, using an electronic scale, Toledo®, with a capacity of up to 200 Kg. To measure the standing height, a SECA® brand stadiometer was used, 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 point marking the average distance 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[16]. The equipment was installed and calibrated following standard procedures in all research centers (RC)[17].

SB was documented for the first time in the second wave of the study. Participants were asked to report the daily average number of accumulated hours they spent

sitting down on weekdays and over the weekend, with the following questions: a) how much time per day, on average, you spend seated during the weekdays; b) how much time per day, on average, do you spend seated during the weekend. A level of sedentary behavior was classified as ≥8 hours/day of total sitting time during the week or during the weekend[8]

The International Physical Activity Questionnaire (IPAQ) was used to identify and quantify physical activity. Leisure-time physical activity was classified as follows: 0 = insufficiently active (< 150 minutes/ week of moderate physical activity or walking and/or < 60 minutes per week of vigorous physical activity or < 150 minutes per week of any combination of walking, moderate or vigorous physical activity); and 1 = physically active (≥ 150 minutes per week of moderate physical activity or walking and/or ≥ 60 minutes per week of vigorous physical activity or ≥ 150 minutes per week of any combination of walking, moderate or vigorous physical activity). Commuting physical activity was categorized as insufficiently active (< 150 min/week in physical walking and / or bicycle) and physically active (≥ 150 min/week in physical walking and / or bicycle).

Overweight and obese participants were identified by the body mass index (BMI) measurement with the equation BMI = weight (kg) / height (m)^2. The following cutoffs were adopted: overweight = 0 if BMI < 25.0 and overweight = 1 if BMI ≥ 25.0; and obesity = 0 if BMI < 30.0 and obesity = 1 if BMI ≥ 30.0. Abdominal obesity was defined as a waist circumference >88 cm in women and >102 cm in men.

The schooling, weekly consumption of beer and current smoking was evaluated through an interview. The schooling was classified in incomplete elementar, complete elementar, high-school and college. The weekly consumption of beer was classified in " < 1500 ml" = 0 or "≥ 1500 ml" = 1; and the current smoking was classified in "no" = 0 and "yes" = 1

SB was the dependent variable, while the independent variables were grouped into blocks from an adapted theoretical ecological model[13,18]: the social demographic environment (age and level of education); the behavioral environment (leisure time physical activity, commuting physical activity, beer consumption, current smoking); and biological environment (overweight, obesity and abdominal obesity).

All analyzes were stratified by sex to highlight differences between males and females. The prevalence of SB by RC and the strata of each independent variable were 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[13,18] to discriminate against potential associated factors of hierarchical levels (Figure 1). The strategy used for the entry of variable blocks was the forward method in the following order: distal blocks (socio-demographic variables), intermediate blocks (behavioral variables) and proximal block (biological variables). During the steps of hierarchical analysis remained in the model variables with p < 0.10. We used the statistical software Stata, version 12.0.

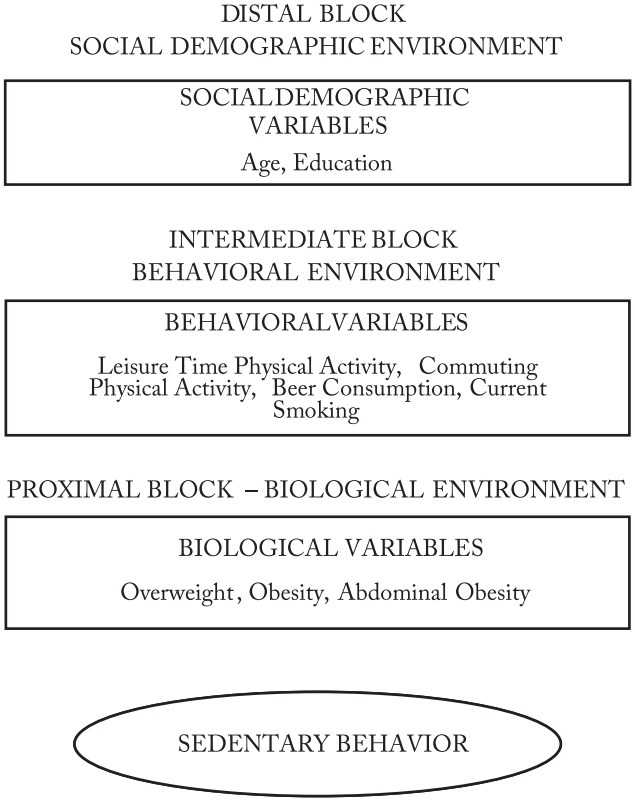

Figure 1 – A hierarchical ecological model for the analysis of factors associated with sedentary behavior in adults from the ELSA-BRASIL.

Results

A total of 6.264 men and 7.501 women were included in the analysis. The SB prevalence rates were 23.7% and 22.7% among men and women, respectively. It is important to emphasize that the prevalences were calculated for the sitting time classified as ≥8 hours/day of total sitting time during the week or during the weekend. When the prevalences are calculated separately there is a reduction in sitting time at the weekend in both men (week = 20.3% and weekend = 10.4%) and

women (week = 20.2% and weekend = 6.7%). Both male and female participants in the Rio de Janeiro RC have more sedentary behavior, while in the Salvador RC the lowest prevalence of sedentary behavior was observed (Figure 2 and 3). In all RC, woman reported significantly less sitting-time than men, except in the São Paulo and Rio de Janeiro sites. The prevalence and confidence intervals of SB per stratum of each variable analyzed in the study are shown in Table 1. Both men and women reported lowest SB in older age (60 years or more). Higher educational attainment was associated with increased SB in both sexes.

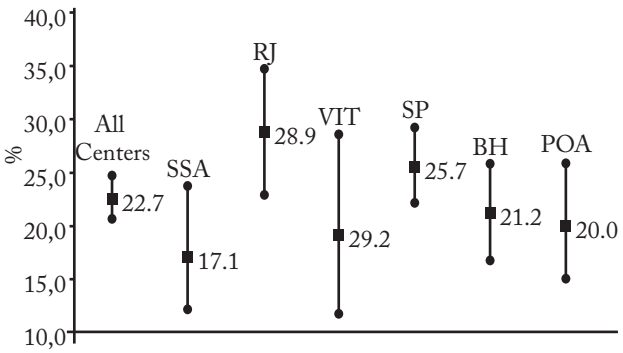

Figure 2 – Prevalence and CI95% of sedentary behavior for centers (Female). Longitudinal Study of Adult Health (ELSA-Brasil), 2012-2014. SSA, Salvador; RJ, Rio de Janeiro; VIT, Vitória; SP, São Paulo; BH, Belo Horizonte; POA, Porto Alegre.

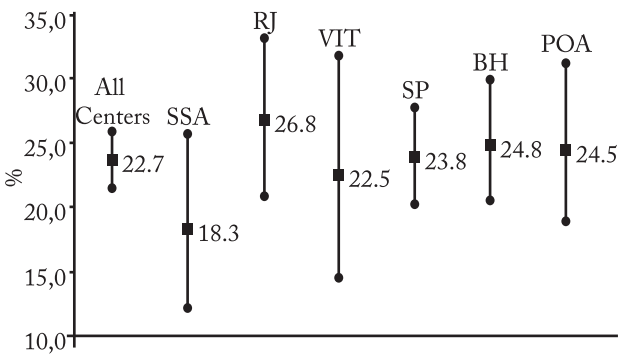

Figure 3 – Prevalence and CI95% of sedentary behavior (Male). Longitudinal Study of Adult Health (ELSA-Brasil), 2012-2014. SSA, Salvador; RJ, Rio de Janeiro; VIT, Vitória; SP, São Paulo; BH, Belo Horizonte; POA, Porto Alegre.

Smaller proportions of SB were observed in men and women who reported more leisure time physical activity. The SB frequency was higher in current smokers, but was not associated with beer consumption. The proportion of SB was higher in men and women who were overweight, obese and had abdominal obesity. However, none of these differences was statistically significant.

The social demographic, behavioral and biological variables included in the hierarchical model were associated with SB in leisure time in both sexes (Tables 2 and 3). Among men and women being better educated, being a current smoker and having abdominal obesity were positively associated with SB, while being over 51 years old and physically active were negatively associated with SB (Table 2 and 3).

Table 1 – The prevalence of sedentary behavior by strata of the variables analyzed in the study. Longitudinal Study of Adult Health (ELSA-Brasil), 2012-2014.

Variables	Men		Women	
	n = 6,264	% (CI95%)	n = 7,501	% (CI95%)
Socialdemographic environment				
Age (years)				
38-50	2039	28.1 (26.1-30.1)	2321	29.6 (27.9-31.6)
51-59	2155	23.4 (21.6-25.2)	2718	25.4 (23.8-27.1)
≥60	2070	19.9 (18.2-21.7)	2462	13.1 (11.8-14.5)
Education				
Incomplete elementar	434	8.8 (8.4-9,1)	253	4.3 (3.7-5.0)
Complete elementar	479	10.8 (8.2-14,0)	376	7.4 (7.9-7.9)
High-school	1905	17.0 (15.3-18.8)	2409	16.2 (14.8-17.8)
College	3442	31.1 (25.6-32.3)	4463	28.6 (27.2-29.9)
Behavioral environment				
Leisure time physical activity				
Insufficiently active	3267	24.8 (23.4-26.4)	4667	23.7 (22.5-24.9)
Active	2994	22.5 (21.1-24.1)	2834	21.1 (19.6-22.6)
Commuting physical activity				
Insufficiently active	4108	26.8 (25.5-28.2)	5152	25.3 (24.1-26.5)
Active	2154	17.9 (16.3-19.6)	2348	17.0 (15.5-18.6)
Weekly beer consumption				
< 1500 ml	4651	24.0 (21.5-26.6)	6978	22.3 (20.2-24.4)
≥ 1500 ml	1613	23.0 (18.7-27.5)	523	27.9 (21.0-36.1)
Current smoking				
No	3269	22.9 (20.1-26.2)	4803	21.3 (18.9-24.0)
Yes	2994	24.5 (21.4-27.8)	2698	25.1 (21.8-28.5)
Biological environment				
Overweight				
No	1811	21.1 (17.2-25.6)	2442	21.7 (18.3-25.5)
Yes	4453	24.8 (22.3-27.5)	5059	23.2 (20.8-25.7)
Obesity				
No	4722	22.7 (20.1-25.2)	5240	22.5 (20.1-25.0)
Yes	1542	27.0 (22.9-31.6)	2261	23.2 (19.7-27.1)
Abdominal obesity				
No	4246	22.0 (19.3-24.7)	3435	22.1 (19.2-25.3)
Yes	2003	27.5(23.9-21.5)	4053	23.2 (20.6-26.1)

Discussion

The study sought to identify the prevalence and factors associated with SB in adult participants of the Longitudinal Study of Adult Health (ELSA-Brasil). The prevalence of SB among participants of the ELSA-Brasil,

23.7% in men and 22.7% in women were minor than those observed in studies conducted in Germany[19], 36.1% in men and 24.5% in women. In addition it was observed that men spend more sitting time at the weekend (10.4%) than women (6.7%), although they do more leisure-time physical[13] thatis, it is possible that the sitting time that the women do not have at the weekend is due to the inadequate division of tasks at the domestic level that overloads them. It is noteworthy that in the study conducted in Germany SB was considered with the cutoff point> 6 hours of sitting time.

In a recent systematic review study[20] with the aim of identifying individual, social, environmental, and policy-related determinants or correlates of SB among adults aged 18–65 years it was not iced that factors such as age and socio-economic level were all significantly correlated with sedentariness

In our study in the Block 1 (social demographic environment) it was observed that age was inversely associated and level of education was positively associated with SB among men and women. These results are very similar to those observed in the study carried

Table 2 – The association between sedentary behavior and selected variables among men. Longitudinal Study of Adult Health (ELSA-Brasil), 2012-2014.

Variables	OR (95%CI)			
	Crude	Men (n = 6,264)		
		Block 1 #	Block 2 §	Block 3*
SOCIALDEMOGRAPHIC ENVIRONMENT				
Age				
38-50	1	1	1	1
51-59	0.78 (0.68-0.90)	0.91 (0.79-1.05)	0.86 (0.74-0,99)	0.84 (0.73-0.98)
≥ 60	0.64 (0.55-0.74)	0.67 (0.58-0.78)	0.62 (0.53-0.72)	0.61 (0.52-0.71)
Education				
Incomplete Elementar	1	1	1	1
Complete Elementar	1.27 (0.80-2.03)	1.23 (0.79-1.92)	1.26 (0.81-1.96)	1.21 (0.77-1.88)
High-School	2.14 (1.49-3.13)	1.92 (1.35-2.75)	1.99 (1.39-2.84)	1.95 (1.37-2.79)
College	4.71 (3.34-6.81)	4.41 (3.13-6.21)	4.74 (3.35-6.70)	4.64 (3.28-6.56)
BEHAVIORAL ENVIRONMENT				
Leisure Time Physical Activity				
Insufficiently active	1		1	1
Activity	0.88 (0.79-0.99)		0.80 (0.71-0.90)	0.80 (0.73-0.93)
Commuting Physical Activity				
Insufficiently active	1		1	1
Activity	0.59 (0.52-0.68)		0.70 (0.61-0.80)	0.70 (0.62-0.81)
Weekly Beer Consumption				
< 1500 ml	1		1	
≥ 1500 ml	0.95 (0.86-1.08)		0.96 (0.84-1.11)	
Current Smoking				
No	1		1	1
Yes	1.09 (0.97-1.23)		1.44 (1.26-1.63)	1.38 (1.22-1.57)
BIOLOGICAL ENVIRONMENT				
Overweight				
No	1			1
Yes	1.23 (1.08-1.41)			1.07 (0.92-1.25)
Obesity				
No	1			1
Yes	1.27 (1.11-1.45)			1.06 (0.88-1.28)
Abdominal Obesity				
No	1			1
Yes	1.35 (1.19-1.52)			1.22 (1.02-1.47)

Adjusted for sociodemographic variables; § Adjusted for sociodemographic and behavioral variables; * Adjusted for socio demographic, behavioral and biological variables; Variable with drawn analysis: p > 0.10.

Table 2 – The association between sedentary behavior and selected variables among men. Longitudinal Study of Adult Health (ELSA-Brasil), 2012-2014.

Variables	OR (95%CI)			
	Crude	Women (n = 7501)		
		Block 1 #	Block 2 §	Block 3*
SOCIALDEMOGRAPHIC ENVIRONMENT				
Age				
38-50	1	1	1	1
51-59	0.80 (0.71-0.91)	0.87 (0,77-0.99)	0.84 (0.74-0.96)	0.82 (0.72-0.93)
≥ 60	0.36 (0.31-0.41)	0.40 (0.34-0.46)	0.40 (0.34-0.47)	0.38 (0.33-0.44)
Education				
Incomplete Elementar	1	1	1	1
Complete Elementar	1.77 (0.83-4.02)	1.58 (0.77-3.25)	1.60 (0.77-3.27)	1.63 (0.79-3.35)
High-School	4.25 (2.30-8.71)	3.03 (1.63-5.62)	3.13 (1.68-5.83)	3.19 (1.71-5.92)
College	8.79 (4.80-17.9)	6.41 (3.48-11.8)	6.83 (3.70-12.6)	7.16 (3.87-13.2)
BEHAVIORAL ENVIRONMENT				
Leisure Time Physical Activity				
Insufficiently active	1		1	1
Activity	0.86 (0.77-0.96)		0.79 (0.70-0.89)	0.82 (0.73-0.93)
Commuting Physical Activity				
Insufficiently active	1		1	1
Activity	0.61 (0.53-0.69)		0.68 (0.60-0.78)	0.69 (0.61-0.78)
Weekly Beer Consumption				
< 1500 ml	1		1	
≥ 1500 ml	1.35 (1.10-1.65)		1.19 (0.96-1.46)	
Current Smoking				
No	1		1	1
Yes	1.24 (1.11-1.38)		1.38 (1.22-1.55)	1.39 (1.23-1.56)
BIOLOGICAL ENVIRONMENT				
Overweight				
No	1			1
Yes	1.09 (0.97-1.23)			1.12 (0.95-1.31)
Obesity				
No	1			1
Yes	1.04 (0.93-1.17)			0.99 (0.85-1.15)
Abdominal Obesity				
No	1			1
Yes	1.07 (0.96-1.19)			1.20 (1.02-1.42)

Adjusted for socio demographic variables; § Adjusted for sociodemographic and behavioral variables; * Adjusted for socio demographic, behavioral and biological variables; Variable with drawn analysis: p> 0.10.

out in Germany[19] and confirm the current trend of reducing sedentary behavior in older people. The greater use of technology, work and seated occupations, and forms of passive displacement among younger adults could explain this behavior. In addition, particularly in ELSA-Brasil participants it was observed that retirees are more physically active than those still in professional activity, fact that reflects the specific characteristics of this population of civil servants who become elderly and retired in more favorable social conditions than other population groups.

Regarding education level, a positive association with SB was observed, indicating that interventions to reduce the sitting time in more educated people should be developed. It is important to note that, in studies that specifically investigate screen time, people with lower levels of schooling present more sedentary behavioral in relation to time watching television[21]. Results similar to ours were found in a study with Brazilian elderly workers when it was observed that higher income and schooling increase sedentary behavior[12].

As for block 2 (behavior environment) we found that leisure time physical activity and commuting physical activity was inversely associated with SB among men

and women. We also found appositively association between tobacco use and SB among men and women. Regarding physical activity, it should be emphasized that the evidence is not consensual and some studies have not been able to find an association[22], and others have observed positive associations indicating that physical activity and sedentary behavior are independent constructs, that is, being physically active is not a guarantee that you will not have sedentary behavior[23]. In our study only the domains of leisure time physical activity and commuting physical activity were analyzed and it was expected that these two physical activity contexts presented inverse associations with SB, since, principally, active displacement may influence the reduction of sedentary behavior.

With regard to smoking, a positive association between smoking and SB was observed in both men and women. On the other hand we cannot demonstrate associations between weekly beer consumption and SB. Contrary results were observed in a recent study in Stockholm, Sweden[24], when it was observed that unfavorable alcohol consumption, but not smoking, was associated with sedentary behavior.

As for block 3 (biological environment) there were positive associations only between abdominal obesity and SB both among men and women. No association between overweight or obesity with SB was observed. These results are not consistent with the recent systematic review cited above[19], when it was found that in the majority of studies analyzed it was observed that the higher the BMI, the higher the SB level. Another study carried out in Korea[25] found an association between obesity and abdominal obesity with SB among men and only in obesity with SB among women.

On the other hand, the results found in our study that there is no association between overweight and obesity with sitting time are consistent with the findings of systematic review[26], which identified only limited evidence of longitudinal association between sedentary behavior, overweight and obesity. In addition, other studies suggest the existence of an association between overweight and time watching television[27], although there is no association between overweight and obesity with total sitting time, as analyzed in the present study. These results may have been found by virtue of the fact that food consumption may be increased during the time in front of the television.

A possible limitation of the study is that the information on SB 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 among SB of the six centers is located in different regions provides important information.

The proposed ecological model explains the SB through the social demographic, behavioral and biological environment. These results can make important contributions to public policies to promote reduction of sedentary behavior by acting on factors associated with this human behavior. The SB prevalence were 23.7% and 22.7% among men and women, respectively. The information that social demographic, behavioral and biological environment of the proposed ecological model are associated with SB should be used by public health managers to encourage reduction of sedentary behavior in the most vulnerable groups, such as men and women with higher educational level, younger and who do not comply with the recommendations for physical activity practice. Our findings should also encourage programs to reduce abdominal obesity and smoking, as all of these actions together can influence the population to reduction sedentary behavior.

Conflict of interest

The authors declared no conflict of interest.

Contribution of the authors

Pitanga FJG was responsible for analyzing and interpreting the data and for writing the manuscript. Matos SMA and Melo ECP contributed writing and revision of the manuscript, Almeida MC participated in the interpretation and analysis of data, Griep RH, Viana MC and Aquino EML were responsible for the project that originated the database, coordination of data collection and final revision of the text.

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