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RESEARCH

GAIT SPEED AND OCCURRENCE OF FALLS IN THE LONG-LIVED ELDERLY

A VELOCIDADE DA MARCHA E OCORRÊNCIA DE QUEDAS EM IDOSOS LONGEVOS

VELOCIDAD DE LA MARCHA E INCIDENCIA DE CAÍDAS EN ANCIANOS LONGEVOS

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ABSTRACT

Objective: to analyze the relationship between gait speed and fall occurrence in long-lived elderly. **Method:** a cross-sectional study with 243 long-lived elderly (≥80 years old), primary health care users. Data collect took place in the residences of the participants, using a socio-demographic and clinical questionnaire and a gait speed test. Descriptive analyses and an association test were performed among the variables (chi-square), the p≤0.05 values were considered statistically significant. **Results:** among the 243 long-lived elderly, 111 (45.7%) reported falls in the last 12 months, 50 (20.6%) reduced gait speed and 30 (60%) of these fell in the last year. Among the elderly with reduced gait speed, there was a female gender predominance (n = 33; 66%) and mean age 86.24 years old (± 4.64). The reduced gait speed showed a significant association with fall occurrence in the last 12 months (p = 0.023). **Conclusion:** the reduction of gait speed in long-lived elderly shows relationship with the fall episode, which was present in more than half of the long-lived elderly with reduced gait speed.

Keywords: Gait; Aged, 80 and Over; Frail Elderly; Accidental Falls; Geriatric Nursing.

RESUMO

Objetivo: *analisar a relação entre a velocidade da marcha e a ocorrência de quedas em idosos longevos.* ***Método:*** *estudo transversal realizado com 243 idosos longevos (≥80 anos), usuários da atenção primária à saúde. A coleta de dados ocorreu nos domicílios dos participantes, mediante aplicação de questionário sociodemográfico e clínico e teste de velocidade da marcha. Realizaram-se análises descritivas e teste de associação entre variáveis (qui-quadrado), consideraram-se os valores de p≤0,05 estatisticamente significativos.* ***Resultados:*** *dos 243 longevos, 111 (45,7%) relataram quedas nos últimos 12 meses, 50 (20,6%) velocidade da marcha reduzida e, destes, 30 (60%) caíram no último ano. Entre os idosos com velocidade da marcha reduzida, houve predomínio do sexo feminino (n=33; 66%) e média de idade 86,24 anos (±4,64). A velocidade da marcha reduzida mostrou associação significativa com a ocorrência de quedas nos últimos 12 meses (p=0,023).* ***Conclusão:*** *a redução da velocidade da marcha em longevos mostra relação ao episódio de quedas, o qual esteve presente em mais da metade dos longevos com velocidade da marcha reduzida.*

Palavras-chave: *Marcha; Idoso de 80 Anos ou mais; Idoso Fragilizado; Acidentes por Quedas; Enfermagem Geriátrica.*

RESUMEN

Objetivo: *analizar la relación entre la velocidad de la marcha y la incidencia de caídas en ancianos longevos.* ***Método:*** *estudio transversal llevado a cabo con 243 ancianos longevos (≥80 anos), usuarios de la atención primaria de salud. La recogida de datos se efectuó en el domicilio de los participantes, con encuesta sociodemográfica y clínica y la prueba de velocidad de la marcha. Se realizaron análisis descriptivos y pruebas de asociación entre variables (chi-cuadrado), los valores de p≤0,05 se consideraron estadísticamente significativos.* ***Resultados:*** *de los 243 ancianos, 111 (47,5%) relataron caídas en los últimos 12 meses, 50 (20,6 %) velocidad de la marcha reducida y, entre ellos, 30 (60%) caídas durante el último año. Entre los ancianos con velocidad de la marcha reducida predominó el sexo femenino (n= 33; 66%) y promedio de 86,24 años*

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(±4,64). La velocidad de la marcha reducida mostró una significativa asociación con la incidencia de caídas en los últimos 12 meses (p=0,023). ***Conclusión:*** *la reducción de la velocidad de la marcha en ancianos tiene relación con el episodio de caída, presente en más de la mitad de los ancianos con velocidad de la marcha reducida.*

Palabras clave: *Marcha; Anciano de 80 o más Años; Anciano Frágil; Accidentes por Caídas; Enfermería Geriátrica.*

INTRODUCTION

Gait speed (GS) is considered by gerontology and geriatric scholars as an important indicator for the functionality of the elderly, due to its capacity to predict adverse events such as functional limitations, loss of independence, increased incapacity, hospitalizations, fractures, falls and death.[1] In addition, it is an easily measurable measure that does not require specialized equipment and does not burden the health institutions.

The reduction in GS is considered a marker of physical frailty in the elderly and characterizes the elderly in a pre-frailty state. This condition increases the chances for progression to the frailty syndrome and different negative outcomes, including falls.[2]

A study carried out with 240 elderly in the city of *Ribeirão Preto*, Brazil, aimed to identify the causes and consequences for falls in the elderly at home by gender and age group. Fall prevalence in the frail elderly was 38.6%. It was identified that the frail elderly are more likely to suffer a fall (RCP 1.973) when compared to the non-frail elderly.[3]

A prospective study in 8,009 Korean elderly (≥65 years old) investigated the relationship between gait speed and falls. The results revealed a fall prevalence of 22.2% (n = 1,780). The elderly with a fall history had the lowest mean GS (0.62 ± 0.23 m/s) compared to the non-falling elderly (n=6,229) (0.67 ± 0.25 m/s). The authors concluded that gait speed is a reliable predictor for falls among the elderly in the community.[4]

According to the World Health Organization's global report, falls are defined as an "inadvertent movement of the body to the ground or another lower level caused by multiple factors".[5,9] The old age has been recognized as an important factor in the relationship between reduced gait speed and falls.[6] However, in the national context there are few studies that explore this relationship, especially with the long-lived age group, that is, the elderly that are 80 years old or more.

Fall prevalence is higher among the long-lived elderly, when compared to the younger ones.[7] This statistic was also found in the study conducted with 389 elderly resident in the municipality of *Chapecó*-SC (Brazil). The elderly who were 80 years old or older were the ones that suffered most falls when compared to the other age groups, with a mean of 2.16 (± 1.34) episodes per year.[8] This represents more severity, considering the number of fractures, hospitalizations and mortality. [9]

Considered an adverse event for the long-lived elderly, falls result in health lesions, such as bruising, hematomas, dislocations, fractures, and fear of a new fall. All of these are factors that can trigger a decrease in daily living activities.

The literature has not yet established evidence on the relationship between gait speed reduction and fall episodes. Research on it allows elderly with changes in gait speed and the resulting factors to be tracked, as well as to evidence the benefits in establishing gerontological care in this older population segment (oldest-old).

According to the above, the purpose of this study was to analyze the relationship between gait speed and fall occurrence in long-lived elderly.

METHODS

This is a cross-sectional study carried out at the home of long-lived elderly registered in three basic health units (BHU), in a capital of the South region of Brazil.

This was a proportional-stratified type sample, calculated from the total population of long-lived individuals enrolled in the three BHU (n = 503). For the sample calculation, we considered a beta power of 80% (1-ß) and an alpha significance level of 5%. Sample size was augmented 10%, considering the possibilities for losses and refusals, which resulted in a sample of 243 long-lived elderly.

From the list of registered long-lived elderly, provided by the city's electronic system, the long-lived elderly were recruited at random. Home visits were made and, in cases of refusal or absence (three attempts for each residence), a new elderly person was selected.

The following longevity inclusion criteria were considered: age ≥ 80 years old; be enrolled in one of the BHU to carry out the research; to have a cognitive capacity to answer the questionnaires of the study, which was evaluated through the Mental State Mini-Testing (MSMT).[10] The following cut-off points were used: 13 points for the illiterate, 18 for low and medium schooling and 26 for high schooling.[11] Exclusion criteria for the long-lived elderly were: being physically unable to perform the gait speed test (bedridden, wheelchair and limb amputated); being on chemotherapy; not having a family caregiver present at the time of the home visit.

For the long-lived elderly with cognitive alterations, the caregiver was invited to respond to the socio-demographic and clinical questions of the research. Therefore, the following were chosen as caregiver inclusion criteria: age ≥18 years old; being a family caregiver; living with the elderly for three months (minimum). And, as an exclusion criterion, show significant communication difficulties, cognitive deficit or other incapacities that made it impossible to answer the questionnaire.

Socio-demographic and clinical data were collected through the application of a questionnaire. The socio-demographic and clinical variables of interest for the study were age, gender and fall occurrence in the last 12 months.

In order to evaluate the GS, the long-lived elderly were oriented to walk six meters, usually, on a flat surface, marked by four marks (beginning, one meter, five meters and end).[12] To reduce gait's acceleration and deceleration effects, the test was initiated in the second mark, interrupting the gait's timing in the third mark. The GS was calculated in meters per second (m/s) with a digital timer, as recommended by an international study on frailty in the elderly.[3] The values were adjusted for the gender and median height, so that the lowest quintile of the sample indicated the reduced GS[3], as shown in Table 1.

Table 1 - Cut-off point for the lower quintile of gait speed, adjusted according to gender and median height of the participants, to identify the reduced gait speed. *Curitiba, Paraná*, Brazil, 2015

Gait Speed (GS)	Men		Women	
	Height ≤ 1.66 m	Height > 1.66 m	Height ≤ 1.52 m	Height > 1.52 m
Reduced GS	≤0.41 m/s	≤0.50 m/s	≤0.31 m/s	≤0.34 m/s
Preserved GS	>0.41 m/s	>0.50 m/s	>0.31 m/s	>0.34 m/s

Caption: GS – Gait Speed.

Data was organized in the Excel®2007 computer program. Typing occurred by double checking and verified by a third person, in order to guarantee data accuracy. For analyzing the results the software Statistical Package for the Social Sciences (SPSS) version 20.0 was used. Descriptive statistics (relative and absolute frequency, mean and standard deviation) and non-parametric (chi-square) test were used for association between variables. The 95% significance level was adopted. p≤0.05 values were considered significant.

The study received a favorable opinion from the *Comitê de Ética em Pesquisas em Seres Humanos do Setor de Ciências da Saúde* under Nº 156.413. The ethical principles of voluntary and consensual participation of each participant were observed, according to the resolution in force during the study approval period.

RESULTS

Among the 243 long-lived elderly, the female gender predominated (n=161; 66.25%), with mean age 84.38 (± 3.76) years old; and 111 (45.67%) had a falling episode in the last year. Among these elderly, the female gender predominated (n = 75; 67.57%); and the mean age was 84.33 (± 3.77) years old.

As for gait speed, 50 (20.57%) of the long-lived patients walked slowly, with the majority being of female gender (n = 33; 66%), with a mean age of 86.24 (± 4.64) years old.; In the total sample, the lowest identified GS was 0.05 m/s or greater, corresponding to 1.95 m/s, with an average of 0.60 (± 0.30) m/s. Among the elderly who reported a fall in the last year, GS mean value was 0.56 (± 0.30) m/s and among those who did not fall, GS mean value was 0.64 (± 0.30) m/s.

Table 2 shows the association between GS and the long-lived elderly and fall occurrence in the last 12 months.

It can be seen in Table 2 that there was a statistically significant association among GS and falls (p=0.023). Of the 50 long-lived patients who showed reduced MS, more than half suffered at least one fall in the last 12 months (n=30; 60%).

DISCUSSION

The highest frequency of falling elderly is among the long-lived elderly with reduced GS. This suggests that the decrease in gait speed is related to fall occurrence among the long-lived elderly.

Likewise, one highlights the Cooperative Health Research in the Region of Augsburg-Age conducted in the city of Augsburg (Germany) with 890 elderly of both genders, aged between 65 and 90 years old, living in a community, with the purposes of describing the characteristics of the gait spatial-temporal parameters and investigating the association among the parameters and fall history. The researchers used an electronic platform with pressure sensors, in which the elderly were instructed to walk at usual speed. The parameters of speed, cadence, time, length, width and step duration were evaluated. The results showed no significant association between gait parameters and fall history (p=0.1550).[13]

Table 2 -Association between gait speed and socio-demographic and clinical variables of the participants. *Curitiba, Paraná*, Brazil, 2015

Characteristics	Classif.	Reduced GS n (%)	Preserved GS n (%)	Total n (%)	Value of *p**
Fall episode in last 12 months	Yes	30 (60)	81 (42)	111 (45.7)	0.023
	No	20 (40)	112 (58)	132 (54.3)	
Total		50 (100)	193 (100)	243 (100)	

Caption: GS - Gait Speed, *Chi-square test.

A prospective study with 125 elderly (≥60 years old) from Olomouc, (Czech Republic), compared the gait spatial-temporal parameters and their variability with the variability of the pressure displacement center, between falling and non-falling elderly during gait in usual speed. Fall history was raised every two weeks by telephone contact for six months and, from these data, the participants were divided into two groups: falling elderly (n=31) and non-falling elderly (n=94). There was no significant association between GS and fall history (p=0.674), however, the GS of the falling elderly was lower (1.11 m/s) than that of the non-falling elderly (1.13 m/s). The authors concluded that gait spatial-temporal parameters, including the GS, showed the potential to distinguish the falling elderly from non-falling elders.[14]

Conducted in the United States of America, The MOBILIZE Boston Study investigated 600 elderly individuals with a mean age of 78 years old who were classified into three groups according to GS mean value: performance being slow (>0.6 m/s), intermediate (0.6 – 1.0 m/s), normal (1.0- 1.3 m/s) and fast (>1.3 m/s). The results showed non-linear (U-shaped) type relationship between gait speed and falls. Elderly with slow performance (IRR = 1.60; 95% CI = 1.06-2.42) and elderly with fast performance (IRR = 2.12; 95% CI = 1.48-3.04) displayed a high risk for falls compared to the elderly with normal gait speed (RR=1.0). In the adjusted analyses, slow performance was associated with a high risk for falls within the residence (IRR = 2.17; CI = 1.33-3.55), while fast performance was associated with a high risk for falls outside the residence (IRR = 2.11; CI = 1.40-3.16). They also concluded that the annual decline of 0.15 m/s in gait speed was able to predict an increased risk for falls in and outside of the residence (IRR = 1.86; CI = 1.15-3.01). [15]

Another prospective study accomplished with 457 older adults (≥65 years old) in Pittsburgh (Pennsylvania/USA) compared GS with the Timed up and go (TUG) test regarding the ability to predict fall events. The elderly were classified according to GS mean value: performance being slow (>0.6 m/s), intermediate (0.6 – 1.0 m/s), normal (0.6- 1.0 m/s) and fast (>1.0 m/s). The prevalence in falls was 92.99% (n=425), and among the elderly with slow performance (n=56; 12.25%) the occurrence of at least one fall was displayed in 92.9% (n=26) of them. Both TUG and GS testing were associated with falls (p<0.01) in the comparison among elderly subjects with fast and intermediate performance and elderly with slow performance. The authors concluded that the TUG test does not provide additional information to those provided by the GS test, but its qualitative elements may have other uses.[16]

A literature review study sought to summarize evidence on gait speed as a screening tool for risk for falls in community elders. The analysis showed that there is no consensus on gait speed as an instrument to identify falling elderly from non-falling elderly. However, the risk for falls was categorized based on gait speed values, suggesting that decreased velocities between the elderly increase the risk for falls.[17]

The op cit results are corroborated by the research developed aiming at describing the conditions and relationships between grip strength, gait speed and health self-assessment. With a probabilistic sample consisting of 689 community-dwelling elderly (≥65 years old), participants were divided into three groups according to their performance in the GS test: elderly who scored below the quartile 1 (Q1) of the time to cover the distance of 4.6 meters were considered fast (24.45%); those who scored between Q1 and Q3 were classified as intermediate speed ones (50.66%); and those who scored above Q3, as slow ones (24.89%). There were statistically significant differences (p <0.001) between the frequencies of responses of the age groups in GS measurements. One considered a higher frequency of fast elderly in those aged from 65 to 69 years old (28.4%); of elderly aged between 75 and 79 years old (31.85%) and among those aged 80 and over (41.33%); and elderly with intermediate speed between the ages 70 and 74 (51.19%).[6]

This relationship between old age and falls was observed in a study carried out in Tokyo, Japan. The researchers evaluated 848 elderly individuals aged from 73 to 93 years old, with the objective of identifying changes in age-related gait parameters (speed, stride length, cadence and step width) and to examine the relationship between these variables and fall history. The results showed that gait speed decreased with increasing age, more significantly from 80 years old in women and 90 years old in men. Also, reduced gait speed was associated with a fall history (p<0.05).[18]

A study performed in the city of *João Pessoa* (*Paraíba*, Brazil) with a sample of 240 elderly (≥60 years old) evaluated the risk for falls in the elderly, compared with socio-demographic and cognitive factors, falls and self-referred comorbidity. The risk for falls was measured by the Fall Risk Scale, from which the elderly were classified in: high risk for falls (n = 120) and low risk for falls (n = 120). Within the socio-demographic variables, the age group had a significant association with the risk for falls (p=0.054), being that, from the 39 elderly individuals aged 80 years old or older, 25 (64.1%) showed a high risk for falls.[7]

Still on this relation between age and fall episodes, we highlight the investigation that observed possible differences in the severity of the fall between younger and long-lived elderly. We reviewed the reports on falls healthcare in 2010 in two emergency and emergency care units in *Porto Alegre* (*Rio Grande do Sul*, Brazil). The consequences from the falls were classified according to the degree of severity: intense, moderate, mild or non-severe. Of the 4,681 elderly treated for falls in the one-year period, 1,045 (22.32%) were long-lived elderly. The age group was associated with the severity of the falls (p<0.001), and 39.33% of the long-lived elderly presented intense severity, while in 36.52% of the young elderly the severity was mild.[9]

Another possible relationship is that reduced GS acts as a fall protection factor. Motivated by the preexisting fear of falling again and/or as prevention, many elderly use adaptation strategies to maintain balance while walking. These strategies are characterized by a slower speed, due to the decrease in the size of the stride, which increases the support base and the permanence time in the double support phase, shortening the permanence time in the oscillation phase, a period with more instability.[19]

In this perspective, the study carried out with 60 elderly individuals (≥65 years old) of the community in the city of *Natal* (*Rio Grande do Norte*, Brazil), which analyzed GS's ability to identify elderly with fear of falling, is highlighted. GS was assessed according to the frailty phenotype and the fear of falling through the Falls Efficacy Scale – International (FES-I). Mean speed was 0.71 (±0.21) m/s. Both in the FES-I correlation with the independent GS variable (p=0.005) and in the linear regression analysis (p=0.001), the authors found a relationship between MV and fear of falling. It was concluded that the GS measurement is a good tool to identify the fear of falling in the elderly.[20]

A prospective study in *Belo Horizonte* (*Minas Gerais*/Brazil) sought to determine whether spatiotemporal gait parameters predict recurrent falls in 148 elderly women (≥65 years old). Seven gait parameters were evaluated, including GS. Fall occurrence retrospectively (during the initial evaluation) and prospectively (during the following year, through telephone contact every 15 days), was questioned each 15 days). During the one-year follow-up period, 23 elderly women (17.3%) were recurrent fallers (two or more falls in the year) and 110 (82.7%) were considered non-recurrent fallers (one or none falls in the period).[21]

The op cit research data indicated that the GS of the recurrent fallers was lower (125.8 ± 15.9 cm/s) when compared to the non-recurrent fallers (128.3 ± 15.6 cm/s). The authors concluded that although the gait parameters analysis failed to predict fall occurrence in the studied sample, the interpretation of the PCA-biplot analyzing technique showed a tendency of elderly women to reduce their gait rhythm, decreasing their speed and cadence and increasing the stay time in the double support phase.[21]

The association between reduced GS and fall occurrence was also observed in a study with elderly in ambulatory care. In a sample of 145 elderly (≥ 60 years old) of a Geriatrics clinic in *Campinas* (*São Paulo*/Brazil), researchers related physical performance variables (evaluated using the Short Physical Performance Battery) to fall history. Fall prevalence was 51%, of which 56.2% had fallen at least twice over the 12-month period. Significant differences were found regarding GS (p=0.01) among the worst and better physical performance groups. Also, among the elderly women with worse physical performance, fall prevalence was higher (60.9%) than among the elderly women with better physical performance (39.1%). It was concluded that the highest fall occurrence is associated with the profile of female gender elderly, with worse levels of muscular strength and worse physical balance and gait performance.[22]

This study's results differ from those found by two investigations carried out in *Curitiba* (PR, Brazil). In order to analyze the correlation between sarcopenia indicators and extrinsic and intrinsic factors for falls in 85 elderly women (≥65 years old) of the community, results showed that there was no significant difference for GS among falling and non-falling women (p=0.71).[23]

Similarly, researchers evaluated and compared muscular strength, gait kinematics, and performance in functional tests among 62 elderly individuals (≥60 years old) with and without fall history. There was little difference between GS mean values for falling and non-falling elderly individuals and there was no significant association between GS and fall occurrence (p=0.3).[24] It is believed that these results reflect the age range of the elderly, since they are not long-lived elderly, as well as the reduced quantitative of participants, in both studies.

CONCLUSION

Gait speed showed a significant relationship among fall occurrence, being that they were present in more than half of the long-lived elderly with reduced GS, and less frequently in those with preserved GS.

The study's deficit regarding the long-lived age group, which restricted the discussions about its outcomes, is considered a limitation of the study. Due to the divergences found in the literature and to the lack of consensus among the results of the studies, which supported the discussions, it is suggested to carry out multicenteric studies involving a significant sample, in order to generate different evidence levels and a reliability degree.

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