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Associated between sedentary behavior and diabetes in low-income older adults in the city of Ibicuí-BA: brazilian population survey

Associação entre comportamento sedentário e diabetes em idosos de baixa renda na cidade de Ibicuí-BA: pesquisa populacional brasileira

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ABSTRACT: The aim of this study was to estimate a cut-off point in the time spent in sedentary behavior as a discriminator of the presence of diabetes mellitus in the elderly population. Methods: cross-sectional study, population-based, with data from 310 low-income elderly people from Ibicuí-BA, Brazil, randomly selected. Sedentary behavior was assessed by time spend in sitting week and weekend, and diabetes was assed by self-reported. The data were analyzed using descriptive statistics, Received Operations Curve, and Poisson regression ($p \leq 0.05$). The mean time spent in sedentary activities was 272.63 ± 163.71 min/day. The overall prevalence of diabetes was 13.5%. The sociodemographic characteristics, life habits and presence of diabetes have not been shown a statistically significant association ($p > 0.05$). The area under the ROC curve was 0.60, 95% CI (0.54-0.65) and p=0.003 and the cutoff point was >325 min/day which best discriminated the presence of diabetes mellitus between the elderly people. The raw and adjusted analysis for the association between sedentary behavior and diabetes revealed no association between the variables. It was identified that the time spent in sedentary behavior has a good discriminatory capacity for the presence of diabetes mellitus. On the other hand, there was no association between the first one and the presence of Diabetes, after adjustment for the intervening variables.

Keywords: Aged; Chronic disease; Motor activity; Diabetes mellitus/epidemiology; Brazil/epidemiology.

RESUMO: O objetivo deste estudo foi estimar um ponto de corte do tempo gasto em comportamento sedentário como discriminador da presença de diabetes mellitus na população idosa. Métodos: estudo transversal, de base populacional, com dados de 310 idosos de baixa renda de Ibicuí-BA, Brasil, selecionados aleatoriamente. O comportamento sedentário foi avaliado pelo tempo gasto na semana e no fim de semana, e o diabetes foi avaliado por autorrelato. Os dados foram analisados pela estatística descritiva, Curva ROC e regressão de Poisson ($p \leq 0,05$). O tempo médio gasto em atividades sedentárias foi de 272,63 ± 163,71 min/dia. A prevalência geral de diabetes foi de 13,5%. As características sociodemográficas, hábitos de vida e presença de diabetes não demonstraram associação estatisticamente significante ($p > 0,05$). A área sob a curva ROC foi de 0,60, IC 95% (0,54-0,65) ep = 0,003 e o ponto de corte foi > 325 min/dia que melhor discriminou a presença de diabetes mellitus entre os idosos. A análise bruta e ajustada para a associação entre comportamento sedentário e diabetes não revelou associação entre as variáveis. Identificou-se que o tempo despendido no comportamento sedentário possui boa capacidade discriminatória para a presença de diabetes mellitus. Por outro lado, não houve associação entre o primeiro e a presença de diabetes, após ajuste pelas variáveis intervenientes.

Descritores: Idoso; Doença crônica; Atividade motora; Diabetes mellitus/epidemiologia; Brasil/epidemiologia.

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INTRODUCTION

The increase in the number of diabetes mellitus (DM) cases is a public health problem. Results from national and international studies show that the global prevalence of dm was approximately 463 million people (9.3%) in 2019 and estimates that it ranges from 578 million (10.2%) in 2030 to 700 million (10, 9%) in 2045. Projections say that almost half a billion people live with diabetes worldwide and the number is expected to increase 25% in 2030 and 51% in 2045[1,2].

Diabetes Mellitus is associated with genetic influences, population aging, quality of life, diet, obesity and many other elements. Among these, the aspects related to the adoption of a sedentary lifestyle are the main causes of this pathology[3,4].

Sedentary Behavior (SB), which is characterized as a time period when there is a low level of prolonged metabolic energy expenditure[5], is strongly related to the increasing risk of the development of chronic diseases with a high prevalence in the elderly population, such as the cardiovascular diseases, diabetes mellitus type II and cancer[6].

The mechanisms involved in the relationship between SB and health problems, the reduction of expression of the Lipoprotein Lipase, membrane-bound enzyme on the surface of endothelial cells lining the vessels, is considered as a essential key in the understanding of the changes observed in the lipidic metabolism involving especially increased of triglycerides[7].

In addition, SB is also correlated with decreased levels of high-density lipoprotein (HDL) and insulin sensitivity[8], as well as the induction of changes in carbohydrate metabolism through changes in the glucose transport protein in insulin-stimulated skeletal muscle (GLUT-4)[9]. However, there is only one study showing the relation of time spent in sedentary activities, specifically >330 minutes/week, and its association with the higher chances of developing DM in the elderly population[10].

Thus, the scarcity of studies and the need for more knowledge about the relationship between time spent in sedentary activities and diabetes mellitus confirm the importance of the present study, whose objective is to estimate a cut-off point of the time spent in sedentary behavior as a discriminator of the presence of diabetes mellitus in the elderly population.

METHODS

This is a cross-sectional study carried out in February 2014. The study was performed in Ibicuí, which has an estimated population of 15,785 inhabitants, of which 525 were enrolled in the Family Health Units (USF) during the period of data collection[11]. Ibicuí is located in the physiographic zone of Vitória da Conquista in the Southwest of Bahia.

The sample size was determined using criteria of Luiz and Magnanini for finite populations[12], considering a 95% confidence interval, a significance level of 5% and a tolerable error of 3%. It was inserted 10% more subjects to compensate possible losses and rejections.

The target population of the present study was made up of individuals aged 60 or over, registered by the USF of the municipality. All the elderly were bedridden, with a diagnosis of Alzheimer's or other neurological disease that compromised the veracity of the information (recorded in the medical record of the Unit).

Thus, the final sample was made by 310 elderly people, 201 them live in the urban area and 109 live in the rural area. The response rate was estimated at 91.2%, 8.8% of refusals (n = 31) and 9.2% of exclusion (n = 29).

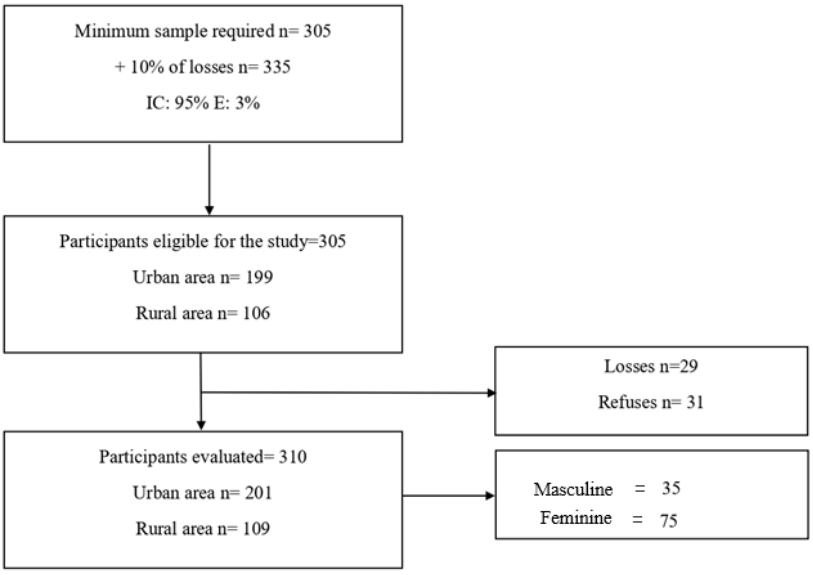


Figure 1. Organization chart of sample distribution of the study.

The Elderly Health Assessment Tool, duly validated[13], was answered by the individuals at the Health Unit where each one was registered. Data were collected by health professionals, undergraduate and graduate students of the State University of the Southwest of Bahia, previously trained.

The sociodemographic variables included were: gender (male and female); age group (60-79, 80 years old or older); schooling (literate, non-literate); family income (in reais); and marital status (with or without partner).

The variables related to the habits of life, physical inactivity in the free time was evaluated through the following question: "How would you classify your physical activity in leisure time?": light (walking, pedaling or dancing three or more hours per week); moderate (running, exercising or playing sports three or more hours per week); intense (competition training); Does not do (there is not practice of physical activity). Being considered inactive in leisure time, those who did not participate in any physical activity or participated in less than 150 minutes per week of physical activities in their leisure time[14].

In addition, the variables related to regular ingestion of alcoholic beverages (yes/no) were included; smoking habits (it currently smokes yes/no); and the frequency of regular ingestion of fruits and vegetables, divided on two levels (one or more times per week and less than once a week or does not eat).

Regarding the presence of Diabetes Mellitus, it was determined by self-report to the question: "Has any doctor ever told you that you have Diabetes?". The subjects who answered yes to this question were considered diabetics. About the Sedentary Behavior, the questions of the International Questionnaire of Physical Activity, in version adapted for the elderly, regarding to the time spent sitting on a regular weekday and on a usual weekend day validated for the elderly population of Brazil were evaluated[15].

The database was tabulated and analyzed using the statistical software Social Package for the Social Sciences (SPSS), version 22.0. Initially, the studied population was characterized by obtaining simple frequencies and relative frequencies of categorical variables of interest and obtaining measures of central tendency and variability for continuous variables.

Then, the bivariate analysis was performed, estimating the Prevalence Ratio (PR) and its respective Confidence Intervals (CI) and p values by the Wald chi-square tests with a significance level of 5% in addition to the ROC curve. In addition, a multivariate analysis was performed to find the PR variables that presented $p \leq 0.20$.

The present study followed the precepts referring to research involving human beings, and all the subjects filled the informed consent form. The research norms were evaluated and approved by the Human Research Ethics Committee of the State University of Southwest of Bahia (Protocol nº 613.364 / CAAE: 22969013.0.0000.0055).

RESULTS

The mean age of the investigated individuals was 71.62 ± 8.15 years old (ranging from 60 to 108 years old) and most of them were woman (56.5%). The mean of familiar income was 708.26 ± 303.69 *reais*. The mean time spent in sedentary activities was 272.63 ± 163.71 minutes. The overall prevalence of DM was 13.5%.

When analyzing the sociodemographic characteristics, life habits and presence of Diabetes, has not shown any statistically significant association ($p > 0.05$) between these and Diabetes Mellitus (Tabela 1).

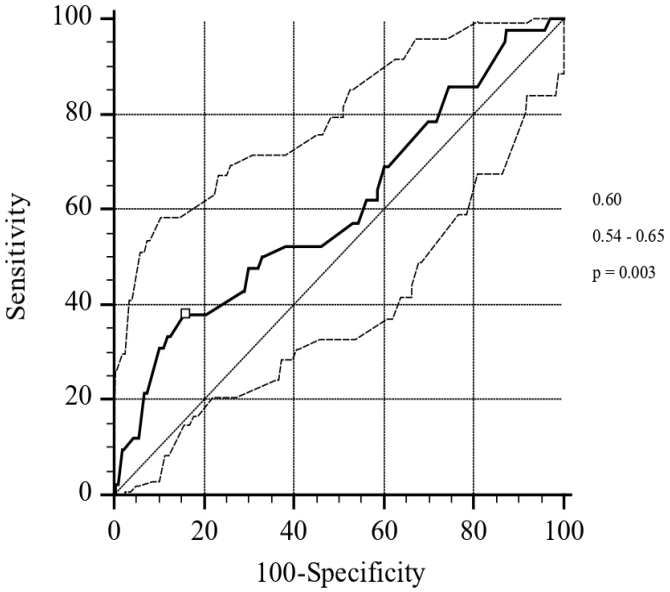
Table 1 - Association between the variables and the presence of Diabetes Mellitus, Ibicuí, Bahia, 2014, Brazil

Variables	n (%)	RP (IC 95%)	p-value
Sexo			
Female	19 (45.2%)	1	0.11
Male	23 (54.8%)	1.68 (0.87 – 3.24)	1
Age group			
60-79 years	32 (76.2%)	1	0.14
80 years or more	10 (23.8%)	1.78 (0.81 – 3.90)	1
Schooling			
Literate	19 (45.2%)	1	0.12
Non-literate	23 (54.8%)	1.66 (0.86 – 3.19)	1
Marital Situation			
Does not have a partner	19(45.2%)	1	0.42
Does have a partner	23 (54.8%)	1.30 (0.67 – 2.50)	1
Ingestion of fruits. vegetables and legumes			
Yes	02 (4.80%)	1	0.98
No	40 (95.2%)	1.02 (0.22 – 4.68)	1
Physical inactivity at free time			
Yes	30 (71.4%)	1.14 (0.55 – 2.33)	1
No	12 (28.6%)	1	0.71
Currently Smoking habits			
Yes	05 (11.9%)	1	0.94
No	37 (88.1%)	0.96 (0.35 - 2.64)	1
Regularly habits of drinking alcohol			
Yes	03 (7.10%)	1	0.30
No	39 (92.9%)	0.50 (0.13 – 1.91)	1

PR: Prevalence ratio; CI95%: confidence interval; p-value: significance leve

The Figure 2 shows the area on the ROC curve between Sedentary Behavior and Diabetes Mellitus in the elderly population. The area under the ROC curve was 0.60, 95% (CI 0.54-0.65) and p = 0.003, showing a satisfactory predictive capacity for Diabetes Mellitus in elderly.

The cut-off of >325 min/day was one that best discriminated the presence of Diabetes Mellitus among the elderly, since it shows the most adequate balance between sensitivity and specificity. When analyzing gender-specific SB cutoff points, the best ones were found to be very close to the total sample (>330 min/day for men and >320 min/day for women).



ROC: receiver operating characteristic; CI95%: 95% confidence interval; p: significance level.

Figure 2. Area under the ROC curve and CI 95% between SB and Diabetes among the elderly people, Ibicuí, Bahia, 2014, Brazil.

Figure 2 – Area under the ROC curve and CI95% between SB and diabetes among the elderly people, Ibicui, Bahia, 2014, Brazil

Table 2 - Cut-off points, sensitivity and specificity of SB as a discriminator of the presence of Diabetes, Ibicuí, Bahia, 2014, Brazil

Sedentary Behavior	Cut-off Point*	Sensibility (%)	Specificity (%)
Geral	>325 min/day	61.9	43.8
Men	>330 min/day	60.9	39.3
Women	>320 min/day	63.2	47.7

*Time spent sitting (min/day).

The Sedentary Behavior was divided at two levels: up to 325 min/day and >325 min/day, taking as reference the best cut-off found in the ROC curve analysis.

The Table 3 shows the raw and adjusted analysis for the main association of this study. The results reveal that there is no association between SB and the presence of Diabetes. However, from the findings, it may be considered, that the time invested up of to 325 min/day in sedentary behavior can be considered a protective factor, so that when this value is exceeded, there is an increase in the probability of development of Diabetes Mellitus in this group of individuals, no statistical significance was found, though.

Table 3 - Crude and adjusted analysis of the association between Sedentary Behavior and the presence of Diabetes among the elderly, Ibicuí, Bahia, 2014, Brazil

Variable	Diabetes			
Sedentary Behavior	RP_{crude} (IC95%)	p-value	$RP^{\#}_{adjusted}$ (IC95%)	p-value
> 325 min/day	1	0.48	1	0.63
0-325 min/day	0.81 (0.45 -1.45)		0.85 (0.45 -1.60)	

PR: Prevalence ratio; CI95%: confidence interval; p: significance level; # Adjusted for gender, age and education level.

DISCUSSION

This study aimed to estimate a cut-off point of the time spent in Sedentary Behavior as a discriminator of the presence of Diabetes Mellitus in the elderly population. The results showed that the time 325 min/day is the one of the best capacity to discriminate the presence of Diabetes Mellitus in this population. In addition, it is known until now only one published study that showed a cut-off in a time spent in Sedentary Behavior to discriminate DM in the elderly population.

The authors identified that the time of 330 min/day was the best cut-off point for the identification of DM in the elderly, a very close value to the results that was found in the present study[10]. The analysis of cut-off points by gender have not shown many divergent times. In fact, the approximation of these cut-off points seems to indicate that the time of about 300 min/day is one of the best times which determines the probability of developing Diabetes Mellitus. In addition, the analysis of the area on the ROC curve showed that the SB presented a satisfactory discriminatory capacity to identify DM[10].

On the other hand, there was no association between SB (categorized by cut-off point identified in the study) and DM. These results disagree with other findings in the literature that indicate a relationship between more time spent sitting with Diabetes and global chronic diseases regardless of physical activity and other potentially influencing factors[16]. This relationship between SB and Diabetes has been demonstrated in different contexts. In a prospective cohort study, showed that Sedentary Behaviors developed by a group of healthy women between 30 and 55 years old, were positively associated with Diabetes, where an increase of 2 hours/day watching TV was associated with an increase of 14% in the risk of developing Diabetes[17]. In another study, among Australian men aged 45-64 years old, those who invested >4 hours/day in SB were significantly more likely to have some chronic disease[16].

The physiological changes related to the excess of time spent in Sedentary Behavior have molecular bases demonstrated in the literature. Among these, alterations in Lipoprotein Lipase, membrane-bound enzyme on the surface of endothelial cells lining the vessels, which are responsible for the hydrolysis of the triglyceride molecules that constitute lipoprotein particles and for facilitating the absorption of free fatty acids by skeletal muscle and adipose tissue, it is considered as a important key in this process[18].

Reduction of lower limb muscle lipoprotein activity. The authors observed a dose-dependent relationship between SB and lipoprotein activity, every 6 hours of SB there was a reduction of more than 25% and in 18 hours approximately 75%[19]. The metabolic dysfunction induced by SB corresponds to the increase in triglyceride level and the decrease in high density lipoprotein (HDL) and insulin sensitivity[8]. These changes were observed in the experiments carried out by[18]. In addition, excessive time in SB also induces changes in carbohydrate metabolism through changes in the glucose transport protein in skeletal muscle insulin-stimulated (GLUT-4)[20]. Thus, a lower amount of glucose is used by the muscle tissue, increasing insulin resistance and liver overload for energy production with deviation from the metabolic pathway that favors the production of lipids accumulated in central adipose tissue[21].

Thus, from the results found and the studies available in the literature, it is speculated that the relationship between excessive time in SB and the presence of Diabetes Mellitus are still not conclusive.

In this instance, the search for evidence such as discussed, it is an initiative in the field of gerontology, as it allows to implement greater recognition of the specificities of contextualized assistance to the elderly population, offered in health services by managers and multiprofessional teams, who can act in the awareness and guidance to reduce the time invested in behavior sedentary, instituting this practical perspective in daily activities, in the attitudes of caregivers, in moments of leisure, as well as in non-pharmacological measures of clinical conduct, such as groups of activities programmed by the basic units, in view of efforts to strengthen preventive health, increasingly necessary in the context of an aging population.

As the limitations of this study, it can be considered that the cross-sectional study does not allow the establishment of a causal and temporal relationship between Sedentary Behavior and Diabetes Mellitus in the elderly population. Besides the possibility of the presence of bias related to the process of data collection and registration. However, in the case of population-based research that complements studies related to the effects of Sedentary Behavior on health, it can contribute to the development of preventive strategies. It is suggested that the same study could be developed in children, adolescents and adults of different age groups in order to verify the power of discrimination of Sedentary Behavior on Diabetes Mellitus in such subgroups.

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