



Physical activity and sedentary behavior as predictors of fear of falling and risk of sarcopenia in older adults

Atividade física e comportamento sedentário como preditores do medo de cair e do risco de sarcopenia em idosos

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Date of first submission: April 1, 2023

Last received: May 8, 2023

Accepted: May 22, 2023

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Abstract

Introduction: Low-level physical activity and sedentary behavior are factors that can impact the fear of falling and risk of falls in older adults. **Objective:** This study aimed to determine whether the duration and frequency of physical activity and sedentary behavior predict the fear of falling and risk of sarcopenia in older people.

Methods: This was a cross-sectional study with 116 older individuals from southern and southeastern Brazil. A sociodemographic and health questionnaire, the International Physical Activity Questionnaire (IPAQ - short version), the Falls Efficacy Scale - International (FES-I), and the SARC-f were used. Data were analyzed by bootstrapping procedures, Pearson's correlation, and regression analysis ($p < 0.05$). **Results:** Walking days ($\beta = -0.38$; $p < 0.001$) and moderate activity days ($\beta = -0.23$; $p < 0.001$) showed a negative prediction of fear of falling. Walking days also had a significant and negative prediction of the risk of sarcopenia ($\beta = -0.34$; $p < 0.001$).

Conclusion: We conclude that weekly walking and the practice of moderate-intensity physical activity negatively predict the fear of falling in older adults. Weekly walking also negatively predicts the risk of having sarcopenia. Sedentary behavior was not a predictor of fear of falling and risk of sarcopenia.

Keywords: Aging. Fears. Motor activity. Sarcopenia.

Resumo

Introdução: A prática de atividade física e o comportamento sedentário são fatores que podem impactar o medo de cair e o risco de quedas em idosos. **Objetivo:** Verificar se a duração e a frequência de atividade física e o comportamento sedentário predizem o medo de cair e o risco de sarcopenia de idosos.

Métodos: Trata-se de uma pesquisa transversal realizada com 116 idosos da região sul e sudeste do Brasil. Utilizou-se um questionário sociodemográfico e de saúde, o Questionário Internacional de Atividade Física (IPAQ - versão curta), a Falls Efficacy Scale - International (FES-I) e o SARC-f. Os dados foram analisados por procedimentos de bootstrapping, correlação de Pearson e análise de regressão ($p < 0,05$). **Resultados:** Os dias de caminhada ($\beta = -0,38$; $p < 0,001$) e de atividades moderadas ($\beta = -0,23$; $p < 0,001$) apresentaram predição negativa sobre o medo de cair. Os dias de caminhada também apresentaram predição significativa e negativa sobre o risco de sarcopenia ($\beta = -0,34$; $p < 0,001$). **Conclusão:** A frequência semanal de caminhada e de prática de atividade física de intensidade moderada predizem negativamente o medo de cair dos idosos pesquisados. A frequência semanal de caminhada também prediz negativamente o risco de o idoso ter sarcopenia. O comportamento sedentário não se mostrou como um preditor do medo de cair e do risco de sarcopenia nos idosos.

Palavras-chave: Envelhecimento. Medo. Atividade motora. Sarcopenia.

Introduction

Aging increases the risk of falls, compromising the functionality and independence of older people, and the fear of falling can trigger psychological and behavioral consequences, as the individual seeks protective measures to avoid another fall.¹ This fear is called ptophobia, which is described as psychological and behavioral consequences or sequelae arising from a fall event.²

Fear of falling in older adults is related to multiple factors such as advancing age, being female, having reduced satisfaction with life, low perception of health status and self-efficacy, being obese, living alone and/or with reduced social network and having already fallen.³ In addition, fear of falling can limit performance in participating in physical activities and also increase sedentary behavior.⁴

Sedentary behavior is one of the greatest risk factors for the health of older people, predisposing them to various diseases that directly reduce their quality of life.⁵⁻⁶ Along with the aging process, they are associated with decline in muscle function, resulting in a decrease in the ability to perform activities of daily living and maintain independent functioning.⁷

The morphological, generalized and progressive changes in the musculoskeletal system of older people have an impact on the decrease in muscle performance, increasing the risk of falls and sarcopenia.⁴⁻⁸ Sarcopenia includes not only loss of muscle mass but also loss of muscle strength and performance,⁹ increasing the risk of disability, low levels of physical activity, falls and fall-related injuries, hospitalization, limitation of independence, and mortality.¹⁰ In particular, the low level of physical activity has negative repercussions on the muscular structure of older people, being associated with a higher risk of falls, pre-frailty, frailty and sarcopenia.¹¹

Few studies have investigated the associations between physical activity, sedentary behavior and fear of falling.¹² Conclusions are still inconsistent and limited because of different methods of measuring physical activity and sedentary behavior, lack of adjustments for confounding factors and sample characteristics.¹²

There is overwhelming evidence that physical activity, mainly through exercise, can reduce fear and the risk of falls in older adults, preventing sarcopenia and improving balance control.^{13,14} Studies that address falls and physical exercise, however, show high variability of protocols and great heterogeneity regarding the volume, frequency and intensity of training.¹³ Many older people are not involved in structured exercise programs, but they can be physically active on a daily basis. Thus, identifying whether the level of physical activity predicts psychological and biological factors is important.

A study carried out with older Chinese women suggested that daily physical activity, at moderate to vigorous intensity, and the number of daily steps were protective factors against fear of falling.¹⁵ A recent systematic review,¹⁴ however, pointed out the lack of studies that investigate low-level physical activity and sedentary behavior as determinants of fear of falling, suggesting that the directionality of findings in this area needs further investigation. Given the above, this article aimed to determine whether the duration and frequency of physical activity and sedentary behavior predict the fear of falling and the risk of sarcopenia in older people.

Methods

This was a quantitative, analytical, observational, cross-sectional study, approved by the Human Research Ethics Committee of Cesumar University (Unicesumar), through Approval No. 5.391.064.

A total of 116 older people from southern and southeastern Brazil were evaluated, and this sample was chosen in a non-probabilistic, intentional and convenience way. Those who did not respond to all forms were excluded. Those who were wheelchair users and/or restricted to bed, partly or fully, were also excluded. Older people (≥ 60 years) of both sexes were included, if they answered all the items on the forms, with or without help from someone else.

A sociodemographic and health questionnaire, prepared by the authors, was used to characterize the older individuals, with questions related to age, sex, age group, retirement, education, monthly income, physical exercise, use of medication, presence of diseases, use of walking accessories, region of residence (southern or southeastern Brazil, history of falls and history of near falls.

For the evaluation of physical activity, the International Physical Activity Questionnaire (IPAQ) was used. This instrument evaluated physical activities carried out during leisure time, such as moving from one place to another, household chores and occupational activities, considering the time of 150 minutes per week of physical activities for the subject to be classified as physically active. For less than 10 minutes a week, the subject was considered sedentary, and those who performed at least 10 minutes, but did not reach 150 minutes, were considered insufficiently active.¹⁶

Fear of falling was assessed using the Falls Efficacy Scale - International - FES-I. This scale contains sixteen domains with different activities of daily living with four possible answers and respective scores from one to four ("not at all worried" to "extremely worried"). The total score can vary from 16 to 64, ranging from no concern to extreme concern, in relation to falls, while performing specific activities in the questionnaire.¹⁷

To assess the risk of sarcopenia, the SARC-f was used, which includes five components: strength (if the subject is able to lift 2.5 kg), ambulation (if the subject is able to walk across a room or in his room), getting up from a chair (if the subject can get up from a chair),

climbing stairs (if the subject can climb a flight of 10 steps), and falls (if the subject has had falls in the last year). The scores vary from zero to two points, and for the first four the interpretation is zero = no difficulty, 1 = some difficulty and 2 = great difficulty or inability to do it, while for the last the interpretation is zero = they did not suffer falls in the last year, 1 = fell 1-3 times in the last year, and 2 = 4 or more falls in the last year. The older individuals scored four points or more for the risk of sarcopenia, in the total sum of the scores of the five components.¹⁸⁻¹⁹

Data collection took place through an online form available free of charge through Google Forms. Only individuals who signed an informed consent form in the online form participated in the research.

The link developed to host the electronic questionnaire for the study was made available through the researchers' social networks (WhatsApp, Instagram, Twitter and Facebook). The online questionnaire was open to receive responses for 90 days (from June to August 2022). In the collection, the ethical precepts of non-exposure of the study participants were respected, thus guaranteeing the confidentiality of the information.

Preliminary data analysis, descriptive statistics, correlations and multiple regression were performed using SPSS version 23.0.²⁰ Bootstrapping procedures were performed (1000 re-samplings; 95% confidence interval) to obtain greater reliability of the results, to correct deviations from normality of the sample distribution and differences between the sizes of the groups, and also to present a 95% confidence interval for the differences between the means.²¹

Pearson's correlation was used to investigate the relationship between the duration and frequency of physical activity, sedentary behavior, fear of falling and risk of sarcopenia. Multiple linear regression analysis was used to determine whether the variables of duration and frequency of physical activity and sedentary behavior predict fear of falling (Model 1) and risk of sarcopenia (Model 2) in the older subjects. Two models were conducted using the enter method to enter variables to investigate the prediction of duration and frequency of physical activity and sedentary behavior (independent variables) on fear of falling (Model 1) and sarcopenia score (Model 2) (dependent variables). There were no correlations strong enough between variables that indicated problems with multicollinearity.

Results

Of the 116 older participants in the research, most were women (75.9%), between 60 and 70 years old (68.1%), with a partner (63.8%), white (88.8%), retirees (83.6%), with a monthly income of more than three minimum wages (54.3%) and with higher education (57.8%) (Table 1).

Table 1 - Profile of the older people in southern and southeastern Brazil participating in the study, 2022

Variable	n (%)
Sex	
Female	88 (75.9)
Male	28 (24.1)
Age range (years)	
60 to 70	79 (68.1)
70 to 79	25 (21.6)
80 or older	12 (10.3)
Marital status	
With partner	74 (63.8)
Without partner	42 (36.2)
Color	
White	103 (88.8)
Black	2 (1.7)
Yellow	11 (9.5)
Retired	
Yes	97 (83.6)
No	19 (16.4)
Monthly income (minimum wage)	
1 to 2	36 (31.0)
2.1 to 3	17 (14.7)
More than 3	63 (54.3)
Education	
Illiterate	8 (6.9)
Incomplete elementary school	24 (20.7)
Complete elementary school	3 (2.6)
Complete high school	14 (12.1)
Higher education	67 (57.8)

Descriptive statistics and intercorrelations

It is noted in Table 2 that the older participants reported taking more walks per day (mean \pm SD of 3.44 ± 2.54) than moderate (2.08 ± 1.17) and vigorous (0.86 ± 0.55) physical activity during the week, in addition to having more minutes of sedentary behavior during the weekend (392.24 ± 272.22) than during the week (281.37 ± 184.60). Finally, it is noteworthy that they had low fear (concern) of falling (26.07 ± 10.30) and low risk score for sarcopenia (1.55 ± 1.04).

When analyzing the correlations between the duration and frequency of physical activity, fear of falling and risk score for sarcopenia in the older subjects (Table 2), it was found that fear of falling showed a significant correlation ($p < 0.05$), weak and negative with walking days ($r = -0.41$), moderate activity days ($r = -0.31$) and vigorous activity days ($r = -0.20$), in addition to a positive and weak correlation with time sitting during the weekend ($r = 0.22$). The sarcopenia risk score showed a significant correlation ($p < 0.05$), negative with weak to moderate intensity, with all variables of duration and frequency of physical activity ($r = -0.27$ to $r = -0.47$), and positive correlation with time sitting during the weekend ($r = 0.24$). It is also noted that time sitting during the week was negatively and weakly correlated only with minutes of vigorous activity per day ($r = -0.19$), while time sitting during the weekend was negatively and weakly correlated with walking days ($r = -0.31$), moderate activity days ($r = -0.27$) and minutes of moderate activity per day ($r = -0.20$).

Multiple regression analysis

Multiple regression analyzes (Table 3) revealed in the first model that the variables of duration and frequency of physical activity and sedentary behavior explained a significant amount of fear of falling in the older individuals ($R^2 = 0.16$; $p < 0.001$). However, only walking days ($\beta = -0.38$; $p < 0.001$) and days of moderate activity ($\beta = -0.23$; $p < 0.001$) showed a negative prediction of fear of falling. In the second model (Table 3) it can be seen that the risk of sarcopenia was explained in 26% of the older participants by the variables of duration and frequency of physical activity and sedentary behavior; however, only walking days showed a significant and negative prediction on the risk of sarcopenia ($\beta = -0.34$; $p < 0.001$).

Table 2 - Correlation between the duration and frequency of physical activity, fear of falling and sarcopenia score in older individuals in southern and southeastern Brazil, 2022

Variable	1	2	3	4	5	6	7	8	9	10
1	-	0.48**	0.31**	0.24*	0.29*	0.12	-0.05	-0.31*	-0.41**	-0.47**
2	-	-	0.37**	0.39**	0.32**	0.17	-0.05	-0.11	-0.16	-0.37**
3	-	-	-	0.54**	0.46**	0.29**	-0.11	-0.27**	-0.31**	-0.36**
4	-	-	-	-	0.36**	0.36**	-0.13	-0.20*	-0.16	-0.32**
5	-	-	-	-	-	0.60**	-0.10	-0.18	-0.20*	-0.28**
6	-	-	-	-	-	-	-0.19*	-0.07	-0.16	-0.27**
7	-	-	-	-	-	-	-	0.32**	0.10	0.12
8	-	-	-	-	-	-	-	-	0.22**	0.24**
9	-	-	-	-	-	-	-	-	-	0.75**
10	-	-	-	-	-	-	-	-	-	-
Mean	3.44	43.70	2.08	44.82	0.86	22.41	281.37	392.24	26.07	1.55
SD	2.54	42.63	1.17	33.37	0.55	19.74	184.60	272.22	10.30	1.04

Note: 1 = Walking days; 2 = Minutes walking per day; 3 = Moderate activity days; 4 = Minutes of moderate activity per day; 5 = Vigorous activity days; 6 = Minutes of vigorous activity per day; 7 = Time sitting during the week (minutes); 8 = Time sitting during the weekend (minutes); 9 = Fear of falling; 10 = Risk of sarcopenia; SD = standard deviation. Pearson's correlation. *Significant correlation at the 0.05 level. **Significant correlation at the 0.01 level.

Table 3 - Duration and frequency of physical activity and sedentary behavior as predictors of fear of falling and indicative of sarcopenia in older people in southern and southeastern Brazil, 2022

Predictor	M1 β (IC)	M2 β (IC)
Walking days	-0.38 (-2.36; -0.71)***	-0.34 (-0.43; -0.12)***
Minutes walking per day	0.101 (-0.03; 0.08)	-0.10 (-0.01; 0.01)
Moderate activity days	-0.23 (-2.11; -0.03)***	-0.12 (-0.31; 0.08)
Minutes of moderate activity per day	0.04 (-0.03; 0.05)	-0.06 (-0.01; 0.01)
Vigorous activity days	0.05 (-1.20; 1.90)	0.03 (-0.25; 0.32)
Minutes of vigorous activity per day	-0.11 (-0.09; 0.03)	-0.16 (-0.02; 0.01)
Time sitting during the week	0.03 (-0.01; 0.01)	0.03 (-0.01; 0.01)
Time sitting during the weekend	0.06 (-0.01; 0.01)	0.06 (-0.01; 0.01)
R ²	0.16	0.27
F	3.824***	6.219***
Durbin-Watson	1.82	1.91

Note: M1 = fear of falling; M2 = indicative of sarcopenia; β = standardized regression coefficient; 95%CI = 95% confidence interval; *p < 0.05; **p < 0.01; ***p < 0.001; R² = coefficient of determination; F = Fisher's test. Only standardized regression coefficients that were less than the 0.05 significance level are highlighted in bold.

Discussion

The main findings of this study indicate that the days of moderate-intensity physical activity showed a negative prediction of fear of falling, and that the weekly frequency

of walking showed a significant and negative prediction of the risk of sarcopenia in the older participants.

As seen in Table 3, the frequency of moderate-intensity physical activity was related to fear of falling, that is, the more days of moderate physical activity

practiced, the lower the fear of falling. This fact raises the hypothesis that the fear of falls causes changes in the psychosocial function in older people by causing restriction in social interaction.²¹ There is therefore a bidirectional relationship here, where the older people have less fear of falling because engage in more moderate physical activity or practice more moderate physical activity because they feel safer and have less fear of falling. The practice of moderate-intensity physical activity performed for at least 150 minutes a week seems to be a protective factor against fear of falling.⁴

It is noteworthy that changes in balance patterns and progressive decrease in fall reaction strategies with age increase the risk of falls and the emergence of fear of falls, also known as ptophobia. Ptophobia has an important psychological and functional impact, restricting activities of daily living and worsening the quality of life of older people.²² The fear of falling can have a serious impact on the health and life of an older person, as it often reduces their physical and social activities.²³ One of the main consequences of fear of falling is the subsequent restriction of physical activity, leading to a downward spiral of inactivity, deconditioning, loss of confidence and increased risk of falling.²⁴ This restriction of activity is observed in 50% of older people with fear of falling and can lead to functional decline, muscle atrophy, loss of balance, gait changes, depression and social isolation, with obvious repercussions on quality of life and the ability to perform physical activities.³⁻²⁶

In a survey of 144 older people, 75 with no or low concern about the possibility of falling (G1) and 69 with high concern about the possibility of falling (G2), the authors found better performance in the Timed Up and Go (TUG) test. and less fear of falling in G1, assessed by FES-I.⁴ It is inferred, therefore, that older people with better mobility, that is, capable of performing more physical activities, have less fear of falling.

Another survey, with older people from the community, users of an outpatient clinic of the private health system in Santiago, Chile, evaluated the level of physical activity and fear of falls.²⁷ The authors observed that the fear of falling was the same in sedentary and active older people who lived in the community, a fact that can be explained by the diversity of factors that impact the fear of falling and the level of physical activity, which can differ between different regions and cultures. It is worth recalling that the mean FES-I in the present study was 26.07, suggesting a low fear of falling. In their

study, Araya e Iriarte²⁷ also showed that the fear of falling was the same in sedentary and active older people living in the community, again reinforcing the complex etiology of fear of falling in older people. Similar results were found in a study carried out in Thailand with rural older people,²⁸ and in a study carried out in Brazil with older people enrolled in the Family Health Strategy (ESF).²⁹

In Table 3, it can be seen that the more days the older participants walked a week, the lower their risk of sarcopenia. It is inferred that the regular practice of physical activity, even at light intensities, such as walking, is positively related to the prevention of sarcopenia.³⁰ Marzetti et al.³¹ reinforce that a substantial increase in the level of physical activity has been associated with a reduction in the risk of sarcopenia and improved muscle mass and function in older persons. In contrast, a sedentary lifestyle is the main factor responsible for muscle weakness, which in turn, results in a further decrease in activity levels and loss of muscle mass and strength, which are associated with the risk of sarcopenia.³² In fact, physical activity represents the most effective strategy currently available in the management of sarcopenia.³³

A result similar to that of the present study was found with Brazilians who frequent gyms for older people (ATI).³⁴ The authors observed that older people who practice light intensity physical activities (walking) and those of moderate intensity have a lower tendency to show signs of sarcopenia.³⁴ In a survey of 304 people in older community, it was found that 10.9% of those who did not practice physical activity and had a sedentary behavior were associated with sarcopenia or components of sarcopenia (low muscle mass, low handgrip strength or slow walking speed).³⁵ On the other hand, Johansson et al.³⁶ report that older people, when they reach at least 30 minutes per day of moderate to vigorous physical activity, even when there is a long time of sedentary behavior, have a reduction in the risks of probable sarcopenia. Finally, it is highlighted that increasing moderate to vigorous physical activity and reducing sedentary behavior can also be beneficial for managing the fear of falling and should be involved in public health guidelines, especially for older women who have experienced falls.¹²

Despite the important results found in this study, it has some limitations: 1) it was a cross-sectional and observational study, which prevents inferring cause and effect between variables; 2) the sample studied was

located only in southern and southeastern Brazil, mainly because most of the authors of the present study are from this region of the country; 3) advertising/recruitment bias on social media; 4) bias in online responses and profile of online respondents; 4) online survey (access and understanding of those evaluated).

Conclusion

From the results obtained, we conclude that weekly walking and practice of moderate-intensity physical activity negatively predicted fear of falling in the older people surveyed. Weekly walking also negatively predicted the risk of the older persons with sarcopenia. Sedentary behavior did not prove to be a significant predictor of fear of falling and the risk of sarcopenia in the older people. As practical implications, we point out the importance and need for more frequent practice of moderate-intensity physical activities to prevent fear of falling in older people, and walking to prevent fear of falling and the risk of having sarcopenia. It is necessary that future studies investigate the fear of falling as a barrier to engaging in physical activity in older persons and as a facilitator in the adoption of a sedentary lifestyle.

Acknowledgments

This study received funding from Coordination for the Improvement of Higher Education Personnel (CAPES).

Authors' contributions

GN, JРАНJ and DVO were responsible for the conception and design of the study, and analysis and interpretation of data. GN, YLF and DVO wrote and revised the manuscript. All authors approved the final version.

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