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Community Medicine and Public Health

ISSN: 2455-5479 DOI: https://dx.doi.org/10.17352/acmph

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Received: 27 May, 2019
Accepted: 19 August, 2019
Published: 20 August, 2019

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Research Article

Sedentarism and Metabolic Syndrome: Broadening the measurement of sedentarism

Abstract

The metabolic syndrome (MS) is a combination of cardiovascular risk factors, including visceral obesity, low HDL cholesterol level, increased triglycerides, hyperglycemia and high blood pressure. This sequence of risk factors contributes towards the development of atherosclerotic cardiovascular disease (ACVD) and diabetes mellitus. Sedentarism is not widely studied. This habit is a determinant factor for chronic or acute diseases. This study tests the hypothesis of the association between overall sedentarism, including professional work, travel and leisure and the MS, in adult men and women in Salvador, Bahia. A population based cross-sectional study of both genders, ages ≥ 20 years. MS is defined by the criteria of the International Diabetes Foundation, characterized as the MS when considering the presence of abdominal obesity (waist ≥84 cm for women and ≥ 88cm for men) plus two of the following criteria: arterial hypertension (≥130/85mmHg) hyperglycemia (≥100mg/dl) hypertriglyceridemia (≥150mg/dl). Hypoalphalipoproteinemia (hdl-cholesterol below 40mg/dl for women and below 50 for men). Sedentarism is defined by means of the four criteria of physical inactivity described below. Athletes were excluded. Inactivity in the professional work: lack of physical activity in the professional work or the presence of light physical activity such as: working mostly seated or less than 25% of the time standing or moving around. Inactivity in household work: lack of household work or light work, such as small repairs, light cleaning or preparation of food. Physical inactivity during travel to work: traveling by car or bus, walking less than 30 minutes as well as performing most of the outside activities by car or walking. Physical inactivity during leisure: leisure does not include physical activities. The final sample totaled 1,333 individuals. In logistic regression, the adjusted prevalence ratio (PR) of overall sedentarism and the MS for women was of 1.31 (CI95% 0.86-1.91). For men the adjusted prevalence ratio was of 1.68 (CI95% 1.05-2.53), statistically significant. This paper reveals, in men, that overall sedentarism is associated to the MS. There was no statistically significant association between sedentarism exclusively in leisure and the MS. Marital status was a confounding factor and raises the issue of this variable not being widely studied as a cardiovascular risk factor.

Introduction

Since the eighties, with the publication of the first studies by Framingham [1] and Tromso [1], it was demonstrated that physical inactivity is associated to the risk of cardiovascular morbi-mortality. Subsequent studies confirmed these findings and added the knowledge that physical inactivity is also associated to general mortality [3,4], as well as to the development of arterial hypertension [5], diabetes [6] and obesity [7]. In further analysis to these initial cohorts, it was determined that the increased mortality in inactive individuals was due to excess weight, with this association having been confirmed over the years. More recent studies, such as Lee & col. [8], evidenced that the relationship between health and physical activities could be better represented by a "J" curve, in other words, both sedentarism and strenuous physical effort are associated to higher general and cardiovascular morbi-mortality. Stevens & col. [9], and Wei & col. [10], demonstrated that the association between sedentarism and cardiovascular risk was independent of the increase in corporal fat, independently of the indicator used – weight, body mass index (BMI), waist/hip index ratio or abdominal waist. This was confirmed for men and women. In accordance with the line of investigation, the cardiorespiratory capacity of the individuals was more important than corporal fat, and more associated to health than the quantity of corporal fat. As opposed to this theory, a recent article in 2006, Diaz & col. [11] demonstrated that individuals not overweight or obese have improved cardiovascular risk profiles when compared to those with overweight or obesity with good physical capability, assessed by means of a stress test.

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Sedentarism can be measured in various manners, the most frequent manner being an assessment only in relation to leisure activities [8-10]; and more rarely in professional work [12]. Nevertheless, the extension of the assessment of sedentarism incorporated to the daily routine, such as household activities and travel time to perform routine activities, begins to be demanded when further studying the relationship between sedentarism and health.

Accordingly, around a decade ago, studies began to emerge associating a higher cardiovascular risk not only in relation to sedentarism in leisure and work, but also in relation to other activities of the individual, such as the amount of time spent in front of the "screen" (TV, computer, games, etc.). This broader form of assessing physical inactivity has been described as "sedentary behavior", and, presently, is assessed as an important indicator of cardiovascular risk. For Dietz [13], sedentarism is defined as a state in which there is a minimum amount of corporal movement. According to the mentioned author, "minimum movement" is different than physical activity and represents a behavior that is always associated to adverse effects to health, today defining physical activity of light to moderate intensity being associated to protection, and physical activity of high intensity being associated to risks.

The recent trend of investigating classic cardiovascular risk factors, as an aggregate, has contributed towards a better understanding of the determination of morbid events in its the various phases of development. Since 2004, the metabolic syndrome was defined as a combination of interrelated cardiovascular risk factors, including visceral obesity, low HDL cholesterol levels, increased triglycerides, glycaemia and blood pressure [14]. Presently, the MS is an important mediator in the increased risk of cardiovascular atherothrombosis (CVAT) and diabetes *mellitus* type 2 [15].

Studies on physical inactivity and the MS are still scarce in literature, despite the association of both phenomena being plausible. The majority of the existing studies is of clinical design and physical inactivity assessed by one of its consequences, low physical performance, measured by means of a stress test [16-21]: Others are intervention studies [22,23], most of which [17,19-21] assessed physical activity during leisure and demonstrated that good physical conditions in this sphere of life is inversely associated to MS or to its components. However, the survey by Whaley & col. [16], the only one that did not confirm this association, was published in 1998, when there was still a profound uncertainty as to the criteria of the MS, which only began to be well established as of January 2004 [15]. Recently, also in a cohort study, Laaksonen & col. [21] Demonstrated that a short period of physical activities during leisure, with low cardiorespiratory capacity, was a predictive factor for the development of the MS.

Two cross-sectional studies were identified that assessed the role of "sedentary behavior" in a more comprehensive manner, including physical inactivity during leisure and in household activities. The study of Ford & col. [24] indicated that individuals that do not engage in any kind of physical activity, of moderate and vigorous intensity, during their leisure time, had double the case of developing MS.

Additionally, individuals who watched TV, or other activities in front of screens, outside their working hours, for over 4 hours per day, also had a risk for developing the MS. In the study of Bertrais et col. [25], the frequency of the components of the MS increased with the time spent in front of a computer screen, videos or TV, when compared to individuals engaged in any daily physical activity, either in their leisure time or at work.

National studies on physical activities or sedentarism, associated to the MS were not identified. Some studies are descriptive and point out to the prevalence of physical inactivity during leisure periods. A study on adults, in Pelotas, Rio Grande do Sul, demonstrated that 41% of individuals presented this type of sedentarism [26]. In another descriptive study in a representative sample of the city of São Paulo, 87% of the individuals were sedentary during their leisure [27]. A study on some of the constituents of the MS, such as hypertension, diabetes *mellitus*, overweight and obesity associated to physical inactivity were identified, demonstrating a high prevalence in all age groups [28]. Pitanga & Lessa [29] indicate that 60.4% of men and 82.7% of women were sedentary in their leisure periods, which was directly associated to low schooling levels and marital status, mostly prevailing among the married women.

Population based studies, assessing sedentarism under different aspects, such as in household activities, professional work, displacement during routine activities and in leisure periods and the

MS were not found. Thus, the present investigation aimed to fulfill this knowledge gap, studying sedentarism in its different demonstrations, and associating it to the MS.

Methodology

This study is part of the Cardiovascular Disease Monitoring Project ("Monite"), developed by the Public Health Institute ("*Instituto de Saúde Coletiva*"), of *Universidade Federal da Bahia*, as support to *Cenepi – Centro Nacional de Epidemiologia/ Ministério da Saúde* (National Center for Epidemiology/Ministry of Health). It is characterized for being a population based cross-sectional study performed between 1999 and 2000, in a sample of adults, of both genders, of ages equal to or above 20 years, residents of private permanent homes in the city of Salvador, Bahia. Pregnant women were excluded.

The area of coverage was defined based on a sample of a study described previously [30], on health conditions, carried out in Salvador. A cluster sample was selected in two stages:

- **First stage:** simple random sample of residences without replacement based on the register of the mentioned study [30].
- **Second stage:** after the register of all the adults, one man and one woman, of ages equal to or over 20 years, were chosen in each house, by draw.

The size of the theoretic sample for the domiciles was

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estimated according to expected prevalence of arterial hypertension of 15%, arterial coronary disease of 5%, obesity of 30% and diabetes of 7%. A variation coefficient of 5% was used, for a confidence interval of 95%. Considering the existence of partially performed interviews, and interview not performed, at the residences, the weights of the respective homes were calculated. Nevertheless, this was not considered in the final statistical analysis once some units presented negative weights.

The data production was by means of face-to-face interviews with the application of a structured instrument and of measurement procedures of biological measures. The questionnaire encompassed sociodemographic information, physical activities, nourishment, tobacco, consumption of alcoholic beverages and personal health. Blood pressure measurements were taken, using OMRON HEM 705 CP digital equipment and "standard and big adult" cuffs, previously validated [31]. Measurements were performed on the left arm of the seated individual, divided into two blocks of three (total of six measurements): the 1st block, after at least 5 minutes of rest, and the 2nd block, with at least 20 minutes of interval from the 1st block, with the individual remaining seated during this interval. The material for blood exams was collected in a chosen health center, using standard techniques [32] and adopting the following ones: glycaemia, Labtest technique; HDL cholesterol, Labtest technique; triglycerides, modified Soloni technique.

Anthropometric measurements were performed, with the individual barefoot and using light clothing. A standard inelastic measuring tape, of synthetic material, was used to measure waist circumference, defined as midpoint between the last rib and the iliac crest.

Interviews were carried out by interviewers with minimum schooling levels of secondary school graduates and prior experience in field research, selected and trained for this purpose.

For quality control, a sub-sample of 10% of the interviewed parties was selected, whereby a reviewer repeats the questionnaire and the measurements.

For setting up the databank, the EPIINFO, version 6.04b, software was used and for analysis the STATA version 8.

In the analysis, the dependent variable was the Metabolic Syndrome, defined based on the criteria of the International Diabetes Foundation [33]. The Metabolic Syndrome was considered when, in the presence of abdominal obesity – for men with waists measuring 88cm or more and for women with 84 cm or more [34]. Over two of the following criteria were fulfilled: arterial hypertension; hyperglycemia; hypertriglyceridemia; hypoalphalipoproteinemia. Hypertension was defined by the average of the six measurements of the systolic arterial pressure (SAP) greater or equal to 130 mmHg, or diastolic arterial pressure (DAP) equal or greater than 85 mmHg; hyperglycemia was defined by the 9 hour fasting glycaemia, equal or greater than 100 mg/dl; triglycerides serum hypertriglyceridemia obtained after a 12 hour fast greater or equal to 150mg/dl and hypoalphalipoproteinemia from low plasma HDL-cholesterol, for men below 40 mg/dl and for women below 50 mg/dl. Amounts below amounts of reference were included for individuals under treatment for regular hypertension, hyperglycemia and dyslipidemia.

The main independent variable is sedentarism defined as of four criteria of physical inactivity:

- **In the professional work:** work performed almost exclusively seated or standing for less than 25% of the total time or in short displacements.
- **In household work:** not performing any work or only small repairs or light cleaning work and preparation of meals.
- **Traveling to work:** going and returning by car or bus and walking less than 30 minutes. Performing outside tasks mostly by car or bus.
- **Leisure:** not including daily physical activities of moderate or vigorous intensity. Only including light non-routine walks.

Athletes were excluded (reference of intense physical activity over the last 12 months). This decision was supported by the most recent understanding that athletes are part of a very heterogeneous group in relation to cardiovascular risks [4,5,35].

Sedentarism exclusively in leisure was additionally analyzed separately, with the purpose of comparison with literature. In this case athletes were included.

The co-variables analyzed were: age, self-referred race/color (white, brown, black and others such as East Asians and indigenous), schooling, recent migration, marital status, tobacco, menopause and alcohol consumption.

Data analysis involved the initial description of the variables of interest, with the purpose of characterizing the population of the study. Differences between proportions were tested in relation to statistical significance, using Pearson χ^2 at the level of 5%. Prevalence was calculated as measure of frequency and prevalence ratio (PR) as a measure of association.

In the stratified analysis, the Mantel-Haenszel method was used to estimate the prevalence ratio, confidence intervals and verification of the difference between the strata (considering a p-value ≤ 0.05). The identification of the effect modification was preceded by means of the observation of the behavior of the stratum-specific measurements, in relation to the confidence intervals of the opposing strata. Each PR was compared with the confidence interval of the following category, and when this PR was not contained in the confidence interval, the variable was considered as potential effect modifier. For the identification of probable confounders, the parameter used was the difference of approximately 10% for comparison of the gross association measure to the adjusted association measure, using the Mantel-Haenszel method.

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Unconditional logistic regression was used for obtaining association measure estimates, based on the maximum likelihood, with the purpose of confirming the hypothesis of the study. The *backward* strategy was used for the selection of variables, having included in the study all the variables in which the univariate tests obtained a p-value ≤ 0.25%. For the criteria for permanence, in the final model, all the variables presenting statistical significance levels of ≤ 0.10 were included. To verify the existence of effect modification, the likelihood ratio test was used, in the assessment of the deviation differences, comparing the complete model (with product terms) with the reduced model (without product terms) for alpha ≤ 0.05. The confounding variables considered were those that when removed from the complete model produced a statistically significant difference in the isolated measurement of the leading association, considering confidence intervals of alpha ≤ 0.10. Such procedures permitted the construction of a final model, based on the measures of the leading association, controlled by effect modifying variables, and adjusted by the confounding variables [36,37].

The study complied with the requirements of the National Research Ethics Committee (Conepe), including the right of refusal in any phase of the study. Confidentiality and privacy of information was guaranteed, as well as access to the results of the exams and priority in the attendance to individuals with complaints or with abnormal laboratory exams, at the primary healthcare units of reference for the project. This study was approved by the Ethics Committee of the Bahia Regional Medical Council (“*Comitê de Ética do Conselho Regional de Medicina do Estado da Bahia*”).

Results

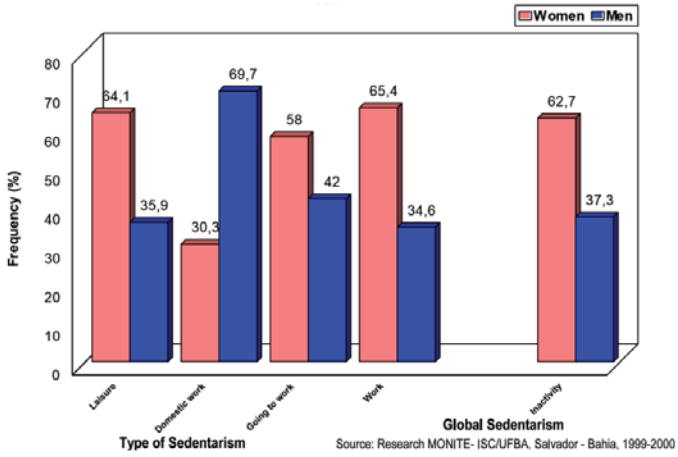
The effective sample was composed of 1,503 units, with 90.2% of the homed having been visited. Out of the 2,442 eligible individuals, 94.4% 2343 interviewed; from these, 1,333 (58.0%) took part in all of the phases, including exams and measurements, comprising the population of this study.

The individuals not included, compared to those examined, were more frequently young men, white, not working at the time of the interview, with no knowledge of any prior diagnosis of arterial hypertension or hyperglycemia.

Sedentarism in leisure and at work predominated among women, being twice as frequent as men. Sedentarism during travel was also more frequent in women, although the differences were not so significant. Nevertheless, when analyzing sedentarism in the domestic environment, the standard is inverted, being 2.5 times more frequent among men. In the combination of sedentarism in the different spheres the result was of a higher incidence among women, with 62.7% vs. 37.3% for men. (p=0.000) (Graph 1).

When grouping active and inactive (sedentary) individuals, in relation to sociodemographic characteristics, statistically significant associations are observed among women; for sedentary women, older, in the menopause and with higher schooling levels (p ≤0.05). However, among the men, there were no statistically significant associations (Table 1).

The association between sedentarism and MS was determined. The gross prevalence ratio was of 1.64 (CI 95% 1.01-2.64) for men and 1.52 (CI95% 1.02-2.27) for women.



Graphics 1: Prevalence of diferentes types of sedentarism and global sendentarism by sex.

Table 1: Sociodemographic characteristics of the population of the study in relation to overall sedentarism in men and women. Salvador, BA, 1999-2000.

Co-variables	Women		Men	
	Active Inactive (n=172) (n=506)		Active Inactive (n=112) (n=302)	
	(%)	(%)	(%)	(%)
Age	*p=0,000		*p=0,069	
20 – 49	86.1	68.4	78.6	69.5
50 and over	13.9	31.6	21.4	30.5
Race/Color	*p=0.296		*p=0.243	
White	9.3	13.8	10.7	13.2
Brown	68.0	65.4	72.3	63.6
Black	22.7	20.7	17.0	23.2
Schooling	*p=0.015		*p=0.504	
Elementary (incomplete)	26.7	21.2	16.1	21.2
Elementary (complete)	21.5	14.8	19.6	17.9
Secondary complete/higher	51.7	64.0	64.3	60.9
Smoker	*p=0.151		*p=0.932	
Yes	13.9	81.2	30.4	30.8
No	86.1	18.8	69.6	69.2
Recent Migration	*p=0.884		*p=0.109	
Yes (< 10 years)	8.1	8.5	15.2	9.6
No	91.9	91.5	84.8	90.4
Menopause	*p=0.002			
Yes	22.7	35.5	...	...
No	77.3	64.5	...	...
Marital status	*p=0.789		*p=0.357	
Single	19.8	20.9	16.1	21.9
Married	64.5	61.7	81.2	74.5
Widow(er)/Separated/Divorced	15.7	17.4	2.7	3.6
Alcohol consumption	*p=0.076		*p=0.953	
Light and moderate	48.3	40.5	58.9	58.6
Absent and excessive	51.7	59.5	41.1	41.4

*p-obtained using the Pearson χ^2 test

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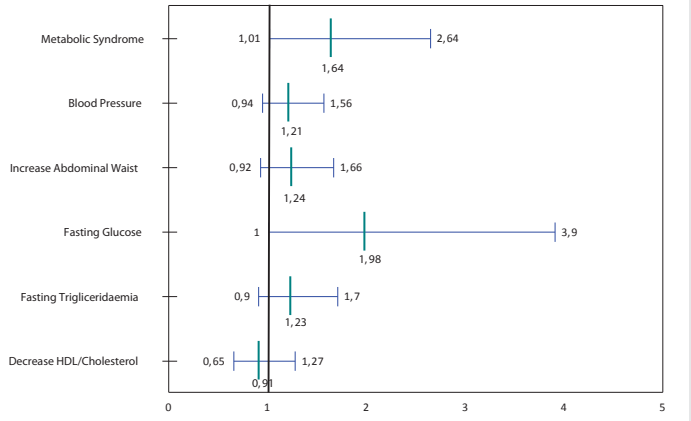
In relation to the constituent parts, there was no statistically significant association between men and women, only blood pressure was significantly associated, with a PR of 1.47(CI 95% 1.07-2.01). (Graphs 2,3).

In logistic regression, the adjusted prevalence ratio between sedentarism and MS was, for women, of 1.31 (CI 95% 0.86-1.91). However, for men the adjusted prevalence for sedentarism and MS was of 1.68 (CI 95%1.05 -2.53). We draw attention to both genders, where the eldest, married and the divorced/separated/widow(er)s; these associations were statistically significant, making these variables as confounders.

In adjusted logistic regression, assessing sedentarism exclusively during leisure, a PR of 1.01 for men (CI95% 0.64-1.47) and for women a PR of 1.03 (CI95% 0.68-1.51) was evidenced, with non-significant statistical associations (data not presented) (Table 2).

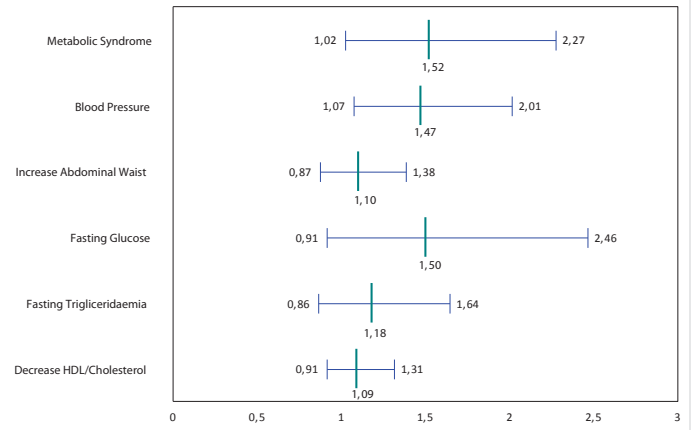
Discussion

Some aspects should be highlighted in this investigation. No other article was identified measuring self-referred sedentarism, considering its various dimensions, as was perfumed herein. Most of the studies either assess physical activity during leisure [17-21, 28-31], or add physical activities in the professional work [12,24,25]. The incorporation of sedentarism in household activities and in the travel to routine activities is necessary due to the social characteristics of this population. This sample was composed of around 80% of individuals belonging to the working class or to the poor [38], with the need to consider other forms of sedentarism, once these individuals may be very active in the household work and in the travel to their daily activities, and sedentary in their leisure activities. The analysis of sedentarism exclusively during leisure, or even including professional work, may be applied in populations of the first world, as can be verified in the quoted international publications. Populations of regions such as Scandinavia or North America are very different to the populations studied in this investigation, in relation to physical exertions. Despite those individuals having a lot of activities, they perform these activities in a frequently automatized manner, with the presence of equipment in their daily activities. Additionally, the populations of those studies have different living conditions than those of this study, where access to public or private transportation requires less physical effort, with lower caloric output. Accordingly, in this investigation, when measuring physical inactivity exclusively during leisure, it was not possible to obtain the association with MS found among men, which was observed when broadening the definition of sedentarism. In this investigation, measuring physical activities instead of sedentarism it was observed, only in relation to leisure, that 37% of men were active, against 16% of women. Different to the overall assessment of sedentarism, in the present investigation, where 62.7% of the men were active and only 37.3% of the women (data not presented).



Source: Research MONITE - ISC/UFBA. Salvador - Bahia, 1999-2000.

Graphics 2: Prevalence Ratio of Metabolic Syndrome and their components (men) by sedentarism.



Source: Research MONITE - ISC/UFBA. Salvador - Bahia, 1999-2000.

Graphics 3: Prevalence Ratio of Metabolic Syndrome and their components (women) by sedentarism.

In the final adjusted model, the statistical significance of the association between overall sedentarism and MS was maintained for men. Another four studies [21,39-41], assessing exclusively men, although only for sedentarism during leisure, demonstrated that physical inactivity was associated to MS or to its components.

In women, there was no significant association between overall sedentarism and MS. Some aspects should be observed in relation to similar studies. Out of the studies in which women were included in the analysis [17,18,20,22], they presented good to excellent cardiorespiratory capacity, obtained in their free time and assessed using the stress tests in physical fitness clinics. These studies demonstrated inverse relation between MS and cardiovascular capacity. This population cannot be compared with the present investigation, due to the differences between the women in these studies. A specialist on sedentarism, researcher Wareham [42], mentions that this means of measuring physical activity cannot be applied or compared with populations of underdeveloped countries or countries under development.

One of the proposed possibilities for the null association, found in this study among women, may be the need for valuing more vigorous physical activities for protection against MS in women [43], in their leisure time or in other daily activities. It is possible that there is a need not only for them to be active, but to develop good cardiovascular capacity in order to have

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Table 2: Stratified analysis and logistic regression for association between overall sedentarism (active and inactive) and the metabolic syndrome.

Variables			Women				Men	
	n	Prev. (%)	PR (CI 95%)	PRAdjusted (CI 95%) n		Prev. (%)	PR (CI 95%)	PRAdjuisted (CI 95%)
Overall sedentarism								
Active	172	14.5	1.00	1.00	112	15.2	1.00	1,00
Inactive	506	22.1	1.52 (1.02-2.27)	1.31 (0.86-1.91)*	302	24.8	1.64 (1.01-2.64)	1.68 (1.05-2.53)*
Age (years)								
20 - 49	494	14.4	1.07 (0.66-1.73)	1.00	298	21.0	1.68 (0.91-3.09)	1.00
50 and over	184	38.8	1.86 (0.83-4.15)	2.10 (1.53-2.77)	116	33.7	1.35 (0.64-2.85)	1.63 (1.08-2.34)
Adjusted Race/Color			1.26 (0.83-1.89)				1.55 (0.96-2.50)	
White	86	18.6	1.48 (0.37-5.94)		52	27.5	0.83 (0.32-2.12)	
Brown and Black	592	22.7	1.54 (1.02-2.33)		362	24.43	1.88 (1.08-3.26)	
Adjusted Schooling			1.53 (1.03-2.29)				1.62 (1.00-2.61)	
Secondary complete/Higher	153	14.0	1.29 (0.50-3.34)		82	26.6	1.60 (0.53-4.84)	
Elementary complete	112	10.7	1.32 (0.37-4.67)		76	24.1	2.65 (0.65-10.78)	
Elementary incomplete	413	27.5	1.44 (0.91-2.28)		256	24.5	1.47 (0.82-2.61)	
Adjusted Smoker			1.40 (0.94-2.07)				1.63 (1.00-2.63)	
No	559	20.7	1.33 (0.87-2.03)		287	25.8	1.83 (1.01-3.32)	
Yes	95	28.4	3.41 (0.87-13.35)		127	22.6	1.28 (0.56-2.90)	
Adjusted Recent migration			1.51 (1.01-2.26)				1.64 (1.01-2.64)	
No	621	23.1	1.59 (1.05-2.40)		368	25.3	1.72 (1.01-2.90)	
Yes (< 10 years)	57	11.6	0.81 (0.18-3.74)		46	20.7	1.17 (0.34-4.09)	
Adjusted Marital status			1.53 (1.02-2.27)				1.63 (1.00-2.64)	
Single	140	14.2	...	1.00	84	9.1	1.64 (0.21-12.73)	1.00
Married	423	18.6	1.09 (0.68-1.74)	1.62 (1.02-2.40)	316	30.7	1.74 (1.07-2.84)	2.54 (1.47-3.72)
Divorced/Separated/Widow(er)	115	44.3	1.99 (0.95-4.19)	2.48 (1.61-3.42)	14	0.0	...	...
Adjusted Menopause			1.51 (1.01-2.23)				1.74 (1.08-2.79)	
No	458	13.8	1.08 (0.64-1.82)					
Yes	218	36.9	1.80 (0.94-3.43)					
Adjusted Alcohol consumption			1.34 (0.89-1.99)					
Light and moderate	288	17.6	1.62 (0.82-3.21)		243	22.6	1.50 (0.79-2.81)	
Absent and excessive	390	25.2	1.41 (0.86-2.28)		171	28.0	1.84 (0.88-3.85)	
Adjusted			1.48 (0.99-2.20)				1.64 (1.01-2.64)	

*Adjusted for age and marital status.

this protection. Despite being active in their daily activities, only 1.2% of them were athletes and only 9.0 % performed heavy professional work, against approximately 32% of men (data not presented).

Another two studies analyzed sedentary behavior [24,25], which included, apart from physical activities during leisure and professional work, they also measure the time spent on sedentary activities, such as watching TV, video games and on computers. From these variables, the authors created a composite indicator for the definition of what they call "sedentary behavior", associated to MS or to its components. In the present investigation, eminently sedentary behaviors were not contemplated, and this may have decreased the power of this study to reveal the association among women, once this sedentary behavior is more frequent among women [25].

In relation to the measurement of physical activity during leisure and in the professional work, Liedfelt & col. [12] demonstrated that middle-aged Swedish women and with low-schooling had association to the components of SM, due to the high physical activity of the professional work of these women with low schooling and almost no leisure activities. It should be emphasized that in that study, the definition of MS and

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the chosen cut-off points were different to the international standards. For example, to define high blood pressure, the study defined the cut-off point of 160/95 mmHg. This criterion, for sure, highly increased the specificity of the mentioned study, possibly explaining the statistically significant association found between the women. Furthermore, Liedfelt & col. disclosed schooling as the confounding effect, whereby 75.4% of the women in the study had completed secondary school or were university graduates. In comparison to the present paper, only 22.6% had the same schooling level. This difference in schooling levels may have weakened the discriminatory power of our sample, in this aspect.

However, in the gross prevalence ratio, blood pressure, one of the constituent elements of MS, demonstrated a significant association, which leads us to presume that hypertension is more strongly associated to sedentarism in women than other components of MS. This is reinforced by Thompson & col. [5], in the analysis of risk factors for the prevention of atherosclerotic diseases, where blood pressure and diabetes *mellitus* were attributed higher risks.

This study has limitations, the ideal assessment of the analysis of sedentarism would be through energy expenditure, ideally measured through marked body fluid, or body calorimetry, considered as gold-standard. Nevertheless, these methods are prohibitive due to their high costs. A more feasible possibility, for countries such as Brazil, would be to assess the heart rate associated to body movements [44]. This method was not assessed, and, when compared to the method of the investigation, the other one is more precise [44].

A methodological decision may have contributed to decrease the power of detecting the association between sedentarism and MS in women, in relation to the adoption of the criteria of the International Diabetes Federation [33], preconizing the use of cut-off points of abdominal waist, adequate to the studied population. In the present study the wait measurement considered for women was greater or equal to 84 cm, below the measurement preconized by ATP lll [14], which was used in all the other studies mentioned above. The new definition may increase the sensitivity for the MS criteria, on one hand, and decrease the specificity, on the other hand, according to the criteria used, people included who would have been excluded if the ATPIII criteria had been used. Hopefully new national studies, with the use of the IDF criteria, may clarify the direction in which the relation between sedentarism and MS in the Brazilian is presented.

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