



## Are functionality and muscle strength associated with risk and fear of falls in the elderly?

### *Funcionalidade e força muscular estão associadas ao risco e medo de quedas em idosos?*

### *¿Están la funcionalidad y la fuerza muscular asociadas con el riesgo y el miedo de caídas en mayores?*

**Daniel Vicentini de Oliveira** 

Maringá University Center (*Centro Universitário de Maringá*) - Maringá (PR) - Brazil

**Naelly Renata Saraiva Pivetta** 

State University of Campinas (*Universidade Estadual de Campinas*) - Campinas (SP) - Brazil

**Felipe Carmona Yamashita** 

Maringá Metropolitan University Center (*Centro Universitário Metropolitano de Maringá*) - Maringá (PR) - Brazil

**Matheus Amarante do Nascimento** 

Paraná State University (*Universidade Estadual do Paraná*) - Paranavaí (PR) - Brazil

**Natália Quevedo dos Santos** 

Maringá University Center (*Centro Universitário de Maringá*) - Maringá (PR) - Brazil

**José Roberto Andrade do Nascimento Júnior** 

Federal University of Vale do São Francisco (*Universidade Federal do Vale do São Francisco*) - Petrolina (PE) - Brazil

**Sônia Maria Marques Gomes Bertolini** 

Maringá University Center (*Centro Universitário de Maringá*) - Maringá (PR) - Brazil

#### ABSTRACT

**Objective:** To investigate whether the level of functionality and muscle strength is associated with the risk of falling and the fear of falling in the elderly. **Methods:** Cross-sectional study, carried out with 80 elderly, from March to August 2019, in the municipality of Maringá, Paraná, Brazil. For evaluation, the following were applied: a sociodemographic questionnaire, the WHODAS 2.0, the International Scale for the Effectiveness of Falls, the test of getting up and sitting on the chair, the forearm flexion test, in addition to the sitting test, walking of 2.44m and sit back. For data analysis, we used Pearson's correlation and multiple regression analysis ( $p < 0.05$ ). **Results:** The domains of functionality and muscle strength explain 40% of the variance of the fear of falling scores; however, only the domains of self-care ( $\beta = 0.409$ ) and ADL ( $\beta = 0.379$ ) showed a significant ( $p < 0.05$ ) and positive association with the fear of falls. The domains of functionality and muscle strength explain 51% of the variance of the risk scores for falling, with only the domain of interpersonal relationships ( $\beta = -0.340$ ), the muscular strength of upper limbs ( $\beta = -0.512$ ), and strength lower limb muscle ( $\beta = -0.192$ ) showed a significant ( $p < 0.05$ ) and negative association with the risk of falls. **Conclusion:** It is observed that in the elderly population in question, measures of functionality and muscle strength are associated with the risk of falling and the fear of falls.

**Descriptors:** Elderly; Exercise; Postural Balance; International Classification of Functioning, Disability and Health.

#### RESUMO

**Objetivo:** Investigar se o nível de funcionalidade e a força muscular estão associados ao risco de queda e ao medo de cair em idosos. **Métodos:** Estudo transversal, realizado com 80 idosos, de março a agosto de 2019, no município de Maringá, Paraná, Brasil. Para avaliação, aplicaram-se: um questionário sociodemográfico, o WHODAS 2.0, a Escala Internacional de Eficácia de



This Open Access article is published under the a Creative Commons license which permits use, distribution and reproduction in any medium without restrictions, provided the work is correctly cited

Received on: 05/07/2020

Accepted on: 08/25/2020

Quedas, o teste de levantar e sentar na cadeira, o teste de flexão de antebraço, além do teste sentado, caminhada de 2,44m e voltar a sentar. Para análise dos dados, utilizaram-se a correlação de Pearson e análise de regressão múltipla ( $p < 0,05$ ). **Resultados:** Os domínios de funcionalidade e a força muscular explicam 40% da variância nas pontuações do medo de quedas, no entanto apenas os domínios de autocuidado ( $\beta = 0,409$ ) e AVD ( $\beta = 0,379$ ) apresentaram associação significativa ( $p < 0,05$ ) e positiva com o medo de quedas. Os domínios de funcionalidade e a força muscular explicam 51% da variância das pontuações do risco de queda, sendo que apenas o domínio de relações interpessoais ( $\beta = -0,340$ ), a força muscular de membros superiores ( $\beta = -0,512$ ) e a força muscular de membros inferiores ( $\beta = -0,192$ ) apresentaram associação significativa ( $p < 0,05$ ) e negativa com o risco de quedas. **Conclusão:** Observa-se que, na população de idosos em questão, as medidas de funcionalidade e a força muscular estão associadas ao risco de queda e ao medo de cair.

**Descritores:** Idoso; Exercício Físico; Equilíbrio postural; Classificação Internacional de Funcionalidade, Incapacidade e Saúde.

## RESUMEN

**Objetivo:** Investigar si el nivel de la funcionalidad y la fuerza muscular están asociados con el riesgo de caída y el miedo de los mayores en caerse. **Métodos:** Estudio transversal realizado con 80 mayores entre marzo y agosto de 2019 en el municipio de Maringá, Paraná, Brasil. Se ha aplicado para la evaluación los instrumentos a continuación: un cuestionario sociodemográfico, el WHODAS 2.0, la Escala Internacional de Eficacia de Caídas, la prueba de sentarse y levantarse de la silla, la prueba de flexión de antebrazo además de la prueba sentada, la caminata de 2,44m y volver a sentarse. Se ha utilizado la correlación de Pearson y el análisis de regresión múltiple ( $p < 0,05$ ) para el análisis de datos. **Resultados:** Los dominios de la funcionalidad y la fuerza muscular explican el 40% de la variancia de las puntuaciones del miedo de caídas, sin embargo, solamente los dominios de autocuidado ( $\beta = 0,409$ ) y AVD ( $\beta = 0,379$ ) presentaron asociación significativa ( $p < 0,05$ ) y positiva con el miedo de caídas. Los dominios de funcionalidad y la fuerza muscular explican el 51% de la variancia de las puntuaciones del riesgo de caída y solamente los dominios de las relaciones interpersonales ( $\beta = -0,340$ ), la fuerza muscular de los miembros superiores ( $\beta = -0,512$ ) y la fuerza muscular de los miembros inferiores ( $\beta = -0,192$ ) presentaron asociación significativa ( $p < 0,05$ ) y negativa con el riesgo de caídas. **Conclusión:** Se observa que en esa población de mayores las medidas de funcionalidad y de fuerza muscular se asocian con el riesgo de caída y el miedo de caerse.

**Descriptores:** Anciano; Ejercicio Físico; Equilibrio postural; Clasificación Internacional del Funcionamiento, de la Discapacidad y de la Salud.

## INTRODUCTION

Aging causes changes in the human organism that especially affect muscle strength, which tends to reduce, thereby contributing to impairment in balance and functional independence<sup>(1)</sup>. Strength can be understood as the muscle's ability to overcome resistance. Balance, on the other hand, is a component of physical fitness related to the ability to maintain static and dynamic stability<sup>(2)</sup>. Functional independence is in turn related to the physical capacity to perform functional activities which are important for maintaining daily life without depending partially or totally on the help of third parties<sup>(3)</sup>.

These variables are important components of health promotion because when they are preserved, they enable older adults to carry out their self-care and their daily activities in a safer and more effective way. When these components are impaired, they can trigger falls, which have been the focus of several studies in recent years<sup>(4-8)</sup>.

Falls are currently considered a serious public health problem and, according to data from the World Health Organization, approximately 30% of older adults experience falls in a period of one year, which can thereby lead to an increase in injuries, emotional disorders and death<sup>(9)</sup>.

Falls are related to multifactorial, intrinsic or extrinsic circumstances. Intrinsic factors are characterized by physiological changes inherent to aging, sensory and cognitive disorders, neuromuscular disorders, and diseases that affect balance and gait<sup>(10)</sup>. As for intrinsic factors, the following should be highlighted: advanced age, comorbidities, musculoskeletal diseases, depression, low self-efficacy to prevent falls<sup>(11)</sup>, and low visual acuity<sup>(6)</sup>. Extrinsic factors are related to the risks offered by the environment, such as uneven surfaces, slippery floors, inadequate lighting, stairs without handrails<sup>(12)</sup>, loose carpets, and high-rise or narrow steps<sup>(6)</sup>.

Extrinsic factors are often related to the occurrence of a single fall as they are modifiable<sup>(12)</sup>. Intrinsic factors, on the other hand, are not subject to change or cure (in the case of chronic diseases, for example), so they can result in fractures, sprains, and injuries, thus leading older adults to be afraid of falling<sup>(13)</sup>, which can be defined as a concern about having a fall making older adults avoid many activities in their daily lives<sup>(14)</sup>.

It is well established in the literature that falls have a significant impact on some aspects of an older adult's life as it causes losses in quality of life and high costs<sup>(5-8)</sup>. It is estimated that approximately 70% of older adults who have fallen in their lifetime have developed fear of falling, and the older the age, the higher the prevalence of fear of falling, this being most predominant in women<sup>(10)</sup>. Being afraid of falling affects autonomy, independence, performance of daily activities and easily exposes older adults to social isolation, insecurity, decreased functionality and, consequently, decreased muscle strength<sup>(15)</sup>.

The literature proposes that the fear of falling leads older adults to reduce the frequency and intensity of their daily activities, which contributes to decreasing functionality and muscle strength. However, the opposite is also true, i.e., physically inactive older adults exhibit a decrease in strength and functionality in relation to physically active older adults. Strength and functionality are highly important for older adults as they provide evidence of their health status and quality of life<sup>(6)</sup>.

Exploring the level of functionality and muscle strength and their relationship to a potential fall and fear of falling can assist in identifying profiles of older adults who fall and are afraid of falling and designing an evaluation plan and specific interventions. In view of the considerations outlined above, this study aimed to investigate whether the level of functionality and muscle strength is associated with the risk of falling and the fear of falling in older adults since the results obtained will support the development of prophylactic and interventionist measures in order to promote older adults' health.

## METHODS

This is an analytical observational cross-sectional study that followed the procedures, steps and guidelines outlined in the STROBE Statement. Data were collected from March to August 2019 in five gyms for seniors (*Academias da Terceira Idade – ATI*) spread across the municipality of Maringá, Paraná, Brazil, at different shifts (morning, afternoon and/or night), according to the availability of the researcher. A total of five of all ATI in the municipality were drawn based on specific regions (north, south, east, west, and downtown).

After approaching older adults, the researcher explained the research procedures and objectives. The older adults who agreed to participate signed an informed consent form.

The sample, chosen intentionally and conveniently, consisted of 80 male and female older adults. Older regulars at gyms for seniors in the city of Maringá, Paraná, who do not do physical exercise were included (the ATI in the municipality do not have full-time physical education professionals available to standardize and prescribe exercises for older adults; therefore, they are classified as places for physical activity, and not physical exercise).

It was necessary to exclude older adults with potential cognitive deficits measured by the Mini Mental State Examination (MMSE). The cut-off values for exclusion using the MMSE were: below 17 for illiterates; 22 for older adults with 1 to 4 years of study; 24 for those with 5 to 8 years of study, and 26 for those with 9 years or more of study<sup>(16)</sup>. The study also excluded older adults with potential dysfunctions that could interfere with their participation in the study (understanding and response, for example) and that were flagged by the evaluators. Only two older adults were excluded.

Data were collected through interviews conducted by the researchers, that is, the questionnaires were read to the older adults, thereby avoiding interpretation and reading errors by the respondents. The interview with each older adult lasted, on average, 15 minutes.

The sociodemographic and health profiles of the older adults were determined using an author-developed questionnaire with questions on age, age range (60-70 years; 71-80 years; 81-90 years; over 90 years), sex (men; women), marital status (with partner; without partner), monthly income in minimum wages (MW) (1-2 MW; 2.1 to 3 MW; more than 3 MW), retirement (yes; no), self-rated current health (good; fair; poor), history of falls in the last six months (yes; no – this question asked whether the older adult had fallen in the last six months), and duration of engagement with ATI activities (less than 3 months; 3 months to 1 year; 1-5 years; more than 5 years).

Fear of falling was assessed using the Falls Efficacy Scale International (FES-I). This questionnaire assesses 16 domains and different ADL with four possible responses and respective scores ranging from one to four ("not at all concerned" to "extremely concerned"). The total score can range from 16 to 64, from absence of concern to extreme concern, respectively, in relation to falls during the activities specified in the questionnaire<sup>(17)</sup>.

Functionality was assessed using the WHO Disability Assessment Schedule (WHODAS 2.0). This instrument assesses functionality in six domains of activity, namely cognition, mobility, self-care, interpersonal relationships, daily activities, and participation, based on 12 questions. Each item assesses the degree of difficulty in carrying out activities that the older person has faced in the previous month. Each question has a Likert scale of scores ranging from 0 (no difficulty) to 4 (extreme difficulty). The sum of the two questions from each domain results in a final score ranging from 0 to 8. Higher scores indicate greater difficulty (inability) in performing activities in the assessed domain<sup>(18)</sup>.

Upper limb muscle strength was also assessed by the elbow flexion test and lower limb muscle strength was assessed by the sit to stand test. This test consists of sitting and then walking for 2.44 m and then sitting down again to assess physical mobility – speed, agility and dynamic balance<sup>(19)</sup>.

Descriptive analysis was performed using measures of central tendency (mean) and dispersion (minimum, maximum, standard deviation, asymmetry, and kurtosis) to describe the study variables. Pearson's correlation was used to check for correlations between functionality, muscle strength, risk of falling and fear of falling. Multiple regression analysis was used to determine whether muscle strength and functionality predicted fear and risk of falls. Two models were built to assess how functionality and muscle strength domains (independent variables) predicted risk of falling (Model 1) and fear of falling (Model 2). All independent variables were included in the model in the same block and the data were tracked to ensure that the assumptions of normality, linearity, multicollinearity and variance-covariance homogeneity were met<sup>(20)</sup>. There were no strong correlations between the variables that indicated multicollinearity problems (variance inflation factors <5.0). All the analyses were performed in SPSS version 22.0.

This study was approved by the research ethics committee of the Maringá Metropolitan University Center (*Centro Universitário Metropolitano de Maringá*) (Approval No. 3.632.033/2019).

## RESULTS

Among the 80 older adults who participated there was a predominance of women (63.7%), people living with a partner (69.2%), people aged 60-70 years (62.5%), monthly income of at least two minimum wages (62.5%), and retirees (65.0%) (Table I). Most of the older adults rated their health as fair/poor (56.3%), had no history of falls (63.7%), and have been attending ATIs for more than 1 year (73.3%) 2 times or more per week (76.0%).

The results presented in Table II depict the descriptive values of the functionality domains, the upper and lower limb muscle strength, the fear of falling, and the risk of falling among older adults.

As shown in Table III, the following significant correlations were found ( $p < 0.05$ ): fear of falling with cognition ( $r = 0.56$ ), mobility ( $r = 0.50$ ), self-care ( $r = 0.58$ ), ADL ( $r = 0.59$ ), social participation ( $r = 0.51$ ). It was moderately correlated with total functionality score ( $r = 0.60$ ) and weakly moderated with interpersonal relationships ( $r = 0.42$ ).

As for risk of falling, it was significantly correlated ( $p < 0.05$ ) with mobility ( $r = 0.40$ ), ADL ( $r = 0.33$ ), social participation ( $r = 0.35$ ), and total functionality score ( $r = 0.31$ ) and moderately correlated with upper limb ( $r = -0.59$ ) and lower limb ( $r = -0.62$ ) muscle strength.

The results obtained (Table IV) indicate that the domains of functionality and muscle strength explain 40% of the variance of the fear of falling scores. However only self-care ( $\beta = 0.409$ ) and ADL ( $\beta = 0.379$ ) were significantly ( $p < 0.05$ ) and positively associated with fear of falling. It should be noted that that worse functionality scores in the aforementioned domains is associated with worse fear of falling scores among older adults (Table IV).

The results shown in Table V indicate that the domains of functionality and muscle strength variables explain 51% of the variance of the risk of falling scores, but only interpersonal relationships ( $\beta = -0.340$ ) and upper limb ( $\beta = -0.512$ ) and lower limb ( $\beta = -0.192$ ) muscle strength were significantly ( $p < 0.05$ ) and negatively associated with risk of falling. It should be noted that the greater the muscular strength, especially of the upper limbs, the lower the risk of falling among older adults. It is also noted an inversely proportional association between interpersonal relationships and risk of falling, that is, the increase in the score of this domain (worse functionality) leads to a reduction in the risk of falling (lower risk).

Table I - Profile of older adults attending ATI in the municipality of Maringá, Paraná, Brazil, 2019.

Variables	n	%
<b>Sex</b>		
Men	29	36.3
Women	51	63.7
<b>Marital status<sup>a</sup></b>		
With a partner	54	69.2
Without a partner	24	30.8
<b>Age range</b>		
60-70 years	50	62.5
over 70 years	30	37.5
<b>Monthly income<sup>a</sup></b>		
1-2 MW	18	37.5
2.1-3 MW	11	22.9
More than 3 MW	19	39.6
<b>Retired<sup>a</sup></b>		
Yes	52	65.0
No	25	35.0
<b>Self-rated health</b>		
Good	35	43.8
Fair/poor	45	56.3
<b>Falls in the past 6 months</b>		
Yes	29	36.3
No	51	63.7
<b>Weekly attendance to ATI<sup>a</sup></b>		
1-2 times	18	24.0
2-3 times	37	49.3
More than 3 times	20	26.7
<b>Duration of enrollment<sup>a</sup></b>		
Up to 1 year	20	26.7
1.1-5 years	30	40.0
More than 5 years	25	33.3

<sup>a</sup>: Variables in missing cases; ATI: *academias da terceira idade* (gyms for seniors); MW: minimum wage

Table II - Analysis of the research variables. Maringá, Brazil, 2019.

Variables	Minimum	Maximum	x (sd)
<b>Functionality</b>			
Cognition	2.00	8.00	2.84 (1.24)
Mobility	2.00	8.00	3.15 (1.49)
Selfcare	2.00	6.00	2.45 (0.87)
Interpersonal relationships	2.00	7.00	2.53 (0.95)
Activities of daily living	2.00	8.00	2.83 (1.30)
Social participation	2.00	6.00	2.70 (1.05)
Total score	12.00	41.00	16.49 (5.99)
<b>Upper limb muscle strength</b> (repetitions)	18.00	27.00	23.07 (1.88)
<b>Lower limb muscle strength</b> (repetitions)	10.00	20.00	15.91 (2.11)
<b>Fear of falling</b>	16.00	56.00	25.55 (8.14)
<b>Risk of falling</b>	4.00	10.00	6.61 (1.45)

X: mean; sd: standard deviation.

Table III - Correlation between functionality, muscle strength, fear of falling, and risk of falling in older adults. Maringá, Paraná, Brazil, 2019.

Variables	Functionality						Muscle strength			Falls	
	1	2	3	4	5	6	7	8	9	10	11
<b>Functionality</b>											
1. Cognition		0.65*	0.74*	0.61*	0.80*	0.78*	0.85*	-0.11	-0.10	<b>0.56*</b>	0.17
2. Mobility			0.62*	0.51*	0.76*	0.77*	0.87*	-0.33*	-0.40*	<b>0.50*</b>	<b>0.40*</b>
3. Selfcare				0.61*	0.73*	0.74*	0.74*	0.03	-0.13	0.58*	0.15
4. Interpersonal relationships					0.55*	0.54*	0.67*	-0.05	0.01	<b>0.42*</b>	-0.01
5. ADL						0.89*	0.85*	-0.17	-0.32*	<b>0.59*</b>	<b>0.33*</b>
6. Social participation							0.85*	-0.22*	-0.30*	<b>0.51*</b>	<b>0.35*</b>
7. Total score								-0.25*	-0.23*	<b>0.60*</b>	<b>0.31*</b>
<b>8. UL MS</b>									0.45*	-0.11	<b>-0.59*</b>
<b>9. LL MS</b>										-0.17	<b>-0.62*</b>
<b>10. Fear of falling</b>											0.19
<b>11. Risk of falling</b>											

Significant correlation: \*p<0.05; Pearson's correlation; ADL: activities of daily living; MS: muscle strength; UL: upper limb; LL: lower limb

Table IV - Multiple regression analysis using functionality domains and muscle strength as predictors of fear of falling in older adults. Maringá, Paraná, Brazil, 2019.

Variables	Standardized B	Adjusted R <sup>2</sup>	p	VIF	DW
<b>Cognition</b>	0.072		0.702	4.295	
<b>Mobility</b>	-0.139		0.392	3.155	
<b>Selfcare</b>	0.409		0.005*	2.645	
<b>Interpersonal relationships</b>	0.034	0.40	0.794	2.389	1.81
<b>Activities of daily living</b>	0.379		0.047*	4.495	
<b>Social participation</b>	-0.053		0.785	4.491	
<b>UL MS</b>	0.025		0.798	1.824	
<b>LL MS</b>	0.112		0.309	2.164	

Significant association: \*p<0.05; Multiple regression analysis; VIF: Variance Inflation Factors; DW: Durbin-Watson; MS: muscle strength; UL: upper limb; LL: lower limb

Table V - Multiple regression analysis using functionality domains and muscle strength as predictors of the risk of falling in older adults. Maringá, Paraná, Brazil, 2019.

Variables	Standardized B	Adjusted R <sup>2</sup>	p	VIF	DW
<b>Cognition</b>	0.082		0.626	4.384	
<b>Mobility</b>	0.075		0.606	3.396	
<b>Selfcare</b>	0.161		0.208	2.588	
<b>Interpersonal relationships</b>	-0.340	0.51	0.004*	2.156	1.86
<b>Activities of daily living</b>	0.239		0.195	4.434	
<b>Social participation</b>	-0.077		0.662	4.727	
<b>UL muscle strength</b>	-0.512		0.001*	1.239	
<b>LL muscle strength</b>	-0.192		0.048*	1.576	

Significant association: \*p<0.05; Multiple regression analysis; VIF: Variance Inflation Factors; DW: Durbin-Watson; UL: upper limb; LL: lower limb

## DISCUSSION

The main results of the study pointed out that a worsening of functionality, self-care and performance in ADL predicts fear of falling among older adults. The greater the muscle strength, the lower the risk of falling among older adults. Additionally, the worse the functionality in interpersonal relationships, the lower the risk of falling.

With regard to the impact of muscle strength on the risk of falling in older adults, researchers<sup>(21)</sup> suggest that the reduction in muscle strength in upper limbs and lower limbs becomes more pronounced from the sixth decade of life, with such reduction being more expressive in the lower limbs. Another study concluded that decreased muscle

strength was associated with the occurrence of falls in the last year in the older adults assessed. Deficit in postural balance in older adults can hinder rapid recovery in the face of minor postural disturbances, thereby making them more susceptible to falls<sup>(22)</sup>. The strength of lower limbs is closely related to balance capacity<sup>(23)</sup>, which prevents the individual from falling.

On the matter, a study that compared balance and maximum strength of the lower limbs in older adults doing weight training, older adults doing water aerobics and inactive older adults found that maximum strength of the lower limbs was directly proportional to functional and dynamic balance<sup>(24)</sup>. Other researchers found that older adults who had not fallen had a better level of lower limb strength compared to older adults who had fallen<sup>(25)</sup>. In addition, a literature review found that lower limb muscle strength reduces the occurrence of falls in older adults, and older adults with a better level of muscle strength also have a better balance, which is a factor that also contributes to a reduction in falls<sup>(26)</sup>.

In the present study, it was also observed that worse the functionality of interpersonal relationships, the lower the risk of falls in older adults. This finding is controversial as older fallers have a tendency to social withdrawal and depression. Confinement and restriction to the bedroom, for example, end up being a way to avoid further falls and hence the cycle of reduction of interpersonal relationships ends up being perpetuated. It should be noted that the occurrence of falls has complex consequences<sup>(6)</sup>. These consequences affect the physical, emotional, psychosocial and family domains and can cause depression, hospitalization and even death<sup>(6)</sup>.

In the present study, the worsening of functionality in ADL and, therefore, self-care was able to predict the worsening of fear of falling in older adults. ADL refer to the tasks necessary for body care or self-preservation, and self-care. Self-care is an important concept within older adults' health. It is understood that older adults capable of carrying out their self-care efficiently have a good general aspect of health and even the preservation of their cognition<sup>(27)</sup>.

Performing ADL suggests a considerable state of preservation of muscle strength and balance. Therefore, it can be inferred that avoiding ADL or even failing to perform them suggest that the older adults are trying to protect themselves from a potential fall or that their motor skills are showing deficits that make it impossible to perform some daily tasks. It is worth mentioning that ADL are used to measure functional capacity. In the present study, in addition to being associated with fear of falling, they also suggest a negative impact on functions, body structure and cognition<sup>(21)</sup>.

From a health promotion perspective, which spans primary care and also public policies and technical issues surrounding the health-disease-care process, it is possible to say that falls are a negative outcome of a cascade of harmful effects on the organism<sup>(28)</sup>. The economic impact of falls generates high costs<sup>(28,29)</sup>. Avoiding such deletion and, therefore, falls will require the articulation of technical, personal, political and community resources<sup>(28)</sup>.

Therefore, it must be pointed out that falls constitute a public health problem that has significant impacts on the functionality and physical and mental health of older adults. Furthermore, they may also affect their interpersonal relationships and the environment in which they are inserted.

Some limitations of the present study must be considered, including its cross-sectional design, which does not allow exploring cause-and-effect relationships between the variables of interest. In addition, some evaluation measures were collected through questionnaires and not through objective measurement, which may partially affect the reliability of the collected data. Finally, the presence of morbidities in the older adults was not evaluated, which can impact the results related to functionality, strength, and falls.

## CONCLUSION

Measures of functionality and muscle strength have been found to be associated with the risk of falling and with the fear of falling in the older population studied.

## CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest, both in the execution of the research project activities and in the writing of this manuscript.

## CONTRIBUTIONS

**Daniel Vicentini de Oliveira, Felipe Carmona Yamashita, José Roberto Andrade do Nascimento Júnior and Sônia Maria Marques Gomes Bertolini** contributed to the study conception and design; the acquisition, analysis and interpretation of data; and the writing and/or revision of the manuscript. **Naelly Renata Saraiva Pivetta** and

**Matheus Amarante do Nascimento** contributed to the writing and/or revision of the manuscript. **Natália Quevedo dos Santos** contributed to the acquisition, analysis and interpretation of data.

## REFERENCES

1. Mendonça TV, Rego AS, Mendonça FMA, Silva, Vieira JNL. Efeitos do uso de um programa cinesioterapêutico na força de preensão manual de idosas. *Rev Investig Bioméd* [Internet]. 2018 [accessed on 2020 July 15];10(1):56-8. doi: 10.24863/rib.v10i1.175
2. Thompson WRDLS, Pescatello RA. Diretrizes do ACSM-para os testes de esforço e sua prescrição. Rio de Janeiro: Ganabara Koogan; 2010.
3. Ribeiro DKDMN, Lenardt MH, Lourenço TM, Betiolli SE, Seima MD, Guimarães CA. The use of the functional independence measure in elderly. *Rev Gaucha Enferm*. 2018;38(4).
4. Fernandes KC, Oliveira RC, Freitas AC, Souza AA, Lopes RA. Associação entre função física e incapacidade autorrelatada em idosos comunitários: uma abordagem de acordo com o Modelo de Funcionalidade, Incapacidade e Saúde. *ConScientiae Saúde* [Internet]. 2019 [accessed on 2020 July 15];18(2):209-17. doi: 10.5585/conssaude.v18n2.11142
5. Bizovska L, Svoboda Z, Janura M, Bisi MC, Vuillerme N. Local dynamic stability during gait for predicting falls in elderly people: a one-year prospective study. *PLoS One* [Internet]. 2018 [accessed on 2020 July 15];13(5):0197091. doi: 10.1371/journal.pone.0197091
6. Moraes SA, Soares WJS, Lustosa LP, Bilton TL, Ferrioli E, Perracini MR. Characteristics of falls in elderly persons residing in the community: a population-based study. *Rev Bras Geriatr Gerontol* [Internet]. 2017 [accessed on 2020 July 15];20(5):691-701. doi: 10.1590/1981-22562017020.170080
7. Silva IGP, Peruzzo HE, Lino IGT, Marquete VF, Marcon SS. Perfil sociodemográfico e clínico de idosos em risco de quedas no sul do Brasil. *J Nurs Heal* [Internet]. 2019 [accessed on 2020 July 15];9(3):1-12. doi: 10.15210/jonah.v9i3.16808
8. Oliveira T, Baixinho CL, Henriques MA. Risco multidimensional de queda em idosos. *Rev Bras Promoç Saúde* [Internet]. 2018 [accessed on 2020 July 15];31(2):1-9. doi: 10.5020/18061230.2018.7058
9. World Health Organization. Global recommendations on physical activity for health [Internet]. 2010 [accessed on 2020 July 15]. Available from: [https://apps.who.int/iris/bitstream/handle/10665/44399/9789241599979\\_eng.pdf;jsessionid=6EFD1359778000FB8E42EA85A4C8DB32?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/44399/9789241599979_eng.pdf;jsessionid=6EFD1359778000FB8E42EA85A4C8DB32?sequence=1)
10. Soares WJS, Moraes SA, Ferrioli E, Perracini MR. Fatores associados a quedas e quedas recorrentes em idosos: estudo de base populacional. *Rev Bras Geriatr Gerontol* [Internet]. 2014 [accessed on 2020 July 15];17(1):49-60. doi: 10.1590/S1809-98232014000100006
11. Santos RKM, Maciel ÁCC, Britto HMJS, Lima JCC, Souza TO. Prevalência e fatores associados ao risco de quedas em idosos adscritos a uma Unidade Básica de Saúde do município de Natal, RN, Brasil. *Cienc Saude Colet* [Internet]. 2015 [accessed on 2020 July 15];20(12):3753-62. doi: 10.1590/1413-812320152012.00662015
12. Morsch P, Myskiw M, Myskiw JC. A problematização da queda e a identificação dos fatores de risco na narrativa de idosos. *Cienc Saude Colet* [Internet]. 2016 [accessed on 2020 July 15];21(11):3565-74. doi: 10.1590/1413-812320152111.06782016
13. Rezende CP, Gaede-Carrillo MRG, Sebastião ECO. Queda entre idosos no Brasil e sua relação com o uso de medicamentos: revisão sistemática. *Cad Saude Publica* [Internet]. 2012 [accessed on 2020 July 15];28(12):2223-35. doi: 10.1590/S0102-311X2012001400002
14. Santos SCA, Figueiredo DMP. Preditores do medo de cair em idosos portugueses na comunidade: um estudo exploratório. *Cienc Saude Colet* [Internet]. 2019 [accessed on 2020 July 15];24(1):77-86. doi: 10.1590/1413-81232018241.29932016
15. Pinheiro PA, Passos TD-RO, Coqueiro RS, Fernandes MH, Barbosa AR. Desempenho motor de idosos do Nordeste brasileiro: diferenças entre idade e sexo. *Rev Esc Enferm USP* [Internet]. 2013 [accessed on 2020 July 15];47(1):128-36. doi: 10.1590/S0080-62342013000100016



16. Brucki SMD, Nitrini R, Caramelli P, Bertolucci PHF, Okamoto IH. Sugestões para o uso do mini-exame do estado mental no Brasil. *Arq Neuropsiquiatr* [Internet]. 2003 [accessed on 2020 July 15];61(3B):777-81. doi: 10.1590/S0004-282X2003000500014
17. Camargos FFO, Dias RC, Dias JMD, Freire MTF. Adaptação transcultural e avaliação das propriedades psicométricas da Falls Efficacy Scale – International em idosos brasileiros (FES-I-BRASIL). *Rev Bras Fisioter* [Internet]. 2010 [accessed on 2020 July 15];14(3):237-43. doi: 10.1590/S1413-35552010000300010
18. Silva C, Coleta I, Silva AG, Amaro A, Alvarelhao J, Queiros A, et al. Adaptação e validacao do WHODAS 2.0 em utentes com dor musculoesqueletica. *Rev Saude Pública* [Internet]. 2013 [accessed on 2020 July 15];47(4):752-8. doi: 10.1590/S0034-8910.2013047004374
19. Rikli RE, Jones CJ. *Teste de Aptidão Física para Idosos*. São Paulo: Manole; 2008.
20. Tabachnick B, Fidell L. *Using Multivariate Statistics*. [place unknown]: Allynand; 2001.
21. Borges V, Silva N, Malta AC, Xavier NC, Santana Bernardes LE. Falls, Muscle Strength, and Functional Abilities in Community-Dwelling Elderly Women. *Arch Phys Med Rehabil* [Internet]. 2017 [accessed on 2020 July 15];98(10):e22. doi: 10.1590/1980-5918.030.002.ao16
22. Howcroft J, Lemaire ED, Kofman J, Mcllroy WE. Elderly fall risk prediction using static posturography. *PLoS One* [Internet]. 2017 [accessed on 2020 July 15];12(2):e0172398. doi: 10.1371/journal.pone.0172398
23. Costa LSV, Sousa NM, Alves AG, Alves FAVB, Araújo RF, Nogueira MS. Análise comparativa da qualidade de vida, equilíbrio e força muscular em idosos praticantes de exercício físico e sedentários. *Rev Fac Montes Belos* [Internet]. 2015 [accessed on 2020 July 15];8(3):161-79. Available from: [http:// revista.fmb.edu.br/index. php/fmb/article/view/190/179](http://revista.fmb.edu.br/index.php/fmb/article/view/190/179)
24. Souza L, Coelho B, Freire B, Delevatti R, Roncada C, Tiggemann C, et al. Comparação dos níveis de força e equilíbrio entre idosos praticantes de musculação e de hidroginástica. *Rev Bras Ativ Fís Saúde* [Internet]. 2014 [accessed on 2020 July 15];19(5). doi: 10.12820/rbafs.v.19n5p647
25. Gonçalves AK, Griebler EM, Possamai VD, Costa RR, Martins VF. Idosos caidores e não caidores: programa de exercício multicomponente e prevalência de quedas. *ConScientiae Saúde* [Internet]. 2017 [accessed on 2020 July 15];16(2):187-93. doi: 10.5585/conssaude.v16n2.6987
26. Castro Finamore ALM. Efeito dos exercícios multimodais na prevenção de quedas em idosos ativos revisão de literatura [trabalho de conclusão de curso] [Internet]. Belo Horizonte: UFMG; 2019 [accessed on 2020 July 15]. Available from: <https://repositorio.ufmg.br/handle/1843/30520>
27. Pivetta NRS, Marincolo JCS, Neri AL, Aprahamian I, Yassuda MS, Borim FSA. Multimorbidity, frailty and functional disability in octogenarians: A structural equation analysis of relationship. *Arch Gerontol Geriatr* [Internet]. 2020 [accessed on 2020 July 15];86:103931. doi: 10.1016/j.archger.2019.103931
28. Crizzle AM, Dykeman C, Laberge S, MacLeod A, Olsen-Lynch E, Brunet F, et al. A public health approach to mobilizing community partners for injury prevention: a scoping review. *PLoS one*. 2019;14(1).
29. Grysztar M, Duplaga M, Wojcik S, Rodzinka M. Eficácia de intervenções de promoção da saúde lideradas por pares dirigidas a idosos: revisão sistemática Marcin Grysztar. *Eur J Public Health*. 2017;27(suppl\_3).

**Mailing address:**

Daniel Vicentini de Oliveira  
Centro Universitário de Maringá  
Avenida Guedner, 1610  
Bairro: Jardim Aclimação  
CEP: 87050-900 - Maringá - PR - Brasil  
E-mail: d.vicentini@hotmail.com

---

**How to cite:** Oliveira DV, Pivetta NRS, Yamashita FC, Nascimento MA, Santos NQ, Nascimento Júnior JRA, et al. Are functionality and muscle strength associated with risk and fear of falls in the elderly? *Rev Bras Promoç Saúde*. 2021;34:10903.

---