Perracini, Monica R.; Teixeira, Luiza F.; Ramos, Juliane L. A.; Pires, Raquel S.; Najas, Myrian S.
Fall-related factors among less and more active older outpatients
Revista Brasileira de Fisioterapia, vol. 16, núm. 2, marzo-abril, 2012, pp. 166-172
Associação Brasileira de Pesquisa e Pós-Graduação em Fisioterapia
São Carlos, Brasil

Fall-related factors among less and more active older outpatients

Fatores associados a quedas em pacientes idosos ambulatoriais menos ativos e mais ativos

Monica R. Perracini[1], Luiza F. Teixeira[1], Juliane L. A. Ramos[2], Raquel S. Pires[1], Myrian S. Najas[3]

Abstract

Background: Fall-related factors in older adults with different levels of physical activity, within a multidimensional approach, have not been widely investigated. **Objective:** To explore fall-related factors among older adults with different physical activity levels. **Methods:** A cross-sectional, exploratory study with 118 older adult outpatients. Participants who reported at least one fall in the previous 12 months were considered fallers. The activity level was assessed through the Human Activity Profile. A cutoff of 54 points was used to define the less active group and the more active group. A multidimensional questionnaire and a set of physical functioning tests were applied. **Results:** Fall prevalence was lower among the more active older adults (47.4%) when compared with the less active older adults (71.4%) (p<0.013). Logistic regression analysis showed that, among the more active group, falls were associated with: depressive symptoms (OR=0.747, 95%CI=0.575-0.970; p=0.029), concern about falling (OR=1.17, 95%CI=1.072-1.290; p=0.001), and self-selected walking speed (OR=0.030, 95%CI=0.004-0.244; p=0.001). For the less active group, the model was composed of age (OR=1.197, 95%CI=1.032-1.387; p=0.017) and functional disability (OR=14.447, 95%CI=1.435-145.45; p=0.023). **Conclusion:** For the more active older adults, reduced self-efficacy suggests that falling can trigger some protective behavior, such as slower gait and depressive symptoms, but the casual link between falls and these outcomes should be further investigated. These data emphasize that physical therapists should be aware that there are differences in fall-related factors depending on the older patients' physical activity level, and this must be considered when planning interventions for this population.

Keywords: physical activity level; accidental falls; older adult; geriatric assessment.

Resumo

Contextualização: Fatores relacionados a quedas em idosos com diferentes níveis de atividade física, por meio de uma abordagem multidimensional, não têm sido amplamente investigados. **Objetivo:** Explorar os fatores relacionados a quedas em idosos com diferentes níveis de atividade física. **Métodos:** Estudo transversal exploratório com 118 pacientes idosos ambulatoriais. Participantes que relataram ao menos uma queda nos últimos 12 meses foram considerados caidores. O nível de atividade física foi avaliado por meio do Perfil de Atividade Humana (PAH). O ponto de corte de 54 pontos foi usado para definir o grupo menos ativo e o grupo mais ativo. Um questionário multidimensional e uma bateria de testes físico-funcionais foram utilizados. **Resultados:** A prevalência de quedas foi menor no grupo de idosos mais ativos (47,4%) quando comparada à dos idosos menos ativos (71,4%) (p<0,013). A análise de regressão logística multivariada identificou que, no grupo mais ativo, ter caído estava associado a sintomas depressivos (OR=0,747, IC95%=0,575-0,970; p=0,029), preocupação em cair (OR=1,17, IC95%=1,072-1,290; p=0,001) e velocidade de marcha autosselecionada (OR=0,030, IC95%=0,004-0,244; p=0,001). Para o grupo menos ativo, o modelo foi composto de idade (OR=1,197, IC95%=1,032-1,387; p=0,017) e incapacidade funcional (OR=14,447, IC95%=1,435-145,45; p=0,023). **Conclusão:** Para os idosos mais ativos, a redução na autoeficácia pode sugerir que cair desencadeia alguns comportamentos protetores, tais como lentidão na marcha e sintomas depressivos, mas a relação causal entre quedas e esses desfechos devem ser mais investigados. Esses dados enfatizam que os fisioterapeutas devem ficar atentos ao fato de que há diferenças nos fatores relacionados a quedas, dependendo do nível de atividade física dos pacientes idosos, e isso deve ser considerado ao se planejarem intervenções para tal população.

Palavras-chave: nível de atividade física; quedas acidentais; idoso; avaliação geriátrica.

[1] Master of Science Program in Physical Therapy, Universidade da Cidade de São Paulo (UNICID), São Paulo, SP, Brazil
[2] Master of Science Program in Gerontology, Universidade Estadual de Campinas (UNICAMP), Campinas, SP, Brazil
[3] Geriatrics and Gerontology Department, Universidade Federal de São Paulo (UNIFESP), São Paulo, SP, Brazil
Correspondence to: Monica R. Perracini, Rua Cesáreo Galeno, 448, Tatuapé, CEP 04026-040, São Paulo, SP, Brasil, e-mail: mrperracini@unicid.br

Introduction :::.

The costs associated with fall-related injuries in older adults are projected to increase substantially[1,2]. Approximately 30% of community-based people aged 65 years or older fall every year, and this rate rises with age[3,4]. The consequences of fall include fractures, death, fear of falling, activity avoidance, health decline, and admission to a long-term care facility[3-7].

Both high and low levels of physical activity have been associated with increased fall risk in older adults, but a U-shaped relationship could not be proven[8-10]. The relationship between falling and physical activity level is complex and can be influenced by many factors, including perceived and objective physical functioning capacity, activity type and intensity, risky behaviors, and environmental circumstances[11-13].

Older adults with lower physical activity levels tend to be more frail and to move around less frequently, which restricts their exposure to activities that demand higher neuromuscular and balance control. In the long term, this inactivity could impair their functional capacity and increase fall risk[14]. In turn, fallers avoid certain activities, tend to be more fearful of falling, and ultimately decrease their activity level[6,15].

Active older adults are much more likely to fall outdoors due to environmental hazards because they are more often exposed to risky situations in their daily life activities[10,16-18]. It is assumed that active older adults have more confidence in their balance and skills in avoiding falls. In fact, men with higher physical activity levels, even those with good leg strength, have increased fall risk[8] and, among people with good physical abilities, the risk of recurrent falling was higher in those who participated in high-intensity activities[11].

There is a continuum along higher and lower levels of physical activity, but it is widely accepted that people who engage in fewer daily activities and/or tasks with low energy expenditure are less active than their counterparts who are involved in more demanding activities. There is a well-known downward spiral of physical function in older adults with lower activity levels that ultimately results in a heightened risk for loss of functional independence and falls[19]. However, the relationship between higher levels of physical activity and falls is not completely understood, particularly among more active older adults, whose falls are only explained by environmental and behavioral factors and are derived from studies focused on outdoor falls. Some studies with community-dwelling healthy older adults, who are supposedly more active, have suggested that certain subclinical characteristics, such as reduced executive function skills and increased gait variability, could also explain the increased fall risk in this group[12,20,21].

Indeed, despite these gaps in the literature, it is part of the physical therapist's daily routine in clinical practice with older adults to increase their physical activity level within their physical functioning capacity. In contrast, some studies revealed an increase in falls and injuries among an intervention group which was encouraged to become more physically active[22,23]. Therefore, clinical studies with a multifactorial approach that investigate the characteristics of fallers with different levels of physical activity could offer some insight for rehabilitation and preventive interventions in older adults. This study explored fall-related factors among older adults with different physical activity levels in an outpatient hospital setting.

Methods :::.

Study design

This is a cross-sectional, exploratory study.

Setting

The older adults were recruited from the geriatric outpatient clinic at the Geriatrics and Gerontology Department, Universidade Federal de São Paulo (UNIFESP), São Paulo, SP, Brazil, between January and August 2008 on the day of their appointment with a physician for a routine consultation.

Participants

A consecutive sample of patients aged 65 years and over, of both genders, who were waiting for their regular doctor's appointment and agreed to participate, was taken. The exclusion criteria followed the recommendations of Ferrucci et al.[24]: cognitive decline as measured by the Mini Mental State Examination (MMSE) adjusted for schooling, considering a cutoff of 17 points for illiterates, 22 points for those with 1 to 4 years of schooling, 23 for those with 5 to 8 years of schooling, and 26 for those with 9 years or more of schooling[25,26]; permanent or temporary walking impairment; severe limitations due to stroke or Parkinson's disease; severe sensory limitations; and treatment for cancer. This study was approved by the Ethics Committee of Universidade da Cidade de São Paulo (UNICID), São Paulo, SP, Brazil, protocol number 13363216, and a signed informed consent form was obtained from all participants.

Variables

Dependent variables

Two dependent variables were used to establish the groups of the study: fallers and non-fallers with low and fair physical activity level (considered the less active group) and fallers and non-fallers with average and above average physical activity level (considered the more active group). The variables were self-report of falls in the previous year and the activity level measured through the Human Activity Profile questionnaire. A fall was defined as "an unexpected event in which the person comes to rest on the ground, floor, or lower level"[27] and the older adults were considered fallers if they reported at least one fall in the last 12 months.

Physical activity was quantified with the Human Activity Profile (HAP)[28,29], which has been widely used in both clinical and healthy populations[30]. It assesses the participant's self-reported performance of 94 activities, ranging from tasks such as getting in and out of bed to running 3 miles, with higher scores representing greater physical activity. Each activity is based on estimated metabolic equivalents (METs), with each successive question representing a slightly higher MET level. Respondents are requested to indicate if (1) they are currently able to perform the activity (unassisted), (2) they have stopped performing the activity, or (3) they have never performed the activity. The adjusted activity score[6] was calculated and is reflective of an individual's typical daily physical activities. The adjusted activity score (AAS) is derived by subtracting the number of activities the participant is no longer able to perform from the value of the maximal activity score that represents the highest oxygen-demanding activity the participant is still able to perform. Correlation coefficients ranged from 0.79 to 0.97 for the AAS[30]. Participants were classified based on the AAS normative fitness values that determined whether an individual's aerobic fitness was low and fair or average and above average[31]. A score lower than 54 points was used to define the less active group (which corresponded to the low and fair activity level, based on a VO_2 max less than 17 ml/kg/minute) and scores of 54 points or higher defined the more active group (classified as average and above average activity level with a corresponding VO_2 max higher than 17 ml/kg/minute)[28].

Data sources and measurement

The data were collected in face-to-face interviews, in patient's medical records, and in physical assessments by trained research assistants. We chose to include a broad range of fall-related factors within a multidimensional approach (sociodemographic, clinical, cognitive, psychological, disability, and physical functioning variables)[12].

Physical health and clinical assessment

A complete medical history was recorded in a medical file including the presence of medical conditions and use of medication. As a measure of comorbidity, the presence of each medical condition was given one point from a list of twelve system-related conditions including cardiovascular, respiratory, musculoskeletal, endocrine, urogenital, oncological, neurological, and mental health diseases. This measure was used as an ordinal variable. Any current medication was recorded in the medical file, and the information was updated during the interview. The variable was categorized as "zero to four medications" and "five or more medications", which is considered polypharmacy[32]. Body mass index (BMI=kg/m²) was calculated after weight and height were recorded and used as a continuous variable. Frailty was determined according to Fried's phenotype[33]. The participants who fit three or more of the following criteria were classified as frail: a) *Unintentional weight loss in the last year* greater than 4.5 kg or 5% of body weight, adjusted for gender and BMI; b) *fatigue* indicated by "always" or "almost always" responses on any one of two items of the Center of Epidemiological Studies-Depression Scale (CES-D)[34]; c) *low grip strength* indicated by values below the first quintile of the sample, adjusted for gender and BMI; d) *low self-selected walking speed* indicated by values above the 80th percentile of time required to walk a 4.6m distance, adjusted for height and gender; e) *low energy expenditure* indicated by a weighted score of kilocalories expended per week below the first quintile of the sample, adjusted for gender.

Psychological and cognitive assessment

Depressive symptoms were assessed using the self-reported 15-item Geriatric Depression Scale (GDS-15) (range 0 to 15, used as an ordinal variable and the mean was ascertained) The GDS-15 was translated into Portuguese and culturally adapted and validated[35,36]. Concern about falling during 16 activities was assessed using the Falls Efficacy Scale-International (FES-I) in its culturally adapted version (range 16 to 64). Higher scores were indicative of more concern about falling or less perceived self-efficacy in avoiding falls[37]. Verbal fluency was measured by the maximal number of words belonging to the category "animal" that the participants were able to recall in one minute. The score is one point for each valid name, and it was used as a continuous variable. A higher number of animals is considered a better result. There is an influence of schooling and age, however

verbal fluency is generally considered an indication of mild cognitive decline, with a cutoff of 9 points[38,39].

Disability and physical functioning

Performance in activities of daily living (ADLs)[40] and instrumental activities of daily living (IADLs) was measured using a list of 15 activities of the OARS Multidimensional Functional Assessment Questionnaire[41]. We ascertained how many activities each participant performed with difficulty or with the need of assistance of others, and the total number of impaired activities was categorized as 0 to 3, 4 to 6, and 7 or more on an ordinal scale.

Physical performance was measured with the Timed Up and Go test (TUG)[40], the average handgrip strength (Kg/f) was measured in the dominant upper limb through with a dynamometer (SAEHAN® SH 5001) following the recommendations of the American Society of Hand Therapy[42], and the average self-selected walking speed (SSWS) which was measured in three trials on a 4.6m path, with 2 meters for acceleration and 2 meters for deceleration. The TUG was applied as follows: participants were asked to stand up from a standard arm chair, walk a distance of 3 m (marked on the floor) as fast and safely as possible, turn back, and sit down. Participants were permitted to use routine walking aids. No physical assistance was given, and the time to complete the task was measured with a stopwatch. Timing began at the word "go" and stopped when the participant's back was positioned against the back of the chair after sitting down. The task was performed once for familiarization and then on the second trial the time was collected. Shorter times indicate better performance. Some of the psychometric properties of the TUG among older adults have been reported previously and are considered adequate[43].

Statistical analysis

The differences in characteristics between fallers and non-fallers with low and fair activity level (less active) and between fallers and non-fallers with average and above average activity level (more active) were tested using the T Student test for normally distributed continuous variables, the Mann-Whitney test for skewed continuous variables, and chi-squared tests for dichotomous variables. The homogeneity and normality of the data were confirmed by the Levene and Kolmogorov-Smirnov tests, respectively. Stepwise logistic regression analysis was used to evaluate the association between falls and all independent variables in the more active and less active groups. Backward and forward procedures (p<0.05 to retain/include), conditional and likelihood ratios, and the Wald coefficient were used to identify the best subset of independent predictors, and the associations were expressed as odds ratio (OR) and 95%

confidence interval (95%CI). The models were adjusted according to -2Log likelihood, the Hosmer-Lemeshow test, and Nagelkerke's R^2 procedure. Any possible multicollinearity interactions observed were tested when there was a 10% increase in the value of β. P values were based on two-sided tests and were considered statistically significant at p<0.05. All analyses were conducted using SPSS software (SPSS Inc., Chicago, version 13.0).

Results ⋮⋮.

Among the 118 older adults studied, 44.1% (52) had not fallen in the previous year, 29.7% (35) reported one fall, and 26.3% (31) reported two or more falls. Regarding physical activity level, 35.6% (42) were classified as less active (low and fair activity level) and 64.4% (76) as more active (average and above average activity level). The mean age of the participants was 79.52 (SD 8.04) years and 76.3% (90) were women. The fall rate (at least one fall reported in the previous year) among the more active older adults (47.4%) was lower than that of the less active older adults (71.4%) (p<0.013).

Table 1 shows the descriptive statistics used to compare the characteristics of the groups. Among the less active participants, the fallers when compared with the non-fallers were significantly older, had more comorbidities, had lower physical activity level, used four or more medications more frequently, were more frail, had higher prevalence of disability, and a lower self-selected walking speed. Among the more active participants, the fallers only differed from the non-fallers with respect to the level of concern about falls, measured through the FES-I and the self-selected walking speed.

The model derived from the logistic multivariate analysis explains 69.7% of falls among the more active group. Table 2 shows that depressive symptoms (OR=0.747, 95%CI=0.575-0.970; p=0.029), fear of falls (OR=1.17, 95%CI=1.072-1.290; p=0.001) and self-selected gait walking speed (OR=0.030, 95%CI=0.004-0.244; p=0.001) were independently associated with falls in the more active group. The model was considered adequate (-2Log likelihood=88.167; Hosmer-Lemeshow X^2=4.867, Nagelkerke's R^2=0.270). The most important variable for predicting falls in this group was self-selected walking speed (higher absolute value for the β coefficient), followed by the GDS and the FES-I.

The model for the less active group (Table 3) explains 76.2% of falls and is composed of age (OR=1.197, 95%CI=1.032-1.387; p=0.017) and impairment in four to six ADLs/IADLs (OR=14.447, 95%CI=1.435-145.45; p=0.023). The model was considered adequately adjusted (-2Log likelihood=32.717; Nagelkerke's R^2=0.489). The most important variable for predicting falls in this group was disability in ADLs/IADLs.

Table 1. Demographic and clinical characteristics of less active and more active fallers and non-fallers.

Variable	Less Active (Low/fair activity level) N=42			More Active (Average/above activity level) N=76		
	Non-fallers N=12	Fallers N=30	p	Non-fallers N=40	Fallers N=36	p
Female gender (%)	22.9	77.1	0.088	56.4	43.6	0.316
Age (years), mean (SD)	77.6 (9.0)	86.6 (6.4)	0.001	75.6 (6.1)	78.5 (7.0)	0.058
Comorbidities, median (IR)	4.5 (4)	6.0 (2)	0.016	4.5 (3)	5.0 (2)	0.285*
BMI (kg/cm²), mean (SD)	27.4 (2.9)	27.3 (5.4)	0.656*	26.9 (4.3)	27.2 (4.3)	0.801
HAP (points), mean (SD)	46.7 (6.8)	36.1 (11.5)	0.001	72.6 (9.1)	71.0 (8.0)	0.450
Polypharmacy (%)	15.4	84.6	0.032	54.3	45.7	0.821
GDS (0-15), mean (SD)	5.6 (3.4)	5.3 (2.4)	0.742	3.3 (2.4)	2.8 (2.4)	0.385
FESI (16-64), mean (SD)	29.5 (10.3)	35.0 (9.7)	0.111	22.4 (4.7)	26.2 (6.9)	0.007*
Verbal fluency, mean (SD)	10.0 (2.7)	10.9 (3.1)	0.414	13.9 (3.7)	14.1 (5.5)	0.883
Frail (%)	16.1	83.9	0.006	40.0	60.0	0.663
ADLs/IADLs (%)						
0 - 3 activities	58.3	10.0	0.004	77.5	61.1	0.177
4 - 6 activities	16.7	33.3		17.5	36.1	
7 + activities	25.0	56.7		5.0	2.8	
TUG (s), mean (SD)	14.6 (6.0)	17.9 (5.0)	0.084	11.9 (2.6)	12.4 (2.7)	0.384
GS (Kg/f), mean (SD)	28.6 (18.4)	20.6 (13.1)	0.107*	38.6 (18.1)	34.0 (12.2)	0.205
SSWS (m/s), mean (SD)	0.78 (0.25)	0.63 (0.20)	0.043	0.92 (0.16)	0.85 (0.16)	0.048

BMI=Body mass index; HAP=Human Activity Profile; GDS=Geriatric Depression Scale; ADL=Activities of Daily Living; IADL=Instrumental Activities of Daily Living; TUG=Timed Up and Go test; FES-I=Falls Efficacy Scale - International; GS=Grip Strength; SSWS=Self-selected Walking Speed; SD=Standard Deviation; IR=Interquartile Range;* Mann-Whitney Test; significance level: α=0.05.

Table 2. Multivariate logistic regression analysis model for the More Active Group (N=76).

Variable	β coefficient	Estimated odds ratio	95%CI for odds ratio	p-value
GDS (0-15pts)	-0.292 (4.796)	0.747	0.575-0.970	0.029
FES-I (14-64pts)	0.162 (11.812)	1.176	1.072-1.290	0.001
SSWS (m/s)	-3.500 (10.786)	0.030	0.004-0.244	0.001

GDS=Geriatric Depression Scale; FESI=Falls Efficacy Scale-International; SSWS=Self-selected Walking Speed; significance level: α=0.05

Table 3. Multivariate logistic regression analysis model for the Less Active Group (N=42).

Variable	β coefficient	Estimated odds ratio	95%CI for odds ratio	p-value
ADLs/IADLs (1-3)	---			0.072
4-6 ADLs/IADLs	2.670 (1.178)	14.447	1.435-145.456	0.023
≥7 ADLs/IADLs	1.339 (1.079)	3.815	0.460-31.465	0.215
Age (years)	0.180 (0.075)	1.197	1.032-1.387	0.017
Constant	-15.181 (6.166)	--		0.014

ADLs=activities of daily living; IADLs=instrumental activities of daily living; significance level: α=0.05

Discussion ⁚⁚⁚.

The fall rate in the more active group was significantly lower than in the less active group, in accordance with a number of previous studies[17,44-46]. As expected, the less active fallers were significantly older and more frail, had a higher number of comorbidities, used more medications, had a lower physical activity level, were more severely disabled, and had a slower self-selected walking speed when compared with non-fallers[32,47]. A recent one-year prospective study[12] found a higher absolute fall risk (54%) in older adults with lower performance levels in balance-related physiological tests, in those with poorer executive function, and in those who did not participate in planned physical activities. The study also pointed out that mobility limitations,

depression, and pain increase the risk of falls, regardless of physiological performance.

Among the more active participants, fallers were significantly more concerned with falls and also had reduced usual gait speed. These findings suggest that, even among active older adults, falls can insidiously compromise self-efficacy[48] and, in turn, fear of falling may cause hesitancy and a shifted control of balance from a fast to a slow mode of control[15].

The multivariate regression model for the less active group showed an independent association between falls and age and functional disability. The strength of association between falls and disability in four to six ADLs/IADLs compared with the older adults with impairment in three or fewer activities was 14.45. The OR was not significant among the participants with seven or more impaired activities when the age effect was adjusted. With each

additional year of age, an individual's chances of being part of the faller group were 1.19. These findings demonstrate that there is an association between physical inactivity, advancing age, functional disability, and falls. There is a well-known decline in physical functioning with age[49]. Additionally, older adults tend to decrease their physical activity level over the years[14]. This interaction between age, decreased physical function, and inactivity ultimately results in a heightened risk for decreased functional independence, declining health, and increased risk of falls[32,50].

Among the more active participants, the odds of having fallen in the previous year were 0.747 with each GDS point, suggesting that older adult patients with more depressive symptoms may be less prone to falling. Additionally, the odds of having fallen in the previous year were 1.17 for each point of the FES-I score and, with each 0.10 m/s unit of gait speed, the odds of having fallen in the previous year were 0.030.

As previously discussed, some studies have shown that a fear of falling is associated with falls[6,51] and a perceived decrease in the ability to avoid falls can lead to protective behavior, such as reducing usual gait speed or withdrawing from demanding situations in order to remain in control of balance[15]. Maki[52] demonstrated that fear of falling is associated with a decreased stride length, decreased gait speed, increased double stance time, and increased stride width. In a prospective study of 597 older participants with a mean age of 80.5 (SD 5.4) years, Verghese et al.[21] established that every 0.10 m/s decrease in gait speed was associated with a 7% increased risk of falls. A moderate meaningful detectable change from 0.10 to 0.14 m/s was identified based on effect size using three data sets of older adults[53].

Friedman et al.[48] emphasized that the fear of falling is not just an acute outcome that results from a fall but a likely recognition of risk and that, once fear of falling develops, it is very likely to persist regardless of whether a fall occurs. This self-perceived low efficacy can reduce gait speed, creating more cautious behavior in daily movements that is not immediately detectable. Cumming et al.[54] demonstrated that older adult patients with higher FES-I scores were twice as likely to fall in the subsequent year than those with lower FES-I scores, which supports our findings.

In our study, we identified an association between falls and depression in more active older adults. Interestingly, those with more depressive symptoms were less likely to have experienced a fall in the previous year. These findings suggest that, among more active older adults, the presence of depressive symptoms and not depression itself could play some role in fall protection. Generally, older adults with mood disorders tend to be poorly motivated and show a lack of interest in social activities. This isolation tends to reduce their exposure to activities outside the home, especially leisure and sports activities, which in turn may reduce the risk of falls[55]. Some studies have stressed the relationship between depression and falls, but the medications used to treat depression may be the most important risk factor. Common adverse effects, such as unsteadiness, impaired alertness, and dizziness are risk factors for falling[32]. However, this interaction between mood and falls in active participants has not been thoroughly explored and was not investigated in our study.

There are limitations that may have affected the results of our study. First, we used a small convenience sample, which can limit generalizations. The cross-sectional design did not allow us to establish any causality between particular variables and falls and activity level, and some recall bias may have occurred. Due to the sample size, some coefficient intervals in logistic regression may have been overestimated. We also failed to explore the level of exposure to different activities, such as leisure, occupational, household or sports activities. Regarding the study's strength, we can report that its participants were derived from an outpatient setting in a large hospital so that our findings are important for physical therapists in clinical practice. These results may help healthcare professionals recognize different fall-risk profiles for more active and less active groups of patients.

In conclusion, fall-related factors differ according to physical activity level in older outpatients. The association between falls and reduced self-efficacy in the more active older adults suggests that falling can trigger some protective behavior, such as a slower gait speed and depressive symptoms, but the casual link between falls and these outcomes should be further investigated. These data emphasize that physical therapists should be aware that there are differences in fall-related factors depending on the patient's physical activity level, and this must be considered when planning interventions for older patients.

References

1. Stevens JA, Corso PS, Finkelstein EA, Miller TR. The costs of fatal and non-fatal falls among older adults. Inj Prev. 2006;12(5):290-5.

2. Roudsari BS, Ebel BE, Corso PS, Molinari NA, Koepsell TD. The acute medical care costs of fall-related injuries among the U.S. older adults. Injury. 2005;36(11):1316-22.

3. King MB, Tinetti ME. Falls in community-dwelling older persons. J Am Geriatr Soc. 1995;43(10):1146-54.

4. O'Loughlin JL, Robitaille Y, Boivin JF, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. Am J Epidemiol. 1993;137(3):342-54.

5. Stel VS, Pluijm SM, Deeg DJ, Smit JH, Bouter LM, Lips P. A classification tree for predicting recurrent falling in community-dwelling older persons. J Am Geriatr Soc. 2003;51(10):1356-64.

6. Zijlstra GA, van Haastregt JC, van Eijk JT, van Rossum E, Stalenhoef PA, Kempen GI. Prevalence

and correlates of fear of falling, and associated avoidance of activity in the general population of community-living older people. Age Ageing. 2007;36(3):304-9.

7. Rubenstein LZ, Josephson KR. The epidemiology of falls and syncope. Clin Geriatr Med. 2002;18(2):141-58.

8. Chan BK, Marshall LM, Winters KM, Faulkner KA, Schwartz AV, Orwoll ES. Incident fall risk and physical activity and physical performance among older men: the Osteoporotic Fractures in Men Study. Am J Epidemiol. 2007;165(6):696-703.

9. Peeters GM, van Schoor NM, Pluijm SM, Deeg DJ, Lips P. Is there a U-shaped association between physical activity and falling in older persons? Osteoporos Int. 2009;21(7):1189-95.

10. Wijlhuizen GJ, Chorus AM, Hopman-Rock M. The 24-h distribution of falls and person-hours of physical activity in the home are strongly associated among community-dwelling older persons. Prev Med. 2008;46(6):605-8.

11. Peeters GM, Verweij LM, van Schoor NM, Pijnappels M, Pluijm SM, Visser M, et al. Which types of activities are associated with risk of recurrent falling in older persons? J Gerontol A Biol Sci Med Sci. 2010;65(7):743-50.

12. Delbaere K, Close JC, Heim J, Sachdev PS, Brodaty H, Slavin MJ, et al. A multifactorial approach to understanding fall risk in older people. J Am Geriatr Soc. 2010;58(9):1679-85.

13. Wijlhuizen GJ, de Jong R, Hopman-Rock M. Older persons afraid of falling reduce physical activity to prevent outdoor falls. Prev Med. 2007;44(3):260-4.

14. Ferreira MT, Matsudo SM, Ribeiro MC, Ramos LR. Health-related factors correlate with behavior trends in physical activity level in old age: longitudinal results from a population in Sao Paulo, Brazil. BMC Public Health. 2010;10:690.

15. Wijlhuizen GJ, Chorus AM, Hopman-Rock M. Fragility, fear of falling, physical activity and falls among older persons: some theoretical considerations to interpret mediation. Prev Med. 2008;46(6):612-4.

16. Li W, Keegan TH, Sternfeld B, Sidney S, Quesenberry CP Jr, Kelsey JL. Outdoor falls among middle-aged and older adults: a neglected public health problem. Am J Public Health. 2006;96(7):1192-200.

17. Ribom EL, Grundberg E, Mallmin H, Ohlsson C, Lorenzon M, Orwoll E, et al. Estimation of physical performance and measurements of habitual physical activity may capture men with high risk to fall--data from the Mr Os Sweden cohort. Arch Gerontol Geriatr. 2009;49(1):e72-6.

18. Wijlhuizen GJ, Chorus AM, Hopman-Rock M. The FARE: a new way to express falls risk among older persons including physical activity as a measure of exposure. Prev Med. 2010;50(3):143-7.

19. Rose DJ. Preventing falls among older adults: no "one size suits all" intervention strategy. J Rehabil Res Dev. 2008;45(8):1153-66.

20. Rosano C, Brach J, Studenski S, Longstreth WT Jr, Newman AB. Gait variability is associated with subclinical brain vascular abnormalities in high-functioning older adults. Neuroepidemiology. 2007;29(3-4):193-200.

21. Verghese J, Holtzer R, Lipton RB, Wang C. Quantitative gait markers and incident fall risk in older adults. J Gerontol A Biol Sci Med Sci. 2009;64(8):896-901.

22. Lawton BA, Rose SB, Raina Elley C, Dowell AC, Fenton A, Moyes SA. Exercise on prescription for women aged 40-74 recruited through primary care: two year randomised controlled trial. Br J Sports Med. 2009;43(2):120-3.

23. Ebrahim S, Thompson PW, Baskaran V, Evans K. Randomized placebo-controlled trial of brisk walking in the prevention of postmenopausal osteoporosis. Age Ageing. 1997;26(4):253-60.

24. Ferrucci L, Guralnik JM, Studenski S, Fried LP, Cutler GB Jr, Walston JD, et al. Designing randomized, controlled trials aimed at preventing or delaying functional decline and disability in frail, older persons: a consensus report. J Am Geriatr Soc. 2004;52(4):625-34.

25. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12(3):189-98.

26. Brucki SM, Nitrini R, Caramelli P, Bertolucci PH, Okamoto IH. [Suggestions for utilization of the mini-mental state examination in Brazil]. Arq Neuropsiquiatr. 2003;61(3B):777-81.

27. Lamb SE, Jørstad-Stein EC, Hauer K, Becker C; Prevention of Falls Network Europe and Outcomes Consensus Group.. Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe consensus. J Am Geriatr Soc. 2005;53(9):1618-22.

28. Souza AC, Magalhaes Lde C, Teixeira-Salmela LF. [Cross-cultural adaptation and analysis of the psychometric properties in the Brazilian version of the Human Activity Profile]. Cad Saúde Pública. 2006;22(12):2623-36.

29. Daughton DM, Fix AJ, Kass I, Bell CW, Patil KD. Maximum oxygen consumption and the ADAPT quality-of-life scale. Arch Phys Med Rehabil. 1982;63(12):620-2.

30. Davidson M, de Morton N. A systematic review of the Human Activity Profile. Clin Rehabil. 2007;21(2):151-62.

31. Bilek LD, Venema DM, Willett GM, Lyden ER. Use of the Human Activity Profile for estimating fitness in persons with arthritis. Arthritis Rheum. 2008;59(5):659-64.

32. Tinetti ME, Kumar C. The patient who falls: "It's always a trade-off". JAMA. 2010;303(3):258-66.

33. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;56(3):M146-56.

34. Batistoni SS, Neri AL, Cupertino AP. [Validity of the Center for Epidemiological Studies Depression Scale among Brazilian elderly]. Rev Saúde Pública. 2007;41(4):598-605.

35. Sheikh JI, Yesavage JA. Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. Clin Gerontol. 1986;5:165-73.

36. Paradela EM, Lourenço RA, Veras RP. [Validation of geriatric depression scale in a general outpatient clinic]. Rev Saude Publica. 2005;39(6):918-23.

37. Camargos FFO, Dias RC, Dias JMD, Freire MTF. Cross-cultural adaptation and evaluation of the psychometric properties of the Falls Efficacy Scale-International Among Elderly Brazilians (FES-I-BRAZIL). Rev Bras Fisioter. 2010;14(3):237-43.

38. Sosa AL, Albanese E, Prince M, Acosta D, Ferri CP, Guerra M, et al. Population normative data for the 10/66 Dementia Research Group cognitive test battery from Latin America, India and China: a cross-sectional survey. BMC Neurol. 2009;9:48.

39. Murphy KJ, Rich JB, Troyer AK. Verbal fluency patterns in amnestic mild cognitive impairment are characteristic of Alzheimer's type dementia. J Int Neuropsychol Soc. 2006;12(4):570-4.

40. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142-8.

41. Ramos LR. [Determinant factors for healthy aging among senior citizens in a large city: the Epidoso Project in Sao Paulo]. Cad Saúde Pública. 2003;19(3):793-8.

42. Crosby CA, Wehbe MA, Mawr B. Hand strength: normative values. J Hand Surg Am. 1994;19(4):665-70.

43. Herman T, Giladi N, Hausdorff JM. Properties of the 'timed up and go' test: more than meets the eye. Gerontology. 2011;57(3):203-10.

44. Heesch KC, Byles JE, Brown WJ. Prospective association between physical activity and falls in community-dwelling older women. J Epidemiol Community Health. 2008;62(5):421-6.

45. Mertz KJ, Lee DC, Sui X, Powell KE, Blair SN. Falls among adults: the association of cardiorespiratory fitness and physical activity with walking-related falls. Am J Prev Med. 2010;39(1):15-24.

46. Karlsson MK, Nordqvist A, Karlsson C. Physical activity, muscle function, falls and fractures. Food Nutr Res. 2008;52.

47. Speechley M. Unintentional falls in older adults: a methodological historical review. Can J Aging. 2011:1-12.

48. Friedman SM, Munoz B, West SK, Rubin GS, Fried LP. Falls and fear of falling: which comes first? A longitudinal prediction model suggests strategies for primary and secondary prevention. J Am Geriatr Soc. 2002;50(8):1329-35.

49. Hebert R. Functional decline in old age. CMAJ. 1997;157(8):1037-45.

50. Kannus P, Sievänen H, Palvanen M, Järvinen T, Parkkari J. Prevention of falls and consequent injuries in elderly people. Lancet. 2005;366(9500):1885-93.

51. Wong CH, Weiss D, Sourial N, Karunananthan S, Quail JM, Wolfson C, et al. Frailty and its association with disability and comorbidity in a community-dwelling sample of seniors in Montreal: a cross-sectional study. Aging Clin Exp Res. 2010;22(1):54-62.

52. Maki BE. Gait changes in older adults: predictors of falls or indicators of fear. J Am Geriatr Soc. 1997;45(3):313-20.

53. Perera S, Mody SH, Woodman RC, Studenski SA. Meaningful change and responsiveness in common physical performance measures in older adults. J Am Geriatr Soc. 2006;54(5):743-9.

54. Cumming RG, Salkeld G, Thomas M, Szonyi G. Prospective study of the impact of fear of falling on activities of daily living, SF-36 scores, and nursing home admission. J Gerontol A Biol Sci Med Sci. 2000;55(5):M299-305.

55. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: the challenges ahead. Lancet. 2009;374(9696):1196-208.