






# Correlation between concern about falling and functional muscle fitness in community-dwelling elderly

*Correlação entre preocupação em cair e aptidão muscular funcional em idosos comunitários*

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## Abstract

**Introduction:** To establish a correlation between concern about falling and a more comprehensive functional parameter, functional muscle fitness, a variable that encompasses functional components such as balance, muscle strength, power, flexibility and motor coordination in an integrated way. Functional muscle fitness is measured using the sitting-rising (from the floor) test (SRT), a simple, safe, fast and ecological test. **Objective:** The aim of our study was to determine the correlation between concern about falling and functional muscle fitness in the elderly. **Methods:** A cross-sectional observational study was conducted. The sample consisted of 53 elderly people of both sexes (86.8% women;  $65.6 \pm 4.7$  years old; body mass index  $28.5 \pm 3.8$  kg/m<sup>2</sup>), who were assessed for concern about falling (through Falls Efficacy Scale International, FES-I-Brazil) and functional muscle fitness (through SRT). Correlation analysis was performed using the Spearman test. For all analyses, a significance level of 5% ( $p < 0.05$ ) was established. **Results:** Concern about falling showed a negative correlation with functional muscle fitness ( $\rho = -0.229$ ;  $p = 0.015$ ). **Conclusion:** Elderly people with lower levels of functional muscle fitness have a higher level of concern about falling.

**Keywords:** Concern about falling. Elderly. Functional muscle fitness. Physical fitness.

## Resumo

**Introdução:** Com o intuito de estabelecer uma correlação entre a preocupação em cair e um parâmetro funcional mais abrangente, a aptidão muscular funcional, variável que engloba componentes funcionais como equilíbrio, força, potência muscular, flexibilidade e coordenação motora de forma integrada, surge como uma alternativa. A aptidão muscular funcional é mensurada por meio do teste de sentar e levantar do chão (TSL), um teste simples, seguro, rápido e ecológico. **Objetivo:** A pesquisa teve como objetivo verificar a correlação entre a preocupação em cair e a aptidão muscular funcional de idosos. **Métodos:** Trata-se de um estudo com delineamento observacional do tipo transversal correlacional. A amostra foi composta por 53 idosos de ambos os sexos (86,8% mulheres;  $65,6 \pm 4,7$  anos; índice de massa corporal  $28,5 \pm 3,8$  kg/m<sup>2</sup>), avaliados quanto à preocupação em cair (através da Escala Internacional de Eficácia de Quedas Brasil - FES-I-Brasil) e à aptidão muscular funcional (através do TSL). A análise de correlação foi realizada pelo teste de Spearman. Para todas as análises foi estabelecido um nível de significância de 5% ( $p < 0,05$ ). **Resultados:** A preocupação em cair apresentou correlação negativa com aptidão muscular funcional ( $\rho = -0,229$ ;  $p = 0,015$ ). **Conclusão:** Idosos com menores índices de aptidão muscular funcional apresentam maior nível de preocupação em cair.

**Palavras-chave:** Preocupação em cair. Idoso. Aptidão muscular funcional. Aptidão física.

## Introduction

According to the projection of the United Nations, it is estimated that in 2050 about 30% of the population will be composed of elderly people.<sup>1</sup> Faced with the increase in the elderly population, the literature has pointed to the importance of increasingly studying the entire process of senescence and its changes.<sup>2</sup> During the aging process, natural losses are observed, such as the decrease in strength, power, flexibility and balance levels, which end up compromising the performance of basic and instrumental activities of daily living,<sup>2-4</sup> thus impacting the functional capacity of the elderly.<sup>5</sup>

Such physical and functional losses are also responsible for the increased risk of falls in this population. Falls affect about a third of the elderly over 60 years and 40 to 50% of the elderly between 80 and

85 years, being the third leading cause of accidental death in Brazil.<sup>6,7</sup> Senescence also brings with it some psychological damage,<sup>8</sup> such as the concern about falling, characterized by the feeling of insecurity during daily activities.<sup>9</sup>

Schepens et al.<sup>10</sup> conducted a meta-analysis pointing out that the concern about falling appears as a protective factor against falls, increasing attention in the performance of daily activities; however, these increases end up developing an excessive restriction of movements, decreasing the levels of physical activity, which can aggravate the loss of functionality in the elderly.<sup>9,10</sup>

The literature demonstrates a correlation between the level of concern about falling and some functional components alone, such as balance,<sup>11,12</sup> strength<sup>13-15</sup> and muscle power.<sup>16</sup> However, an alternative is to establish a correlation between the concern about falling and the most comprehensive functional parameter, functional muscle fitness, a variable that encompasses functional components in an integrated manner, including balance, strength, muscle power, flexibility and motor coordination,<sup>17-19</sup> This variable can be easily measured using the sitting-rising test (SRT),<sup>17</sup> a simple, safe, fast and ecological test.

Considering that previous studies have already demonstrated a correlation between the concern about falling and other isolated functional components in the elderly,<sup>11-16</sup> it is likely that there may also be a negative correlation with functional muscle fitness. In this sense, it would be possible to previously identify possible psychological damage associated with the concern about falling, through a single test capable of predicting the functional status of the elderly. Therefore, the objective of the present study was to correlate the levels of concern about falling with functional muscle fitness in community-dwelling elderly.<sup>17</sup>

## Methods

### Characterization of the study and sample

This was a cross-sectional correlational observational study. Data collection took place between February and March 2020. The research was approved by the Institutional Research Ethics Committee of the Federal Rural University of Pernambuco (UFRPE), under CAEE registration No. 14788819.7.0000.5208, and all participants signed an informed consent form.

The sample, extracted from a longitudinal study,<sup>18</sup> consisted of elderly people living independently in the community, of both sexes, aged 60 years or older, who had not been on a regular exercise program for at least six months. Participation took place on a voluntary basis and the invitation was made through verbal announcements and printed notices through folders fixed on the premises of UFRPE.

### Procedures

#### *Assessment of concern about falling - International Fall Efficacy Scale (FES-I-Brazil)*

Concern about falling was assessed using the FES-I-Brazil, which represents the degree of concern about the possibility of falling when performing activities of daily living (basic and instrumental), socialization and postural control.<sup>19</sup> The scale contains 16 questions with scores ranging from 1 to 4 points per question, where 1 point is the minimum score (not at all concerned) and 4 is the maximum score (extremely concerned).

#### *Evaluation of functional muscle fitness (SRT)*

The measurement of functional muscle fitness was performed using the SRT.<sup>17,20</sup> The test consists of quantifying the supports that the individual uses to sit and get up from the floor, which can be hands and/or knees, or even the hands on the knees and legs. Independent grades are assigned for each of the two acts, sitting and rising. The maximum grade is 5 for each of the two. You also lose half a point for any noticeable imbalance. The best result of two attempts for each of the two acts is chosen as representative of the individual.<sup>20</sup> The participants performed three practice sessions before the application of the test, with an intraclass correlation coefficient of 0.87.

Functional muscle fitness can be classified as favorable or unfavorable.<sup>21</sup> In men and women aged between 56 and 60 years, a score below 8 points indicates an unfavorable condition of functional muscle fitness, while for men and women, respectively, the minimum score for a favorable condition is: 8 and 7 for the age group from 61 to 65 years; 7.5 and 7 between 66 and 70 years; and 6 and 3.5 for elderly people aged 71 to 75 years. For women between 76 and 80 years, the minimum favorable score is 4, and between 81 and 85 years, it is 3.

### Analysis of data

Data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20 (SPSS Inc., Chicago, IL, USA) and GraphPad InStat, version 3 (GraphPad Software, San Diego, CA, USA) programs. The data were entered in the SPSS statistical package, and after their consolidation and validation, descriptive statistics were performed. The Kolmogorov-Smirnov test was used to determine data normality. Spearman's rank correlation was used to analyze the relationship between concern about falling and indicators of functional capacity. For all analyses, a significance level of 5% ( $p < 0.05$ ) was established.

### Results

The sample consisted of 50 elderly people. The sociodemographic data and the results of the functional assessments characterizing the sample are presented in Tables 1 and 2.

Figure 1 shows the result of the correlation analysis between concern about falling and functional muscle fitness. A negative and statistically significant correlation was observed ( $\rho = -0.229$ ;  $p = 0.015$ ).

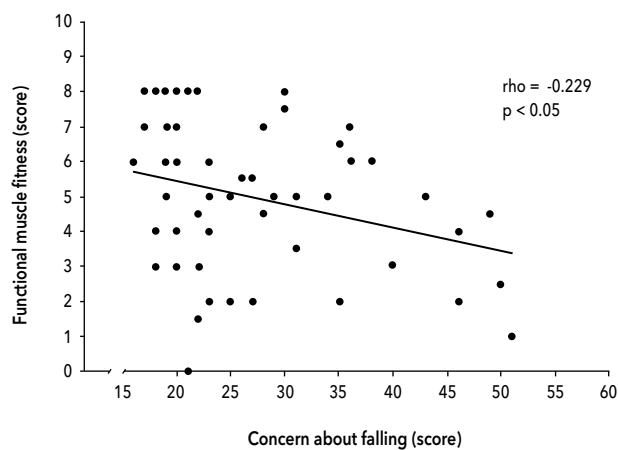
**Table 1** - Sociodemographic and functional characteristics of the elderly included in the study (n = 53)

Characteristics	Values
Sex (% women)	46 (86.80)
Age (years)	65.66 ± 4.77
Weight (kg)	69.86 ± 11.00
Height (m)	1.56 ± 0.07
Body mass index (kg/m <sup>2</sup> )	28.5 ± 3.80
<b>Comorbidities</b>	
Hypertension (%)	32 (60.40)
Diabetic (%)	10 (18.90)
Osteoarticular disease (%)	10 (18.90)
<b>Scores</b>	
Concern about falling	27.23 ± 9.46
Functional muscle fitness	4.96 ± 2.08

Note: Values presented as mean ± standard deviation or absolute (relative frequency).

**Table 2** - Relationship of functional muscle fitness ratings of the elderly included in the study, stratified by sex and age (n = 53)

Sex	Classification (%)
<b>Women</b>	
56 to 60 years (n = 6)	Unfavorable (100)
61 to 65 years (n = 19)	Unfavorable (65)
66 to 60 years (n = 15)	Unfavorable (67)
71 to 75 years (n = 4)	Favorable (75)
76 to 80 years (n = 1)	Favorable (100)
81 to 85 years (n = 1)	Favorable (100)
<b>Men</b>	
61 to 65 years (n = 5)	Unfavorable (60)
66 to 70 years (n = 1)	Favorable (100)
71 to 75 years (n = 1)	Unfavorable (100)



**Figure 1** - Correlation between concern with falling and functional muscle fitness in elderly (n = 53).

## Discussion

Confirming the initial hypothesis, the present study revealed a negative correlation between functional muscle fitness (SRT) and concern about falling (FES-I-Brazil), indicating that functional impairments are related to increased levels of concern about falling. Although the relationship between concern about falling and functional aspects has already been pointed out in the literature, previous findings have demonstrated this relationship only with functional components separately, through a set of tests.

Pereira et al.,<sup>11</sup> on comparing two balance assessment instruments and their relationship with the risk of falling in the elderly, they found that the Berg Balance Scale and the Balance Stability System balance platform were correlated with each other and concluded that the worse the indices balance, the greater the risk of a fall episode among the elderly. With similar findings, Hoang et al.<sup>14</sup> also ratified the relationship between concern about falling and balance among community-dwelling elderly people. Both studies point to the importance of stability and postural control in performing daily activities.<sup>11,14</sup>

With regard to muscle strength, the literature also highlights the inverse relationship between strength levels and concern about falling among the elderly. Alfieri et al.<sup>12</sup> correlated lower limb strength, measured using a dynamometer, with FES-I, with a result of  $\rho = -0.44$ ,  $p = 0.02$ . Sales et al.<sup>15</sup> also evaluated the association between concern about falling with force, through handgrip strength and strength in knee extension, and in both methods significant associations with concern about falling were found.

Regarding muscle power and concern about falling, in the only study found that brought this relationship, Trombeti et al.<sup>16</sup> evaluated power through a pneumatic leg press, in which five repetitions were performed as quickly as possible with a load of 40 to 70% RM, and observed that the lower the muscle power indicators, the greater the concern about falling, especially in relation to the performance of basic and instrumental activities of daily living. Such a relationship can be attributed to the decline in muscle mass and strength and, consequently, a decrease in muscle power, something common during the natural aging process, especially due to the loss of type II muscle fibers, which are responsible for rapid contraction, compromising the functional performance of the elderly.<sup>22,23</sup>

Despite these findings, there is a need to establish such correlations with broader functional parameter, since they all occur with isolated functional components. The use of batteries of functional tests that evaluate more than one functional aspect is an alternative. An example is the Short Physical Performance Battery (SPPB),<sup>24</sup> a battery consisting of balance, gait performance and strength tests. Even though it is a more global evaluation, the evaluations of the parameters still happen independently. When generating a final score, it is natural and possible that one or two of the three variables evaluated may overestimate or underestimate

the results found. In addition, functional test batteries may require more resources for the application, as well as demanding more time to perform.

Unlike the global functionality scores provided by batteries of functional tests, the SRT is capable of measuring functional muscle fitness,<sup>17</sup> a variable that encompasses different functional parameters simultaneously and in an integrated manner, including balance, muscle strength and power, flexibility and motor coordination. The SRT is a simple, ecological and quick-to-perform tool (approximately 20 seconds), which does not require any material resources and can be applied in different contexts, whether in clinics, gyms or even at home.<sup>19</sup> Accordingly, the SRT may be a useful tool for screening, functional classification and risk stratification for a large sample of individuals.<sup>23</sup>

The SRT has been shown to be reliable and sensitive to variations in each of the functional muscle fitness variables.<sup>19,25</sup> Considering that balance assessments,<sup>11,12</sup> strength<sup>13-15</sup> and muscle power<sup>16</sup> are directly related to concern about falling in the elderly, the SRT evaluates all these components in an integrated way. Thus, it is possible to relate functional muscle fitness with concern about falling in the elderly.

Another important finding is that the SRT, according to Brito et al.,<sup>26</sup> is a significant predictor of all-cause mortality in individuals aged 51 to 80 years, and that each increment of one point in the SRT score is associated with a 21% reduction in all-cause mortality.

A study conducted by Araújo et al.<sup>21</sup> with 6,141 individuals revealed reference values in the SRT score for all ages, based on two classifications: 1) favorable functional muscle fitness and 2) unfavorable. These findings agreed with the analysis of the sample characteristics of the present study (Table 2) and confirmed the results that the lower the functional muscle fitness, the greater the concern about falling among the elderly.

The present study showed as strengths the use of a validated, reliable and sensitive instrument for the elderly population, capable of quick, safe, practical and costless determination of functional parameters in an integrated manner. In addition, it is also an instrument capable of offering an overview of another important aspect in the context of the elderly, which is the level of concern about falling, especially useful in times of a pandemic, in which the elderly, classified as a risk group, need to avoid exposures. On the other hand, the sample size, derived from a non-probabilistic sample size, was considered a

limitation, which may limit the extrapolation of results to the elderly population in general.

## Conclusion

Functional muscle fitness showed a negative correlation with the levels of concern about falling ( $\rho = -0.229$ ;  $p = 0.015$ ), indicating that the lower the score obtained through the SRT, the higher the level of concern about falling among the elderly assessed by the FES-I-Brazil. Therefore, it is noteworthy that such findings offer important practical implications, both in the context of evaluation and in the prescription of rehabilitation and training programs for the elderly. It is noteworthy that the use of the SRT goes beyond the measurement of functional muscle fitness, also offering data regarding the prediction of death and indicators referring to the concern of falling in these elderly people, in addition to the possibility of performing the SLT remotely, through cell phones or computers during the COVID-19 pandemic.

## Authors' contributions

FDDA and ALTP were responsible for the conception and design of the study, FDDA and PAFM for data collection, JDAS for statistical analysis, FDDA, PAFM, DCMM and JDAS for writing the manuscript and ALTP for critical review. All authors approved the final version.

## References

1. ONU. Population Division. World Population Prospects 2019 [cited 2021 Mar 12]. Available from: <http://population.un.org/wpp/>
2. Cunningham C, O' Sullivan R, Caserotti P, Tully MA. Consequences of physical inactivity in older adults: A systematic review of reviews and meta-analyses. *Scand J Med Sci Sports*. 2020;30(5):816-27. DOI
3. Santos IS, Silva CFR, Ohara DG, Matos AP, Pinto ACPN, Pegorari MS. Association between frailty syndrome and sedentary behavior among community-dwelling older adults in the Amazon region: a cross-sectional study. *Sao Paulo Med J*. 2021;139(3):226-33. DOI

4. Fachine BRA, Trompiere N. O processo de envelhecimento: as principais alterações que acontecem com o idoso com o passar dos anos. *Inter Sci Place*. 2012;1(20):7. [Full text link](#)
5. Pirauá ALT, Cavalcante BR, Oliveira VMA, Beltrão NB, Batista GA, Pitangui ACR, et al. Effect of 24-week strength training on unstable surfaces on mobility, balance, and concern about falling in older adults. *Scand J Med Sci Sports*. 2019;29(11):1805-12. [DOI](#)
6. Khaw KSF, Visvanathan R. Falls in the aging population. *Clin Geriatr Med*. 2017;33(3):357-68. [DOI](#)
7. Abreu DROM, Novaes ES, Oliveira RR, Mathias TAF, Marcon SS. Internação e mortalidade por quedas em idosos no Brasil: análise de tendência. *Cienc Saude Colet*. 2018;23(4):1131-41. [DOI](#)
8. Oliveira JMB, Vera I, Lucchese R, Silva GC, Tomé EM, Elias RA. Envelhecimento, saúde mental e suicídio. Revisão integrativa. *Rev Bras Geriatr Gerontol*. 2018;21(4):503-15. [DOI](#)
9. Gazibara T, Kurtagic I, Kusic-Tepavcevic D, Nurkovic S, Kovacevic N, Gazibara T, et al. Falls, risk factors and fear of falling among persons older than 65 years of age. *Psychogeriatrics*. 2017;17(4):215-23. [DOI](#)
10. Schepens S, Sen A, Painter JA, Murphy SL. Relationship between fall-related efficacy and activity engagement in community-dwelling older adults: a meta-analytic review. *Am J Occup Ther*. 2012;66(2):137-48. [DOI](#)
11. Pereira VV, Maia RA, Silva SMCA. The functional assessment Berg Balance Scale is better capable of estimating fall risk in the elderly than the posturographic Balance Stability System. *Arq Neuropsiquiatr*. 2013;71(1):5-10. [DOI](#)
12. Alfieri FM, Vargas e Silva NO, Kutz NA, Salgueiro MMHAO. Relações entre equilíbrio, força muscular, mobilidade funcional, medo de cair e estado nutricional de idosos da comunidade. *Rev Kairos Gerontol*. 2016;19(2):147-65. [Full text link](#)
13. Silva C, Oliveira NC, Alfieri FM. Mobilidade funcional, força, medo de cair, estilo e qualidade de vida em idosos praticantes de caminhada. *Acta Fisiatr*. 2018;25(1):22-6. [DOI](#)
14. Hoang OTT, Jullamate P, Piphatvanitcha N, Rosenberg E. Factors related to fear of falling among community-dwelling older adults. *J Clin Nurs*. 2017;26(1-2):68-76. [DOI](#)
15. Sales M, Levinger P, Polman R. Relationships between self perceptions and physical activity behaviour, fear of falling, and physical function among older adults. *Eur Rev Aging Phys Act*. 2017;14:17. [DOI](#)
16. Trombetti A, Reid KF, Hars M, Herrmann FR, Pasha E, Phillips EM, et al. Age-associated declines in muscle mass, strength, power, and physical performance: impact on fear of falling and quality of life. *Osteoporos Int*. 2016;27(2):463-71. [DOI](#)
17. Araújo CGS. Teste de sentar-levantar: apresentação de um procedimento para avaliação em Medicina do Exercício e do Esporte. *Rev Bras Med Esporte*. 1999;5(5):179-82. [DOI](#)
18. Angelo FDA. Impactos do isolamento social, provocado pela COVID-19, sobre a capacidade funcional e preocupação em cair de idosos [dissertação]. Recife: Universidade Federal de Pernambuco; 2021. 76 p. [Full text link](#)
19. Camargos MCS, Gonzaga MR, Costa JV, Bomfim WC. Disability-free life expectancy estimates for Brazil and Major Regions, 1998 and 2013. *Cienc Saude Colet*. 2019;24(3):737-47. [DOI](#)
20. Araújo CGS. Teste de sentar-levantar: apresentação de um procedimento para avaliação em Medicina do Exercício e do Esporte. *Rev Bras Med Esporte*. 1999;5(5):179-82. [DOI](#)
21. Araújo CGS, Castro CLB, Franca JFC, Araújo DS. Sitting-rising test: Sex- and age-reference scores derived from 6141 adults. *Eur J Prev Cardiol*. 2020;27(8):888-90. [DOI](#)
22. Reid KF, Pasha E, Doros G, Clark DJ, Patten C, Phillips EM, et al. Longitudinal decline of lower extremity muscle power in healthy and mobility-limited older adults: Influence of muscle mass, strength, composition, neuromuscular activation and single fiber contractile properties. *Eur J Appl Physiol*. 2014;114(1):29-39. [DOI](#)
23. Reid KF, Fielding RA. Skeletal muscle power: A critical determinant of physical functioning in older adults. *Exerc Sport Sci Rev*. 2012;40(1):4-12. [DOI](#)
24. Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol*. 1994;49(2):M85-94. [DOI](#)
25. Lira VA, Araújo CGS. Teste de sentar-levantar: estudos de fidedignidade. *Rev Bras Cienc Mov*. 2000;8(2):9-18. [Full text link](#)
26. Brito LBB, Ricardo DR, Araújo DSMS, Ramos PS, Myers J, Araújo CGS. Ability to sit and rise from the floor as a predictor of all-cause mortality. *Eur J Prev Cardiol*. 2014;21(7):892-8. [DOI](#)