

# Physical performance and number of falls in older adult fallers

Comparação entre idosos que sofreram quedas segundo desempenho físico  
e número de ocorrências

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## Abstract

**Objectives:** The aim of this study was to determine the relationship between sociodemographic, clinical, physical and functional data according to physical performance and number of falls among older fallers. **Methods:** Cross-sectional study carried out among 72 older adults (76.3 ± 8.3 years) with a history of falls in the past year, 65.3% of which were women. The participants received care at the geriatric outpatient clinic of a university hospital in Campinas, SP. They were divided into the following groups: worst physical performance (WPP) and best physical performance (BPP), one-time fallers (1F) and frequent fallers (2F). Sociodemographic, clinical, physical and functional characteristics were considered as independent variables. Comparison analysis between the groups was conducted. **Results:** The WPP group was older and had a higher number of illnesses and less independence in most motor dimension tasks compared to the BPP group. The 2F group had a higher number of illnesses, less handgrip strength and less independence in the bowel management task in the motor dimension of the Functional Independence Measure (FIM) compared to the 1F group. **Conclusions:** Among older adults fallers, poor physical performance is associated with more advanced age, more illnesses and less functional independence. Moreover, recurrent falls are associated with more illnesses, less muscle strength and less functional independence in the bowel management task.

**Key words:** activities of daily living; muscle strength; musculoskeletal equilibrium; gait; exercise; aging.

## Resumo

**Objetivos:** Analisar, entre idosos com ocorrência de quedas, a relação entre as variáveis sociodemográficas, clínicas, físicas e funcionais segundo as variáveis critério desempenho físico e número de quedas. **Métodos:** Estudo transversal com 72 idosos (76,3±8,3 anos) que sofreram quedas no último ano, sendo 65,3% mulheres, atendidos no ambulatório de geriatria de um hospital universitário de Campinas, SP. Os idosos foram divididos em grupo com pior (PDF) e grupo com melhor desempenho físico (MDF), e em grupo com uma queda (1Q) e grupo com duas quedas ou mais (2Q). As características sociodemográficas, clínicas, físicas e funcionais foram as variáveis independentes do estudo. Foi realizada análise de comparação entre os grupos. **Resultados:** Os idosos do grupo PDF tiveram maior faixa etária, maior número de doenças e menor independência na maior parte das tarefas da dimensão motora em relação ao grupo MDF. Os idosos do grupo 2Q apresentaram maior número de doenças, menor força de preensão manual e menor independência na tarefa "controle das fezes" na dimensão motora da medida de independência funcional (MIF) em relação ao grupo 1Q. **Conclusões:** Entre idosos que já caíram, piores níveis de desempenho físico relacionam-se com maior faixa etária, mais doenças e menos independência funcional. Além disso, ter sofrido quedas recorrentes relaciona-se com mais doenças, menos força muscular e menos independência funcional na tarefa de controle de fezes.

**Palavras-chave:** atividades cotidianas; equilíbrio musculoesquelético; marcha; força muscular; exercício físico; envelhecimento.

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## Introduction

The incidence of falls in individuals over 60 years of age stands out due to the fact that the consequences of a fall can be complex and lead older adults to conditions of morbidity, mortality and dependence in the activities of daily living (ADLs)<sup>1-3</sup>. In Brazil, external causes now rank third as a cause of death, representing 14.9% of the total deaths, and the occurrence of falls ranks first and fourth in morbidity and mortality rates, respectively<sup>4</sup>.

According to the literature, changes in the mobility of older adults result from environmental factors, physiological modifications associated with the aging process, or even from the consequences of the lifestyle adopted by the individual throughout his life<sup>5-8</sup>. The decline in physical capacity is related to the reduction in muscle strength, to impairments in gait performance and to changes in static balance<sup>9,10</sup>. These parameters can vary according to the individual's sociodemographic, physical and functional characteristics, and they are linked to falls because falling can result from the body instability caused by this decline.

Falls in older adults lead to consequences related not only to social aspects, but also to economic, physical and psychological aspects of the individual's life<sup>5</sup>. Older adults often seek outpatient care to treat these consequences that affect the functionality and quality of life of this age group. Studies of this nature are important because they describe the profile of the older adults that are at greater risk of falling, which can prevent the occurrence of this event, maintain a standard of quality of life for older adults and reduce costs to the country's public health system<sup>5,11,12</sup>.

In Brazil, there are few population-based studies on the factors associated with falls, and there is a lack of prevention of falls among older adults in primary and secondary health care, particularly in terms of physical activity that could improve the physical performance of individuals at risk of falling. Therefore, the objective of the present study is to determine whether there is a relationship between physical performance, the number of falls and the sociodemographic, physical, clinical and functional characteristics of older adult fallers.

## Methods

The present research is part of a project entitled "Quality of life among frail older adults: health and subjective well-being indicators", which aims to identify and analyze the predictors and discrimination factors of frailty and subjective well-being in older adults from the greater Campinas area, considering the impact of these variables on their quality of life. This is a

multidisciplinary project, coordinated by the lecturers of the graduate program in gerontology of the Faculty of Medical Sciences of Universidade Estadual de Campinas (UNICAMP), Campinas, SP. This is a cross-sectional study, in which the sample was composed of male and female older adults over 60 years from the greater Campinas area, who received care at the Geriatric Outpatient Clinic of UNICAMP's Hospital das Clínicas from 2005 to 2007.

As many older adults as possible were approached each day to inquire about their willingness to take part in the study, their availability for an interview and their compatibility with the inclusion criteria. We were able to interview two older adults a day. Data were collected through an individual interview, with or without the presence of the caregiver, before the medical appointment at the clinic. Each interview lasted from one hour to one and a half hours. Of the 145 older adults interviewed, 72 had a history of falls and were selected to join the present study which aimed to describe the characteristics of fallers only. The older adults were excluded from the study if they had not fallen in the past year, refused to participate, received care on a gurney, had cognitive impairment identified by the Mini-Mental State Examination (schooling criteria by Brucki et al.<sup>13</sup>) or had a diagnosis that would impair the comprehension of the questionnaires of the study's protocol or impair the performance of the tasks contained in this protocol.

The project of which this study is a part was approved by the Research Ethics Committee of the Faculty of Medical Sciences of UNICAMP, approval 240/2003. The patients were informed about confidentiality and the right to withdraw from the study at any time when they signed the informed consent form, according to Resolution 196/96 of the National Health Council.

The following instruments were used for data collection. First, the sociodemographic characteristics were obtained, including sex, age group and literacy. Second, the clinical characteristics were recorded, including the occurrence of falls (number, fractures, hospitalizations), according to the Kellogg International Work Group (KIWG) on the Prevention of Falls by the Elderly<sup>14</sup>. The older adults and/or their caregiver were asked about the incidence of a fall in the past year and about the number of associated diseases, medications in use, and visual capacity determined by the measure of visual acuity using the Snellen Chart. Visual acuity  $\geq 20/60$  in the best eye, with corrective lenses, if used, was considered low vision. Third, the physical characteristics were obtained for regular physical activity, levels of physical performance through the Short Physical Performance Battery (SPPB) in the domains balance, gait, and lower limb (LL) strength, validated in Brazil by Nakano<sup>15</sup>, and handgrip strength (HS) measured with Crown's dynamometer. Finally, functional characteristics were assessed through the

Functional Independence Measure (FIM), validated in Brazil by Riberto et al.<sup>16,17</sup>.

For the comparison analysis of the present study, we considered as outcome the criterion variables of physical performance level (gait, balance and LL muscle strength) and number of falls. The groups were divided into 1F (one-time fallers) and 2F (frequent fallers in the past year), and they were also divided into worst physical performance (WPP) for scores 0-6 in the SPPB and best physical performance (BPP) for scores 7-12 in the SPPB. These groups were divided according to the previous calculation of the median score obtained by the older adults in the test. The median was 6.0, therefore the WPP group was defined as those who scored from 1 to 6, and the BPP from 7 to 12.

The statistical analysis was descriptive and comparative by means of chi-square tests (categorical data), Student's *t* test (parametric, ordinal or interval data) and Mann-Whitney (non-parametric, ordinal and interval), considering the results of the data normality test (Kolmogorov-Smirnov). The significance value was set at  $p < 0.05$ .

**Table 1.** Description of sociodemographic and clinical variables of older adults (n=72).

Variables	N (%)	Observed Variation	Possible Variation
Sex			
Male	25 (34.7%)	-	
Female	47 (65.3%)	-	
Age		60 a 93	
60-64 years	30 (41.7%)		
>75 years	42 (58.3%)		
Literacy			
Yes	41 (56.9%)		
No	31 (43.1%)		
Number of falls*			
1	32 (43.8%)	1 a 15	
≥2	40 (55.6%)		
Associated illnesses			
0-4	28 (38.9%)	1 a 13	1 a 13
≥5	44 (61.1%)		
Number of medications			
0-4	31 (43.1%)	1 a 13	1 a 13
≥5	41 (56.9%)		
Low vision**			
Yes	24 (34.3%)		
No	46 (65.7%)		
Fracture due to fall*			
Yes	7 (9.7%)		
No	65 (90.3%)		
Hospitalization due to fall*			
Yes	17 (23.6%)		
No	54 (76.4%)		

\* Values according to past year; \*\* Missing=2.

## Results

Most of the older adults were female (65.3%), aged 75 years or more (58.3%), with an incidence of two or more falls (56.2%) in the past year and without low vision (63.9%; Table 1).

With regard to functional independence, the older adults had high mean scores in each of the FIM motor tasks, and more than a half of the participants reported complete independence in these tasks, except in the items of dressing the lower body, bladder management, walking and stairs (Table 2).

When the criterion variable was physical performance, in the sociodemographic and clinical variables, there was a significant difference between the WPP and BPP groups as to age group and number of associated diseases. Most of the older adults in the WPP group were aged 75 years or more and had five or more associated diseases. Concerning functional independence, the WPP and BPP groups showed significant differences in most of the motor tasks of the FIM, except feeding and bowel management. Those with a poor performance were less independent in the tasks.

In the analysis of the number of falls, in the sociodemographic, clinical and physical variables, the findings showed a significant difference between the one-time fallers and the frequent fallers regarding the number of associated diseases ( $p < 0.001$ ) and to HS ( $p = 0.024$ ). The frequent-fallers had more associated diseases and less HS. Considering the functional variables, the frequent-fallers had a significant difference in the motor dimension of the FIM, specifically bowel management, in which they reported lower independence.

## Discussion

In the present study, the majority of fallers were females aged 75 years or more with a high number of illnesses and use of medication and two or more falls. Additionally, most of them had poor physical performance, higher independence levels in ADLs and good visual acuity. These characteristics may be due to the location of the survey, as older outpatients differ from community-dwelling older adults in these factors<sup>3,5</sup>.

These findings indicate that the present study participants had debilitating characteristics and factors often associated with the occurrence of falls, however they also showed alternative ways to overcome the functional difficulties that emerged due to age-related impairments or the consequences of falls. These data support studies conducted in outpatient or hospital settings<sup>18</sup>.

It is important to note that, in the analysis of the factors associated to falls, it is difficult to identify which variables are causes and which are consequences of these events. Low

**Table 2.** Description of physical performance of older adults according to physical and functional variables (n=72).

Variables	Items	Tasks	N(%)	Mean (±SD)
Regular physical activity	Yes		19 (26.4%)	
	No		53 (73.6%)	
Physical performance (SPPB)	Balance*			2.7 (±1.3)
	Gait*			1.1 (±1.0)
	LL Muscle Strength* <sup>α</sup>			1.1 (±0.8)
	Total**			5.9 (±2.6)
Handgrip Strength <sup>β</sup>				20.6 (±8.1)
Functional Independence Measure (FIM) <sup>∞</sup> ***	Self-Care Items	Feeding	56 (77.8%)	
		Grooming	59 (81.9%)	
		Bathing	49 (68.1%)	
		Dressing upper body	52 (72.2%)	
		Dressing lower body	34 (47.2%)	
		Toileting	54 (75.0%)	
	Sphincter Control	Bladder management	33 (45.8%)	
		Bowel management	48 (66.7%)	
	Mobility Items	Bed. Chair. Wheelchair	44 (61.1%)	
		Toilet	44 (61.1%)	
		Tub or shower	43 (59.7%)	
		Walking/Wheelchair	34 (47.2%)	
Stairs		10 (13.9%)		

\* Values = 0 to 4, varying from worst to best performance; \*\* Values = 0 to 12, varying from worst to best performance; \*\*\* Values = 1 to 7, varying from worst to best performance; <sup>α</sup>LL= Lower limbs; <sup>β</sup> Values: 0 to 50 kg; <sup>∞</sup> N(%) of subjects with total independence (±SD) in the FIM scores; SPPB=Short Physical Performance Battery.

levels of muscle strength, for example, can be a cause of falls, and the incidence of one or more falls can limit movement and, consequently, reduce the level of muscle strength. In this context, Gazzola et al.<sup>10</sup> and Estefani<sup>19</sup> reported that the fear of falling prompts relatives to take protective measures that lead the older fallers to restrict their movements to avoid the consequences of a another fall. This fact can increase the cycle of sedentary lifestyle and low physical and functional performance, causing isolation and insecurity and leading the older adult to a condition of morbidity or mortality.

Physical activity is recommended as an intervention that may reduce the structural loss of physical fitness associated with aging. Most of the study participants were sedentary and had poor physical performance, which indicates that older adult fallers should be encouraged to adopt an active lifestyle to prevent falls. The WPP found in the older adults aged 75 years or more may be explained by the progressive degeneration of the physical components throughout life, together with the high number of chronic-degenerative diseases that advanced age tends to manifest. These chronic diseases, especially the musculoskeletal ones, lead to a stiffening of the joints and contribute to poor gait and balance performance<sup>5,20-22</sup>, which can explain the relationship between physical performance and the number of diseases found in the present study.

The older adults with less HS were those who reported the occurrence of two or more falls. This measure has been regarded as a good predictor of musculoskeletal function<sup>22-24</sup>. The

literature has also linked it to low bone mass in menopausal women, which represents a higher risk of lower limb fracture and conditions associated with frailty and falls<sup>8,24</sup>.

Regarding functional independence, the use of stairs, which depends on an ideal physical performance in gait, balance and strength, was one of the tasks associated with WPP in the present study. According to Fabrício, Rodrigues and Costa Junior<sup>18</sup>, it is one of the most impaired activities after a fall. Still regarding functionality, the participants who reported less independence in bowel management had recurrent falls. The consequences of these events may be related to neurological diseases, such as stroke, which can reduce sphincter control and/or require the use of more medication. According to Oliveira et al.<sup>25</sup>, the side effects of antacids (with calcium or aluminum), antispasmodics, diuretics, analgesics, anticonvulsants and antidepressants, used by older adults with severe consequences from a fall, increase the chances of impaired bowel function. These findings can also be understood in light of the bowel urgency experienced by some older adults, which leads to quick and unbalanced movements toward the bathroom and increases the risk for falls.

Older adults with less functional independence in 12 of the 14 FIM tasks had poor physical performance. Satisfactory levels of functional independence seem to generate sufficient movement to maintain physical performance, however that is insufficient to avoid falls. In a longitudinal study, Parayba and Simões<sup>26</sup> verified, in the functional tasks performed by older

adults, a “slight difficulty” in walking 100 meters and a decrease in the prevalence of functional disability in the recent years in Brazil. However, in the present research, this prevalence was distinct and related to worst physical performance, which may be explained by the debilitating characteristics of the studied group.

Although the literature shows a relationship between the occurrence of falls and low visual acuity and physical activity<sup>24,27-29</sup>, this was not observed in the two comparative

analyses of the present study. These results may be explained by the limiting factors of this research, such as the low rate of active older adults, the predominance of normal or close to normal vision, the lack of details in the FIM motor tasks, as well as the indirect measures of strength, gait and balance, in spite of the satisfactory reliability obtained in the validation of the Brazilian version of the SPPB<sup>13</sup>. Environmental factors were not assessed in the present investigation, but should be considered when analyzing falls because they represent one of the

**Table 3.** Comparison between older adults with best and worst physical performance according to sociodemographic, physical, clinical and functional variables (n=72).

Variables	Physical Performance				p
	WPP (n=41)		BPP (n=31)		
	N (%)	Mean (±SD)	N (%) <sup>†</sup>	Mean (±SD)	
Sex <sup>α</sup>					
Male	13 (31.7%)		12 (38.7%)		0.537
Female	28 (68.3%)		19 (61.3%)		
Age <sup>α</sup>					
60-74	12 (29.3%)		18 (58.1%)		0.014
≥75	29 (70.7%)		13 (41.9%)		
Associated illnesses <sup>α</sup>					
0-4	12 (29.3%)		16 (51.6%)		0.042
≥5	29 (70.7%)		15 (48.4%)		
Number of medications <sup>α</sup>					
0-4	16 (39.0%)		15 (48.4%)		0.054
≥5	25 (61.0%)		16 (51.6%)		
Number of Falls <sup>α</sup>					
1	15 (36.6%)		17 (54.8%)		0.123
≥2	26 (63.4%)		14 (45.2%)		
Low Vision <sup>α</sup>					
Yes	13 (31.7%)		11 (37.9%)		0.589
No	28 (68.3%)		18 (62.1%)		
Physical activity <sup>α</sup>					
Yes	10 (24.4%)		9 (29.0%)		0.658
No	31 (75.6%)		22 (71.0%)		
HGS (kg) <sup>*∞</sup>		19.3 (6.9)		20.6 (8.2)	0.458
Functional independence <sup>β</sup>					
Self-Care items					
Feeding	29 (70.7%)		27 (87.1%)		0.079
Grooming	30 (73.2%)		29 (93.5%)		
Bathing	21 (51.2%)		28 (90.3%)		p<0.001
Dressing upper body	24 (58.5%)		28 (90.3%)		
Dressing lower body	13 (31.7%)		21 (67.7%)		0.001
Toileting	25 (61.0%)		25 (80.6%)		0.002
Sphincter control					
Bladder management	14 (34.1%)		19 (61.3%)		0.034
Bowel management	24 (58.5%)		24 (77.4%)		0.094
Mobility items					
Bed. Chair. Wheelchair	19 (46.3%)		25 (80.6%)		0.002
Toilet	19 (46.3%)		25 (80.6%)		0.003
Tub or shower	17 (41.5%)		26 (83.9%)		p<0.001
Walking/Wheelchair	11 (26.8%)		23 (74.2%)		p<0.001
Stairs	2 (4.9%)		8 (25.8%)		p<0.001

<sup>α</sup> Chi-square test; p-value <0.05; <sup>β</sup> Mann-Whitney test; p-value <0.05; <sup>∞</sup> Student t test; p-value <0.05; \*HGS=handgrip strength; WPP=worst physical performance; BPP=best physical performance; <sup>†</sup> N(%) of subjects with total independence (±SD) in the FIM scores.

major causes of these events<sup>10,30</sup>. In addition to the vulnerability of older adults and the consequences of diseases, environmental factors further increase the chance of falling.

This study helps increase the number studies on falls in Brazil, especially in specific settings such as outpatient clinics, however, it is worth noting that a relevant limitation was the sample size caused by the characteristics of the group studied,

which limits data extrapolation to other population groups. Given the limitations of this study, some recommendations could be made to future studies in a country that lacks studies on falls among older adults, i.e. the use of a larger sample, a longitudinal study design, a better description of the fall, the addition of tests using direct measures and the refinement of some factors frequently associated with falls.

**Table 4.** Comparison between one-time fallers and recurrent fallers according to sociodemographic, physical, clinical and functional variables (n=72).

Variables	Number of Falls				p
	1 (n=32)		≥2 (n=40)		
	N (%)	Mean (±SD)	N (%) <sup>n</sup>	Mean (±SD)	
Sex <sup>α</sup>					
Male	14 (43.7%)		11 (27.5%)		0.150
Female	18 (56.3%)		29 (72.5%)		
Age <sup>α</sup>					
60-74	13 (33.3%)		17 (42.5%)		0.856
≥75	19 (66.6%)		23 (57.5%)		
Associated illnesses <sup>α</sup>					
0-4	20 (62.5%)		8 (20.0%)		p<0.001
≥5	12 (37.5%)		32 (80.0%)		
Number of medications <sup>α</sup>					
0-4	14 (43.7%)		17 (42.5%)		0.915
≥5	18 (56.3%)		23 (57.5%)		
Low vision <sup>α</sup>					
Yes	18 (56.5%)		29 (72.5%)		0.851
No	14 (43.5%)		11 (27.5%)		
Physical activity <sup>α</sup>					
Yes	8 (25.0%)		11 (27.5%)		0.811
No	24 (75.0%)		29 (72.5%)		
Physical performance					
(SPPB)	LL Strength*	1.0 (±0.8)	2.3 (±1.2)		0.845 <sup>β</sup>
	Gait	1.9 (±1.0)	2.0 (±1.1)		0.621 <sup>β</sup>
	Balance	2.9 (±1.2)	2.3 (±1.2)		0.055 <sup>β</sup>
	Total	6.0 (±2.5)	5.3 (±2.5)		0.938 <sup>∞</sup>
HGS (kg)** <sup>∞</sup>		22.1(±8.3)	18.1(±6.3)		0.024 <sup>∞</sup>
Functional independence <sup>β</sup>					
Self-care items	Feeding	23 (71.9%)	33 (82.5%)		0.373
	Grooming	27 (84.4%)	32 (80%)		0.559
	Bathing	25 (78.1%)	24 (60.0%)		0.156
	Dressing upper body	25 (78.1%)	27 (67.5%)		0.287
	Dressing lower body	18 (56.3%)	16 (40.0%)		0.172
	Toileting	25 (78.1%)	29 (72.5%)		0.647
Sphincter control	Bladder management	16 (50.0%)	17 (42.5%)		0.686
	Bowel management	26 (8.3%)	22 (55.0%)		0.014
Mobility items	Bed, Chair, Wheelchair	22 (68.8%)	22 (55.0%)		0.308
	Toilet	23 (71.9%)	21 (52.5%)		0.100
	Tub or shower	23 (71.9%)	20 (50.0%)		0.056
	Walking/Wheelchair	16 (50.0%)	18 (12.5%)		0.264
	Stairs	5 (15.6%)	5 (12.5%)		0.932

<sup>α</sup> Chi-square test; p-value <0.05; <sup>β</sup> Mann-Whitney test; p-value <0.05; <sup>∞</sup> Student t test; p-value <0.05; \*LL=Lower limb muscle strength; \*\* HGS=Handgrip Strength; <sup>n</sup> N(%) of subjects with total independence (±SD) in the FIM scores.



The present research data point to the occurrence of falls and their associated characteristics as important factors to be assessed in the clinical health practice of physical therapists, physical education professionals, nurses or physicians. Fabricio, Rodrigues and Costa Junior<sup>18</sup> stated that a fall is indicative of undiagnosed diseases and can be a starting point for a more detailed assessment. However, the results of this and other studies show that the prevention of falls appears to be more relevant, as their consequences can be serious and, in some cases, deadly. This fact may bring about the need to shift the attention of basic health toward family support in older adult care. The reduction in the risk of falls represents a strategy to decrease the costs of older adult care and becomes possible as the predisposing factors are analyzed<sup>8</sup>.

## Conclusions

This study suggests that, among older adult fallers, the worst levels of physical performance were related to more

advanced age, greater number of diseases and lower functional independence. Furthermore, recurrent falls were related to a greater number of diseases, less handgrip strength and lower functional independence in bowel management. Government incentives are also important to help in the development of educational strategies associated with prevention and exercises that improve walking and static and dynamic balance to maintain the movement stability and functionality of older adults. These interventions are necessary to detect the risk of falls and to recommend prevention and/or rehabilitation strategies for older adult fallers.

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