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original article

Which is the impact of sedentary behavior on the physical fitness of women older than 50?

Qual é o impacto do comportamento sedentário na aptidão física de mulheres a partir de 50 anos de idade?

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Abstract – The purpose of this study was to verify the association between sedentary behavior and physical fitness of women aged 50 and older. A cross-sectional study was carried out with 298 women in this age range (mean, 59.8±7.2 years), divided into an at-risk group (n=103) and a non-risk group (n=195) according to sedentary behavior. Anthropometric variables were collected (body mass [kg], height [cm], triceps skinfold thickness [mm] and waist circumference [cm]), and body fat percentage was measured by bioelectrical impedance. Analysis of covariance (ANCOVA) was used to compare performance on physical tests in relation to sedentary behavior, adopting a significance level of 5%. Physical activity level was measured and physical fitness tests (flexibility, abdominal resistance, upper body strength, and aerobic fitness) were administered. At-risk women who exhibited sedentary behavior performed worst on upper body strength (12.0±0.7 repetitions) and aerobic fitness (23.3±0.5 ml/kg/min) when compared to those who had no risky behavior (p<0.05). Physical activity can be encouraged in this age group in order to minimize the effects of aging.

Key words: Aging; Anthropometry; Physical fitness; Sedentary lifestyle; Women's health.

Resumo – *Objetivou-se verificar o impacto do comportamento sedentário na aptidão física de mulheres a partir de 50 anos de idade. Para tanto, foi realizado um estudo transversal com 298 mulheres a partir de 50 anos (59,8±7,2), divididas em relação ao comportamento sedentário em: Grupo de risco (n=103); Grupo sem risco (n=195). Coletaram-se variáveis antropométricas (massa corporal (kg), estatura (cm), dobra cutânea do tríceps (mm) e perímetro da cintura (cm)); percentual de gordura por meio de Impedância Bioelétrica; nível de atividade física; testes de aptidão física (flexibilidade, resistência abdominal, força de membros superiores e aptidão aeróbia). Usou-se a análise de covariância (ANCOVA) para comparar o desempenho nos testes físicos das mulheres em relação ao comportamento sedentário, adotando nível de significância de 5%. Mulheres com comportamento sedentário de risco apresentaram piores desempenhos tanto na força de membros superiores (12,0±0,7 repetições) quanto na aptidão aeróbia (23,3±0,5 ml/kg/min) em comparação às mulheres sem comportamento de risco (p<0,05). A prática de atividades físicas pode ser estimulada para esse grupo etário, com o intuito de minimizar os efeitos do processo de envelhecimento.*

Palavras-chave: *Antropometria; Aptidão física; Envelhecimento; Estilo de vida sedentário; Saúde da Mulher.*

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INTRODUCTION

The World Health Organization estimates that 1.9 million of deaths in the world are a consequence of sedentary lifestyle[1]. Sedentary behavior increases the risk of illnesses and non-contagious diseases such as cardiovascular diseases, diabetes, and some types of cancer[2]. Therefore, promotion of physical activities has been the focus of public health agencies from developed and developing countries[1].

Researchers are consistently stating that over the years the levels of physical activity of the population are reduced and the time spent on sedentary activities increase[3]. The causes of such behavior can be: a larger number of responsibilities and chores, which increases over the years and leads to reduced free time to practice physical activities; absence of environmental facilitators that promote the adoption of healthy habits; increasingly easier access to technology, such as electronic devices leading more and more to a sedentary behavior during leisure time[4]; as well as biological factors such as age[5].

Good levels of physical fitness are associated with capacity to perform physical activities with energy and vigor, without excess of fatigue, and also demonstrating physical characteristics that lead to a lower risk of developing non-contagious diseases and functional disabilities[6]. Accordingly, the improvement of physical fitness can be one of the strategies to reduce public expenses on health and to achieve a healthy ageing, with autonomy and good quality of life.

Regarding the effects of ageing on physical fitness, it has been demonstrated that between 25 and 65 years of age there is a decrease in the lean body mass of around 10 to 16% and, as a consequence, muscle strength also decreases, resulting in sarcopenia, which is one of the main causes of deterioration of mobility and functional capacity. There is evidence in the literature that after 50 years of age there is a progressive neurogenic process, especially in women, due to changes caused by the menopause, which may have an influence on the performance of activities that require muscle strength, flexibility, and aerobic resistance[7].

The factors that affect physical fitness and the performance in motor tests can be biological, such as genetics, age and sex, and lifestyle modifiable factors, such as practice of physical activities[8]. Some studies have consistently shown that anthropometric variables and body composition have a higher influence on the performance on physical tests than age and sex[9]. Conversely, Katzmarzyk et al.[10], investigating a representative sample of 17,013 Canadians aged 18 to 90 years, during 12 years, reported 1,832 deaths during the study period. After conduction adjusted analyses for possible confounding factors, the authors reported that, regardless of the level of leisure physical activity, sedentary behavior (time spent sat down) was associated with all-cause mortality (cardiovascular illnesses), except for cancer. Therefore, there is a range of factors that can have an influence on physical fitness and, consequently, on more autonomous and healthier ageing.

Thus, the objective of the present study was to investigate the impact of sedentary behavior on the physical fitness of women older than 50 years of age.

METHODS

This analytical study, descriptive and cross-sectional study is part of the project The Academy of the City of Aracaju, Sergipe, Brazil, and was approved by the Ethics Committee for Research involving Human Beings at the Universidade Federal de Sergipe (CAAE - 4316.0.000.107 -08).

Population and sample

One of the goals of the Academy of the City of Aracaju project is to offer quarterly physical assessments to all users of the program. Since 2004, more than 5,000 people have already been evaluated, and approximately 80% of them are female[11]. Of this percentage, 298 women older than 50 years enrolled in the program and were evaluated in the first half of 2007.

These women were divided into two groups: a) with risky sedentary behavior and b) no risky sedentary behavior. Sedentary behavior was assessed based on the questions of the International Physical Activity Questionnaire (IPAQ, version 8, short) validated for the Brazilian population[12]: *1) How much time in total would you spend sitting in a usual weekday?; 2) How much time in total would you spend sitting in a usual weekend day?* The answer is given in hours and minutes. In the present study, we calculated the arithmetic mean of the time in hours spent sitting for both questions. After calculating the mean, time was divided into tertiles because a classification of how many hours can be considered risky sedentary behavior for individuals older 50 years has not been established in the literature. With this division, women who were classified in the lower and intermediate tertile of hours seated were considered without risky sedentary behavior (n = 195). Conversely, those who were classified in the upper tertile, i.e., with a larger number of hours seated, were considered to have risky sedentary behavior (n = 103).

Statistical power calculation of the sample selected was performed after the application of the measuring instruments using the statistical package Stata 9.0. With that purpose, literature data were considered[13] and the variable flexibility demanded more subjects, significance level of 95%, power of the test for comparison of two means of 0.80, ratio between the groups of 2:1. After calculations were done, the number of women needed to avoid type II errors and ensure internal validity of the results was 134 in the group of patients without risky sedentary behavior and 67 in the group that had risky sedentary behavior. Thus, the number of women selected, both in the no-risk group (n = 195) and in the risk group (n = 103) was sufficient.

Presence of physical disability that prevented the participants to perform the physical tests was set as the exclusion criterion.

Data collection procedure

Data were collected by physical education teachers, physical assessor of the Academy of the City project, in each of the 15 centers of the program in 2007. After being enrolled in the program, women were informed about the procedures and frequency of assessments related to motor abilities, anthropometric measures, body composition, and level of physical activity. Assessments were carried out individually. The assessors explained the test procedures to participants.

The anthropometric variables considered in the present study were: body mass (kg), height (cm), triceps skinfold (mm), and waist circumference (cm). Such variables were chosen because they are used to assess body composition[14] and because they have some influence on the performance on motor tests, as highlighted by Silva and Oliveira[15].

Body mass was measured using a Techline® digital scale with 100 g accuracy. Height was measured using a Sanny® portable professional stadiometer with 0.1 cm accuracy. Based on these data, body mass index (BMI) was calculated. Triceps skinfold was measured using a Sanny® adipometer with 0.1 mm accuracy, and waist circumference was measured using a Sanny® anthropometric tape with 0.1 cm accuracy. Anthropometric variables were collected according to the standards designed by Petroski[14].

Percentage of body fat was assessed by bipolar bioelectrical impedance analysis using a Techline® device (model FE-068), which uses a generalized estimating equation and does not allow for adjustments to the different characteristics, considering sex, age, and body mass for the conversion of fat mass and fat free mass. We followed the pre-test care suggested by Heyward[16] .

Level of physical activity was defined using the IPAQ (version 8, short) validated for the Brazilian population[12] and it was classified using the criteria developed by the International Physical Activity Questionnaire Research Committee[17], which considers the frequency and duration of activities in order to classify the subjects into low, moderate, and high physical activity.

Physical fitness was investigated based on flexibility, muscle resistance, strength, and aerobic fitness, and the following tests were carried out:

a) trunk flexibility was measured by means of the sit and reach test[18];
b) abdominal muscle resistance was estimated by means of trunk flexion[19], considering the largest number of repetitions within 60 seconds.
c) muscle strength/resistance was estimated for the upper limbs using the arm flexion sustained to exhaustion[19].
d) aerobic fitness was assessed using the one-mile track walk[20]. We calculated the time to cover the distance and checked participants' heart rate immediately after the end of the test by counting heartbeats measured in the radial artery during 15 seconds. Such data were used in equation recommended by the literature[20] to estimate maximum oxygen consumption (VO_2 max).

Statistical analysis

Initially, normality of the data was tested by means of histograms, and data showed normal distribution. We used descriptive statistics to describe age, anthropometric variables, body composition, and sedentary behavior expressed as mean values, standard deviation (SD), and standard error (SE). The groups were compared using the *t* test for independent samples. Interaction between sedentary behavior and the physical fitness variables was investigated. As we could not find interaction between the variables, the analysis of covariance (ANCOVA) was used to compare women's performance on the physical tests regarding sedentary behavior. Four comparison models were developed: model 1, which was considered a gross model, found the difference between the groups without any covariates inserted in the model; in model 2, age was the covariate. In model 3, age, anthropometric measures, and body composition were the covariates used. In model 4, age, anthropometric variables, body composition, and level of physical activity were used as covariates. All analyses used a significance level of $p < 0.05$.

RESULTS

Table 1 shows age, anthropometric measures, body composition, and sedentary behavior of the sample analyzed. There were no significant differences between women with risky sedentary behavior and those without risky sedentary behavior for age, anthropometric indicators, and body composition ($p > 0.05$). Because of the division of the groups, women with risky sedentary behavior spent more hours seated (mean = 8.9; SD = 2.8) compared with those who did not have such behavior (mean = 3.2; SD = 1.5) ($p < 0.05$).

Table 1. Mean values and standard deviation for the whole sample and for the groups in relation to age, anthropometric variables, body composition, and sedentary behavior in women older than 50. Aracaju, Sergipe, Brazil, 2007.

Variables	Whole sample	Group 1	Group 2	p-value
	$\overline{X}$ (D.P)	$\overline{X}$ (D.P)	$\overline{X}$ (D.P)	
Age (years)	59.8 (7.2)	59.8 (7.0)	59.9 (7.6)	0.904
Body mass (kg)	65.8 (10.5)	66.4 (9.8)	64.9 (9.8)	0.257
Height (cm)	153.2 (5.9)	153.6 (5.6)	153.0 (6.3)	0.170
SF Triceps (mm)	22.9 (6.5)	22.6 (6.2)	23.6 (7.2)	0.243
Waist circumference (cm)	91.6 (9.3)	92.0 (9.5)	90.1 (8.8)	0.306
BMI (kg/m^2)	28.1 (4.0)	28.2 (4.0)	27.9 (3.9)	0.575
Fat %	33.6 (4.1)	37.2 (5.1)	37.2 (5.3)	0.997
Sedentary - behavior (hours/day)	5.2 (3.4)	8.9 (2.8)	3.2 (1.5)	<0.001*

Group 1 – group of women with risky sedentary behavior; Group 2 – group of women without risky sedentary behavior; SF – skin fold; BMI – body mass index; Fat % – fat percentage; $\overline{X}$ - mean; SD – standard deviation; *$p < 0.05$ – *t* test for independent samples.

In relation to the level of physical activity, 3% (95%CI: 1.1-4.9) of the sample was considered to have low physical activity, 41.3% (95%CI: 36.6-46.8) had moderate physical activity, and 55.7% (95%CI: 50.0-61.3) had high physical activity (data not shown).

In the gross model (Model 1) of comparison between the groups, we found that women who did not have risky sedentary behavior had better strength of upper limbs than their peers with risky sedentary behavior ($p < 0.05$). When we controlled for age (Model 2), anthropometric variables and body composition (Model 3), there was also a difference between the groups related to the arm flexion test. In model 4, we controlled for the effect of age, anthropometric variables, body composition, and level of physical activity, showing that, in addition to the test of upper limb strength, women without risky sedentary behavior had the best performance on aerobic fitness ($p < 0.05$) (Table 2).

Table 2. Mean values and standard error of the comparison of physical fitness between the groups regarding age, anthropometric variables, body composition, and level of physical activity in women older than 50. Aracaju, Sergipe, Brazil, 2007.

Variáveis	Model 1[a]		Model 2[b]		Model 3[c]		Modelo 4[d]	
	G1	G2	G1	G2	G1	G2	G1	G2
	$\overline{X}$ ± SE		$\overline{X}$ ± SE		$\overline{X}$ ± SE		$\overline{X}$ ± SE	
Flexibility (cm)	26,1±0,5	25,7±0,8	25,9±0,5	25,5±0,8	25,7±0,6	25,5±0,8	25,7±0,6	25,6±0,8
Abdominal resistance (rep.)	2,9±0,4	3,0±0,6	2,8±0,4	3,3±0,6	2,8±0,4	3,2±0,6	2,8±0,4	3,2±0,6
Upper limb strength (rep.)	12,0±0,8	16,2±1,2*	11,5±0,8	16,0±1,2*	12,1±0,8	16,0±1,1*	12,0±0,7	16,5±1,1*
Aerobic fitness (ml/kg/min)	23,3±0,7	25,6±1,0	23,4±0,6	25,2±0,8	23,4±0,6	25,2±0,8	23,3±0,5	25,6±0,8*

G1 – group of women with risky sedentary behavior; G2 – group of women without risky sedentary behavior; a – model of analysis without any covariate (*t* test for independent samples); b – model of analysis with the covariate age (ANCOVA); c – model of analysis with the covariates age, anthropometric variables, body composition (ANCOVA); d – model of analysis with the covariates age, anthropometric variables, body composition, and level of physical activity (ANCOVA); $\overline{X}$ - arithmetic mean; SE – standard error; * $p < 0.05$.

DISCUSSION

The main findings of this research were that women with risky sedentary behavior had the worst performance on the upper limb strength test and aerobic fitness compared with women without risky sedentary behavior. In addition, women's level of physical activity affected their performance on the aerobic fitness test. Conversely, regardless of the variables age, anthropometric measures, body composition, and level of physical activity, there was also a difference in the upper limb strength.

The loss of muscle mass and strength is considered by many authors as one of the main factors responsible for the deterioration of mobility and functional capacity during the ageing process[13,21]. Therefore, researchers have investigated the mechanisms involved in the loss of muscle strength caused by ageing with the purpose of creating strategies considering the practice of physical activity to minimize the deleterious effects of ageing in order to preserve or improve people's quality of life[11].

Amorim et al.[22] compared the upper and lower limb strength in active and sedentary women older than 55 years old and they found that physically active women had better performances than the sedentary women. Similar results were reported by Matsudo et al.[13] in women older than 50 years and by Ringsberg et al.[23] in women older than 65 years. Physical activity programs to prevent the loss of muscle strength caused by the ageing process are recommended based on such evidence.

The present study was not focused only on the investigation of the hypothesis that physically active have better performances on motor tests, since this is well explained in the literature. Our results suggest that even physically active people may have risky sedentary behavior, for example, many hours seated in front of the TV, the computer, or at work. This fact should be taken into account when making comparisons using physical aptitude variables related to health. Reinforcing this idea, Intorre et al.[24] investigated older women in terms of morbidity and nutritional status, and they found that those who spent more than four hours a day on sedentary activities had greater chances of having high levels of body fat. To strengthen the impact of sedentary behavior (time seated) on people's health, Katzmarzyk et al.[10] published results of a longitudinal study showing that, regardless of the level of leisure physical activity, the time spent sitting was associated with mortality from cardiovascular diseases in adults and the elderly in Canada.

The difference in women's upper limb strength in both groups investigated in the present study was maintained, even after not considering the effect of age, anthropometric variables, body composition, and level of physical activity, which suggests that other factors that were not investigated had an influence on the performance in the physical test. A factor that can affect women in the age group investigated and that can change behavior patterns, physical and cognitive performance is the hormonal aspect and, if this is not controlled, it can affect the quality of life of women during menopause[7].

Cooper et al.[7] found an association between postmenopausal women and physical performance in 1,386 women older than 53 years. The authors reported that menopausal women who were not receiving hormonal therapy had lower levels of strength than their peers who were having hormone replacement therapy. In this sense, in addition to controlling the factors investigated in the present study, it is recommended that future research also consider the hormonal aspects for better inferences.

Aerobic resistance is considered an important component of physical fitness related to health for people of all ages[8]. Starting at the middle age, there is a natural contractile reduction of the myocardial, hardening of blood vessels, increased peripheral vascular resistance, change in cardiac output, which affect the performance of physical activities of the daily life[13]. Evidence has shown that adequate levels of aerobic fitness usually postpone the consequences caused by ageing, keeping and improving the performance of daily activities[25,26].

The women included in the present study showed moderate levels of aerobic fitness[27], and after not considering the effect of age, anthropometric variables, and body composition, the groups with risky sedentary behavior and the group without risk did not differ regarding aerobic fitness. This indicated that these variables did not have an influence on the performance of our sample. However, to monitor the effect of level of physical activity, we found that those women who did not have risky sedentary behavior had better performances than the women with risk behavior.

Thus, as evidenced in the present study, other authors have reported that the level of physical activity affects the aerobic fitness of women after middle age, and these studies consistently state that the higher the level of physical activity, the better the performance on aerobic fitness tests[13,26]. Cardoso et al.[25] evaluated the level of physical activity and performance on motor tests in women older than 60 years. The authors found that good aerobic performance, with appropriate health levels, was associated with sufficient levels of leisure physical activity.

The present study has some limitations that need to be mentioned, such as the cross-sectional design that prevents us from establishing causality between sedentary behavior and results in the physical fitness tests. The fact that women do not represent the population of the city since they are different from the general population because they seek a physical activity program may also be considered a limitation. Another limitation is the fact that we did not investigate other factors that may affect the performance on motor tests in women after middle age, such as hormonal aspects for instance. And we also did not investigate other variables related to functional ability, which, according to the literature, is one of the most important markers of successful aging and better quality of life[21]. In addition, it is necessary to consider that the classification of sedentary behavior was done based on statistical division in tertiles. However, there are not cutoff points in the literature identifying risky sedentary behavior in people older than 50 years.

The strong points of our study include: 1) the sample representativeness in both groups, with good statistical power for the proposed tests, which minimizes the chances of type II error; 2) the investigation of sedentary behavior during the week and on weekends, which shows an overview of such behavior in the people evaluated; 3) the use of physical tests recommended by the literature and used in other studies.

CONCLUSION

We concluded that sedentary behavior had an impact on physical fitness of women older than 50 years, suggesting that their performance on upper limb strength test and aerobic fitness was worse women with risky sedentary behavior. Thus, we recommend that programs focused on the promotion of physical activity are offered to people during all stages of life in order to minimize the effects of the aging process.

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