Frailty and risk of falling in the older adult living at home

Fragilidade e risco de queda em idosos que vivem no domicílio
Fragilidad y riesgo de caída de ancianos que viven en su domicilio

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Abstract

Objective: To analyze the association between risk of falling and frailty syndrome in the older adult living at home.

Methods: Cross-sectional study with 261 older adult men and women living in households in a city of São Paulo. The collection took place through the instruments: Demographic Profile, Mini Mental State Examination, Fall Risk Score, Edmonton Frail Scale, Tilburg Frailty Indicator and Groningen Frailty Indicator. For the bivariate analyzes, we used Pearson's chi-square test and, to compare the means of the numerical scale, the nonparametric Mann-Whitney test and the linear logistic regression with p <0.05.

Results: Of the 261 older adults, most were female, widows, with 1 to 4 years of education and living with family members. The prevalence of fall risk was 51.7%. In all scales used, there was an association between frailty and risk of falling (p <0.001). In the linear logistic regression analysis, the older adult considered frail by the Tilburg Scale were 6.05 times more likely to fall than the non-frail. On the Groningen Scale, the chances of the frail older adult falling were 5.55 times higher and, on the Edmonton Scale, those at risk of falling had a 1.53 average increase in the score.

Conclusion: The risk of falling was most significantly estimated when associated with frailty, in the three scales used. Such scales are easily accessible and applicable instruments by nurses and multiprofessional staff and can be adopted to favor active aging.

Resumo

Objetivo: Analisar a associação entre o risco de queda e a síndrome da fragilidade em idosos que vivem no domicílio.

Métodos: Estudo transversal com 261 idosos, de ambos os sexos, residentes em domicílios de um município paulista. A coleta ocorreu por meio dos instrumentos: Perfil Demográfico, Mini Exame do Estado Mental, *Fall Risk Score*, *Edmonton Frail Scale*, Indicador de Fragilidade de Tilburg e Indicador da fragilidade de Groningen. Para as análises bivariadas, utilizamos o teste de Qui-quadrado de Pearson e, para comparar as médias da escala numérica, o Teste não paramétrico de Mann-Whitney e a Regressão Logística Linear com p<0,05.

Resultados: Dos 261 idosos, a maioria era do sexo feminino, viúvas, com 1 a 4 anos de estudo e moravam com familiares. A prevalência do risco de queda foi de 51,7%. Em todas as escalas utilizadas, houve associação entre fragilidade com o risco de queda (p<0,001). Na análise de regressão logística linear, o idoso considerado frágil pela Escala de Tilburg apresentou 6,05 vezes mais chances de cair do que aquele não frágil. Na Escala de Groningen, as chances de o idoso frágil cair foram 5,55 vezes maiores e, na Escala de Edmonton, aqueles que apresentaram risco de queda obtiveram aumento de 1,53 na média do escore.

Conclusão: O risco de queda foi estimado com maior significância quando associado à fragilidade, nas três escalas utilizadas. Tais escalas são instrumentos de fácil acesso e aplicação por parte do enfermeiro e equipe multiprofissional e podem ser adotadas para favorecer um envelhecimento ativo.

Resumen

Objetivo: Analizar la relación entre el riesgo de caída y el síndrome de fragilidad de ancianos que viven en su domicilio.

Métodos: Estudio transversal con 261 ancianos, de ambos sexos, residentes en domicilios de un municipio de São Paulo. La recolección se realizó mediante los siguientes instrumentos: Perfil Demográfico, Mini Examen del Estado Mental, *Fall Risk Score*, *Edmonton Frail Scale*, Indicador de Fragilidad de Tilburg e Indicador de fragilidad de Groningen. Para el análisis bivariado, utilizamos la prueba ² de Pearson, y para comparar los promedios de la escala numérica, la Prueba no paramétrica de Mann-Whitney y la Regresión Logística Lineal con p<0,05.

Resultados: De los 261 ancianos, la mayoría era de sexo femenino, viudas, entre 1 y 4 años de estudio y vivían con familiares. La prevalencia del riesgo de caída fue del 51,7%. En todas las escalas utilizadas hubo relación entre la fragilidad y el riesgo de caída (p<0,001). En el análisis de regresión logística lineal, el anciano considerado frágil por la Escala de Tilburg presentó 6,05 veces más de probabilidad de caer que el no frágil. En la Escala de Groningen, la probabilidad de caída del anciano frágil fue 5,55 veces mayor. Y en la Escala de Edmonton, los que presentaron riesgo de caída obtuvieron un aumento de 1,53 en el promedio de la puntuación.

Conclusión: El riesgo de caída fue considerado de mayor significación cuando se lo relaciona con la fragilidad, en las tres escalas utilizadas. Estas escalas son instrumentos de fácil acceso y aplicación por parte de enfermeros y equipos multiprofesionales y pueden adoptarse para favorecer a un envejecimiento activo.

Introduction

Human aging is a complex process that causes physiological and systemic changes in the body, as well as decreased muscle tone, flexibility and reduction of nerve endings. It is a process that imposes limitations and generates vulnerabilities that can alter the balance functions of the older adult, making them more susceptible to the risk of falling.[1]

According to the World Health Organization (WHO), falling is defined as an involuntary event that will bring the body to the ground or other surface.[2] It is estimated that one third of older people over 65 experience a fall episode annually, which is the second leading cause of death from unintentional injuries in the world.[3] In Brazil, about 30% of the older adult fall once a year, and the most affected people are precisely the oldest (80 years or older).[4]

The fall among the older adult is a factor of great social relevance for public health, as it is a major cause of injuries, trauma, hospitalizations and death in this age group. In addition, these events contribute to functional decline and decrease autonomy, with direct consequences on their quality of life.[5,6]

In the aging process, some intrinsic and extrinsic factors, such as loss of muscle mass, decreased balance, impairment of chronic noncommunicable diseases, polypharmacy, falls, and cognitive impairment, compromise health and increase the risk of falling. These factors, in turn, associate this geriatric syndrome with frailty.[7]

The concept of frailty is discussed among researchers in the areas of geriatrics and gerontology, and may be related to advanced age, comorbidities and/or disabilities. It is conceptualized as "a multifactorial clinical syndrome characterized by decreased energy reserves and reduced resistance to stressors, conditions that result from the cumulative decline of physiological systems."[8]

We also highlight another concept of frailty, understood as "a medical syndrome with multiple causes and contributors that is characterized by decreased strength, endurance and reduced physiological function that increases an individual's vulnerability to develop greater dependence and/or death."[7]

In a meta-analysis of 10 articles about the association between the risk of falling and frailty, the authors found that among the 102,130 older adults over 65 who participated in these studies, 33,503 (32.80%) of them suffered a fall. When comparing both variables, the frail older adult had a higher risk of falling (OR 2.50; 95% CI 1.58-3.96) when compared with the non-frail and the pre-frail (OR 1.47; 95 %CI 1.22-1.79).[9]

In the literature analysis, we observed a scarcity of studies that have verified the risk of falling simultaneously associated with different instruments of frailty of the older adult through different measurement instruments. Therefore, we consider it neces-

sary to develop research that provides subsidies for the implementation of actions that improve the living conditions and health of these people most often affected by these episodes. Comparison of the measurement instruments can prove whether falls are, in fact, related to frailty, and with these results the nurse and the health team can develop a specific care plan to prevent and/or reduce these incidents in this portion of the population. Given the above, the objective was to analyze the association between the risk of falling and the frailty syndrome in the older adult living at home.

Methods

Cross-sectional study conducted in Ribeirão Preto, São Paulo. Data were collected between November 2017 and March 2018.

The sampling process was probabilistic, by double stage conglomerates. In the first, we considered the census tract as Primary Sampling Unit (PSU) and we selected 30 census tracts out of the 600 in the municipality. The second was to visit a fixed number of households to ensure sample self-consideration. As a way to prevent refusals, 496 people were drawn, a figure that results in an expected response rate of 80%, and the final number was 261 participants.

Inclusion criteria for participation in the study were: age 60 years or older, being of both sexes and residing in households in the urban area of the municipality, and exclusion criteria were presenting communication difficulties.

Data collection was performed by previously trained undergraduate and graduate students. The data collection instruments used were:

- **Demographic Profile Questionnaire:** allowed us to characterize the participants as to: sex (male and female); age (in full years); marital status (single, married, separated, divorced or widowed); older adult income (reais); education (in years of formal studies); number of children, how many people the older adult live with and if they are retired (yes and no).

- **Mini Mental State Examination (MMSE):** applied to assess cognitive function. It is translated and validated in Portuguese, with a sensitivity of 82.4% for illiterate people, 75.6% for low and medium education and 80% for higher education. It has a specificity of 97.5% for illiterate people, 96.6% for low and medium education and 95.6% for higher education.[10] It consists of 11 questions grouped into seven categories, with the aim of evaluating different specific cognitive functions: temporal orientation, spatial orientation, three word register, attention and calculation, memory of word recall, language, repetition of the sentence, visual constructive ability, follow orders, write a sentence and draw. The score ranges from 0 to 30 points, but the scale was revised and there were changes in the cutoffs: 20 for illiterate, 25 for those with 1 to 4 years of schooling, 26.5 for people with 5 to 8 years of age, 28 for those between 9 and 11 years old and 29 for those with more than 11 years old.[11]

- **Fall Risk Score (FRS):** developed and published in 1993,[12] is translated and validated in Portuguese,[13] with sensitivity of 74.2%, specificity of 58.8% and accuracy of 62.5%. It consists of five questions grouped into five domains: Previous Falls (whether or not the older adult who suffered falls); Medications (whether or not to use medicines; if so, by name); Sensory Deficit (what type of deficit); Mental Status (whether or not the older adult are considered oriented based on MMSE results); and Gait (what kind of gait does the older adult present). The scale score ranges from 0 to 5 points. Final results with a score of three or higher indicate a risk of falling.

- *Edmonton Frail Scale* **(EFS):** Validated and reproduced for the Portuguese language.[14] It presented reproducibility in the interobserver test by Kappa of 0.81 (95% CI 0.61-1.00), and the interclass correlation coefficient reached 0.87 (95% CI 0.82-0.91, p <0.001). In the intraobserver test, the Kappa of 0.83 (95% CI 0.72-0.94) and the correlation coefficient of 0.87 (95% CI 0.81-1.00, p <0.001) indicat-

ed whether it was treated of a reliable scale for Brazilian population use.[15]

EFS evaluates nine domains, represented by 11 items: Cognition; General state of health; Functional independence; Social support; use of medicines; nutrition; mood; continence; and functional performance. The scale has a score from 0 to 17 points, with the highest score representing a higher level of frailty. [15]

- **Tilburg Weakness Indicator (TFI):** aims to measure the frailty level of the older adult. This scale is validated and reproduced in Portuguese.[16] Regarding the reproducibility of this scale, in Kappa's evaluation, there was substantial agreement in nine items and moderate agreement in two. There was test-retest reliability total TFI score r = 0.88 (95% CI: 0.83-0.92); physical domain r = 0.88 (95% CI: 0.83-0.92); psychological domain r = 0.67 (95% CI: 0.55-0.76); and social domain r = 0.89 (95% CI: 0.84 - 0.92), for the total score of the scale and the scores of each domain.[16]

The TFI is composed of 15 objective and self-reported questions, 11 of which are answered "yes or no" and 4 also provide the option "sometimes". These questions are divided into three domains: physical, psychological and social. The final score ranges from 0 to 15 points, with scores ≥ 5 points indicating that the individual is frail.[16]

- **Groningen frailty indicator (GFI):** indicates the frailty level of the older adult and is validated and reproduced for the Portuguese language.[17] It is a Likert scale, with 15 items referring to 10 components: mobility, comorbidities, nutrition, physical capacity, cognition, vision, hearing, loneliness, depression and anxiety, belonging to the physical, cognitive, social and psychological domains. It characterizes the older adults as dependent or independent, based on the answers "yes" or "no" to the proposed items. The final score ranges from 0 to 15 points, with scores <4 points indicating non-frail older adults and ≥ 4 points, frail older adults.[17]

For data analysis, measures of central tendency (mean) and dispersion (standard deviation) were calculated for quantitative variables and proportions for qualitative variables.

The risk of falling in the older adults was considered the dependent variable, classified as yes or no. The independent variables used were: gender (male or female), age (younger and older), education (in years), marital status (with or without a partner), living alone (yes or no) and frailty, measured Groningen Frail Indicator (frail or non-frail), Tilburg Frail Indicator (frail or non-frail) and Edmonton Fragility Scale (total score).

For bivariate analysis, we used Pearson's chi-square test to investigate fall risk and frailty (Tilburg and Groningen Scales). For the Edmonton frailty scale, we compared the means using the nonparametric Mann-Whitney test.

Linear Logistic Regression analysis was performed to identify the unadjusted Odds Ratio (OR) between the risk of falling with each instrument used to verify frailty. For adjusted OR, the variables gender and age were used for each instrument used in the evaluation of frailty syndrome. For all analyzes, $p < 0.05$ was considered as significance level.

The project was approved by the Research Ethics Committee of the Ribeirão Preto School of Nursing at USP. CAAE 96222418.0.0000.5393. Participants signed the Informed Consent Form, in two copies.

Results

We evaluated 261 older adults, 185 (70.9%) females and 76 (29.1%) males, with a mean age of 80.76 years (SD=7.23). Regarding marital status, 25 (9.6%) were single, 103 (39.5%) married, 19 (7.3%) divorced, divorced or separated, 112 (42.9%) widowed and 2 (0.8) others. The average education level was 5.82 years of education (SD=7.62); 61 (23.4%) lived alone, 197 (75.5%) with family members and 3 (1.1%) with non-family members. The prevalence of fall risk was 51.7%. Table 1 presents the stratified prevalence of fall risk according to sociodemographic variables and frailty

scales. In the association between demographic variables and frailty with the risk of falling, we found statistical significance with gender, age, education and Tilburg and Groningen scales. (Table 1).

The risk of falling was present in 135 (51.7%) older adult. When comparing the risk of falling with frailty, 66.7% of those considered frail by the Tilburg Scale presented this risk. When we applied the Groningen scale, the risk dropped to 65.2%. At all scales, frailty appeared associated with the risk of falling (p <0.001). (Table 1).

Table 1. Bivariate analysis between risk of falling in the older adults, sociodemographic variables and frailty scales (n=261)

Variables	No risk of falling n(%)	With risk of falling n(%)	p-value
Sex			
Male	47(37,3)	29(21,5)	0,005
Female	79(62,7)	106(78,5)	
Age			
60-79 years	64(50,8)	51(37,8)	0,034
>80 years	62(49,2)	84(62,2)	
Marital status			
No partner	71(56,3)	87(64,5)	0,181
With partner	55(43,7)	48(35,5)	
Education			
Illiterate	7 (5,5)	28(20,7)	<0,001
1 - 4 years	66(52,4)	76(56,3)	
5 - 9 years	19(15,1)	15(11,1)	
10 or more years	34(27,0)	16(11,9)	
Living alone			
No	92(73,0)	108(80,0)	0,183
Yes	34(27,0)	27(20,0)	
Frailty			
Tilburg			
Non-frail	97(77,0)	45(33,3)	<0,001
Frail	29(23,0)	90(66,7)	
Groningen			
Non-frail	99(78,6)	47(34,8)	<0,001
Frail	27(21,4)	88(65,2)	

Tilburg and Groningen fragility - Chi-square

Considering that the Edmonton scale is numerical, its analysis was performed by means of the mean and standard deviation. The average score reached 6.9 points. In the older adult without risk of falling, the average was 3.98 (SD = 2.37), while in those with risk of falling reached 7 (SD = 2.59). When comparing the means, we found statistical significance (p <0.0001). Crude and adjusted models were developed for the Tilburg and Groningen scale data and, regardless of statistical significance, we maintained the age and gender variables. Still, we tested the variables marital status (with partner and without partner), education (illiterate, 1 to 4 years of education, 5 to 9 years of education and 10

years or more) and with whom you live (alone and accompanied) by scales alone (Table 2). In the odds ratio adjusted with the Tilburg Scale, we show that the older adult considered frail is 6.05 times more likely to fall than the non-frail. In the Groningen Scale, the chances of the frail older adult falling were 5.55 times higher compared to the non-frail older adult. Finally, in the Edmonton Scale (numeric), we verified that the older adult with risk of falling had an average increase of 1.53 in the scale score. (Table 2).

Table 2. Association between frailty and risk of falling according to gross and adjusted models (n=261)

Frailty Scales	OR (crude) (95%CI)	OR (adjusted) (95%CI)
Tilburg	6.69 (3.86-11.57)	6.05 (3.27-11.18)*
Groningen	6.86 (3.94-11.94)	5.55 (3.07-10.04)**
Edmonton	1.63 (1.42-1.84)	1.53 (1.33-1.75)**

*OR adjusted for sex, age, living with and income of the older adult; **OR adjusted for gender, age and income of the older adult; ** OR adjusted for gender, age and income of the older adult

Discussion

In this study, there was a predominance of older, widowed women, with 1 to 4 years of study and living with their relatives. Similar results regarding advanced age and predominance of female old adult are described in the national and international literature, which is related to the worldwide feminization of old age.[18,19]

Predominant advanced age is explained by various biological changes in the body during the aging process and increased life expectancy.[20]

In this study, we found a 51.7% fall risk prevalence, similar to that described in the national literature.[21] and international.[22,23]

The reasons that lead an older adult to fall may be related to intrinsic factors such as aging, pathologies and medication use. Extrinsic, on the other hand, are related to the environment in which they find themselves, such as lighting, the presence of objects on the floor, wearing inappropriate clothes and shoes, and assistive devices.[7]

Older adult, the fall can cause the loss of functional capacity, also causes injuries, bone fractures, hospitalizations and deaths, which makes the high prevalence of these events in this portion of the population a public health problem.[24]

Studies show that the risk of falling in the older adult may be associated with females, due to human physiology, since the bone and muscle structure of women is more frail and they experience hormonal changes specific to this gender, besides presenting a higher number of diseases more exposed to household chores.[13,25] In this study, however, we observed the presence of another predictor of fall risk that deserves attention: the frailty syndrome.

The occurrence of falls in the older adult are directly related to advanced age and degree of frailty (WHO).[26] A meta-analysis study evaluating the association between risk of falling and frailty in 102,130 older adult over 65 shows that frail older people have a higher risk of falling compared to non-frail ones.[9]

In an Arizona a research conducted with 119 seniors, 48 reported one or more episodes of lifelong falls, with 47% being frail seniors. Balance deficit and walking were the most sensitive predictors of falls associated with pre-frail and frail older adult.[27]

In the logistic regression analysis, we evidenced that the chance of a frail older adult to fall is higher compared to the non-frail older adult, regardless of the categorical or numerical scales and the demographic variables investigated. When applied the Tilburg and Groningen scales, which has categorical data, the frail older adult presented a higher risk of falling than those non-frails. By applying the Edmonton scale, which has continuous data, the frail older adult presented, at each point of the score, more chances of present a fall episode than the non-frail older adult. Measurements of all scales used were significant to estimate the risk of falling among participants.

The relationship between fall and frailty condition of older adult living in the Chinese community was investigated in a study whose results showed that the higher the frailty index, the greater the chance of an older adult presenting this risk, compared to other factors such as gender and age.[28] A study conducted in Spain involved 183 older adult over 69 years old and assessed the risk of falling in relation to the frailty phenotype. Falls Efficacy Scale International (FES-I) found that frail older people were more susceptible to new episodes of fall compared with non-frail older

adults (OR = 3.18; 95% CI 1.32-7.65).[19] They were also more concerned about the possibility of further falls (OR = 3.93; 95% CI 1.85-8.36), with adjusted final values associated with female gender and the risk of depression.[19]

Frailty decreases physical endurance, alters balance, potentiates weakness and reduces motor performance of the older adult, causing a decline in the body's physiological reserve and making them vulnerable to adverse events, including falls.[8] Although they are distinct syndromes, frailty is associated with a decrease due to muscle loss, which can lead to sarcopenia, the development of chronic diseases, the use of drugs, cognitive impairment and episodes of delirium, all of which are known to increase the risk of an older adult man to fall.[7]

As limitations of this study, we highlight the lack of research that has used more than one scale to estimate the risk of falls associated with frailty, which made it difficult to discuss data and debate ideas. A second limitation is the cross-sectional study, which does not allow us to infer whether frailty causes the older adult to fall or vice versa, and it is necessary to follow up with these older adults to clarify this doubt. The third involves the possibility that the fall is influenced by extrinsic factors, such as lighting, floor surface, and the presence of carpets and / or steps, which have not been investigated, although they increase the risk of falling.

Conclusion

The fall event in the older adult is a public health problem, especially when it involves those frail. We found that using different scales to assess frailty is possible to identify the risk of falling, and with the Groningen Scale this risk is higher. The three scales used in the present study have distinct characteristics: Groningen and Tilburg are categorical and Edmonton numerical. However, the scales themselves can predict the risk of falls in the older adult living at home and were unanimous in associating this risk with frailty. They are easy tools for nurses and multiprofessional staff to identify and prevent the risk of falling, which may favor a more active

aging. Thus, this study, by analyzing the association between the risk of falling and the frailty syndrome in the older adult living at home, by applying the three scales, is fundamental, as health professionals can have access to these instruments and use them to prevent falls in the older adults.

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Collaboration

Giacomini SBL, Fhon JR and Rodrigues RAP declare that they contributed to the project design, analysis and interpretation of the data, relevant critical review of the intellectual content and approval of the final version to be published.

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