DOI: 10.1590/1413-81232018241.35472016

Recurrent falls and risk factors among institutionalized older people

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Abstract *Recurrent falls constitute a high risk for morbidity and mortality among older people, especially institutionalized individuals, due to greater frailty and functional decline in this group. The aim of this study was to identify risk factors associated with recurrent falls among institutionalized older persons. A longitudinal cohort study was conducted over a one-year period with a study sample consisting of individuals aged 60 years and over living in 10 Nursing homes (NH) who were able to walk and had preserved cognitive ability. The older persons and carers were asked about the occurrence of falls over the last twelve months. The older persons were considered recurrent fallers if they had had two or more falls during this period. Institutional, sociodemographic and health data was also collected using questionnaires and the residents' medical records. One hundred and thirty individuals were included in the sample out of a total of 364 older people living in the NH. The incidence of recurrent falls was 26.9% (CI95% = 22.4 - 31.5). The results of the chi-square test and logistic regression adopting a significance level of 0.05 showed that fatigue was a risk factor for recurrent falls($p = 0.001$; $RR = 2.9$) and that the use of beta blockers was a protective factor ($p = 0.010$; $RR = 0.1$). It was concluded that recurrent falls are common in NH and that fatigue constitutes an important risk factor.*

Key words *Older persons, Accidental falls, Risk, Incidence, Nursing homes*

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Introduction

Falls among older persons are considered a geriatric syndrome because of their multiple causes and risk factors. Studies have reported that between 30% of community-dwelling older adults fall each year and that 40% experience recurrent falls[1,2]. The incidence among older persons living in Nursing homes (NH) is higher, reaching around 40%[1], while between 13 and 66%[3,4] become recurrent fallers. This difference in incidence can be explained by the frailer nature and greater functional dependency of institutionalized older persons, who are more biologically susceptible to the accumulated affects of disease and/or the use of medications, leading to muscular weakness, confusion, and dizziness[5].

Falls are a serious problem among this age group because they can cause considerable injury, disability, and death. The social cost of this problem is high, particularly when falls result in loss of autonomy and independence[6]. Therefore, the greater the number of falls, the greater the disability and dependence.

Falls and fall related injuries are major public health challenges. The more falls an older person has, the more likely he/she is to suffer serious injury and long-term consequences. Consequently, the identification of risk factors for recurrent falls among institutionalized older persons is an essential step in developing effective fall prevention measures and reducing public spending on admission to nursing homes and rehabilitation. In light of the above, this study aimed to determine the incidence of recurrent falls and associated risk factors among institutionalized older persons.

Method

A cohort study was conducted following the recommendations of the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) and approved by the local Research Ethics Committee.

The study was undertaken in 10 of the 13 NH (76,9%) registered by the health and safety department in Natal, in the State of Rio Grande do Norte, Brazil, with a total of 364 residents. Of the 10 institutions that agreed to participate, five were private and five were run by charities. The participants were older persons aged 60 years and over admitted to the NH at the time of data collection and who agreed to participate in the study. The assessment was carried out in three waves: October and November 2014; April and May 2015; and October 2015.

The following inclusion criteria were adopted: ability to walk (aided or unaided); and a Short Portable Mental Status Questionnaire (SPMSQ or Pfeiffer's Questionnaire)[7] score of at least nine. The following exclusion criteria were adopted, as recommended by Ferruccie et al.[8]: (a) presence of memory, attention, spatial and temporal orientation, and communication problems suggestive of severe cognitive impairment; (b) permanent or temporary walking disability, allowing the use of a walking stick or walker, but not a wheelchair; (c) localized loss of strength and aphasia caused a severe stroke; (d) severely impaired motricity, speech or affectivity, associated with advanced or fluctuating Parkinson's disease; (e) vision or hearing impairments, considerably hindering communication; and (f) older persons in the terminal phase. In addition to these criteria, people of other nationalities who could not speak Portuguese were excluded from the sample. The sample selection process is shown in Figure 1.

The following baseline data was collected and recorded on a questionnaire: information about the institutions – type of organization (private/nonprofit), elderly person-to-caregiver ratio, and length of stay; sociodemographic data – age, sex, color, marital status, level of schooling, and number of children, obtained from the patients' records; and anthropometric data, obtained from a physical examination to assess frailty and calculate Body Mass Index (BMI)[9].

Frailty was classified according to physical condition based on the following criteria: severe cognitive decline and/or unable to walk independently[10]; or, for participants with preserved cognitive ability and able to walk independently, the frailty criteria proposed by Fried et al.[11].

Weight was measured using a Balmak® electronic scale with a capacity of 300 kg and 50g accuracy, while height was taken using a Caumaq® portable stadiometer with precision to 1.0 mm and non-slip base. BMI (body weight in kilograms divided by height in meters squared) was classified according to the SISVAN (*Sistema de Vigilância Alimentar e Nutricional* or Food and Nutrition Surveillance System) protocol[9] for older persons: underweight – BMI < 22 kg/m^2; normal weight –BMI ≥ 22 kg/m^2 and < 27 kg/m^2; and overweight – BMI ≥ 27 kg/m^2.

Additional data was also collected in each wave as follows: Data on long-term medications (taken daily for over 30 consecutive days) and

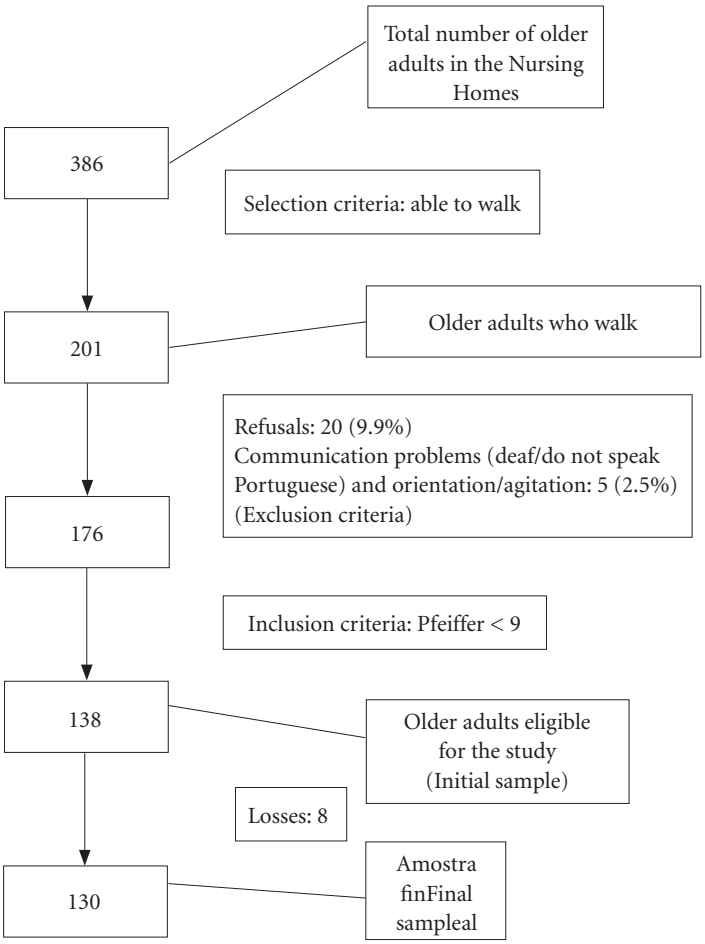

Figure 1. Flowchart showing the sample selection process. Natal, Brazil, 2016.

chronic diseases – classified according to the Anatomical Therapeutic Chemical Classification System[12] and International Classification of Diseases, 10th Edition (ICD-10)[13], respectively, obtained from the patients' medical records. Patient physical and mental health-related data, obtained directly from the participants using the following validated instruments: depression - the Geriatric Depression Scale(GDS)[14,15]; daytime sleepiness – the Epworth Sleepiness Scale(ESS)[16]; fatigue– two questions from the Center for Epidemiological Studies-Depression Scale (CES-D)[17]; cognitive level- Pfeiffer's Questionnaire[7]; dizziness in the last year – question elaborated by the authors. Data used to assess functional independence obtained from the Barthel Index[18] administered to the participants' carers. In the last wave, data regarding the occurrence of falls was obtained by asking the carers and older persons and from active searches of the nursing incident recordsin order to reduce memory bias. Patients were considered recurrent fallers if they had had two or more falls during the 12-month assessment period[3,19].

After data collection the following variables were categorized into means: age, number of children, length of stay, elderly person-to-caregiver ratio, number of medications, number of diseases. The presence of a decline in mobility was classified as a deterioration of mobility over the three waves from walking unaided to a greater level of impairment, such as aided walking, wheelchair or bedbound, while cognitive decline was classified as a deterioration of cognitive status as measured by Pfeiffer's Questionnaire[7], from being cognitively intact to mild, moderate, or severe cognitive impairment.

McNemar's test was performed on the variables explored in the three waves to determine whether there was a variation in status over time. For variables that showed no change, the data was standardized using the baseline data. When there was difference, the data was standardized using the data that showed the highest relative risk. The incidence of recurrent falls in a year was calculated. Bivariate analysis was conducted using the chi-square test or Fisher's exact test. Multivariate analysis was performed initially to test for collinearity using the variance inflation factor (VIF) and then to test for confirmation using the chi-square test, excluding variables with a p-value of < 0.001. The variables were then ranked according to significance and those with a p-value of ≤ 0.20 were included in the final model. Forward stepwise regression was then conducted with residual analysis adopting a significance level of 0.05.

Results

Of the 130 older persons assessed under this study, the majority (62.3%) lived in nonprofit NH, were women (73.1%), had a low level of schooling (28.5% had completed the first stage of primary education and 20.8% were illiterate, meaning that almost half the participants had little schooling), single (45.4%), and did not have children (50.4%). Half of the sample were aged up to 79 years and had lived in the institution for up to 33 months.

Seventeen (13.1%) of the 130 individuals had suffered recurrent falls (at least two episodes) in the year prior to the study baseline.

With respect to fall incidence, 62 participants (47.7%; CI 95% = 39.6-55.8) had suffered a fall and 35 (26.9%. CI 95% = 22.4 – 31.5) had suffered recurrent falls during the assessment period, meaning that over half the group (56.4%) that fell during the twelve month period had more than one fall.

The majority of recurrent fallers were women (68.6%), belonged to nonprofit NH (65.7%), had an average age of 79.2 years (SD: $\pm$ 7,4), had been staying in the institution for an average of 60.1 months (SD: $\pm$ 67.9), and lived in a NH whose elderly person-to-caregiver ratio was 7.38 (SD: $\pm$ 3.8). The average number of falls among recurrent fallers was 5.34 ($\pm$ 15.8). The most common location of fall for recurrent fallers was the bedroom (31.4% fell just in the bedroom and 11.5% fell in the bedroom and other places), followed by the corridor and bathroom (Figure 2).

With respect to health-related variables, differences were observed between those who did not fall, fell only once, and recurrent fallers with the variables urinary incontinence (incidence of falls was lowest among those who did not have urinary incontinence) and decline in mobility (incidence of falls was lowest among those who had suffered a decline in mobility) (Table 1).

The results of the multiple regression analysis showed that fatigue was a risk factor for recurrent falls and that the use of beta blockers was a protective factor when adjusted for the use of antithrombotic medications (Table 2). Fatigue was associated with a 190% increased risk of recurrent falls, while the use of beta blockers constitutes 90% protection.

The parameters used to test for goodness of fit of the logistic regression model were the Hosmerand Lemeshow test ($p = 0.991$), variance of the Cox and Snell R-square and Nagelkerke R-square between 0.207 and 0.299, the omnibus test ($p < 0.001$), and initial and final model correction factors of 70.4% and 77.0%, respectively.

Discussion

The findings reveal that over half of the study participants that fell had at least two falls within a year, showing that the incidence of recurrent falls was high. An incidence rate of 26.9% is consistent with the findings of other studies with older persons living in NH, which have reported rates of between 33%[20] and 65%[21]. The incidence of recurrent falls is significantly higher among institutionalized older persons when compared to rates for community-dwelling older adults reported by Perracini and Ramos (between 10% and 12%)[22], Swanenburg et al.[23] (11%), and Ranaweera et al. (14.5%)[24], illustrating the precarious health of older persons and facilities in NH.

Studies suggest that falls in NH are more frequent in the bedroom[25] close to the bed, probably in the act of getting up due to the loss of balance or postural hypotension. Other explanations for the high frequency of falls in the bedroom is the lack of adequate facilities in many institutions, including the lack of non-slip flooring, grab bars, and adequate lighting. According to an international study conducted in NH, fall incidence is greatest in the bedroom, with the bedroom and bathroom together accounting for 75% of all locations of fall[26], corroborating the findings of the present study, which showed that the majority of recurrent falls occur in the bedroom.

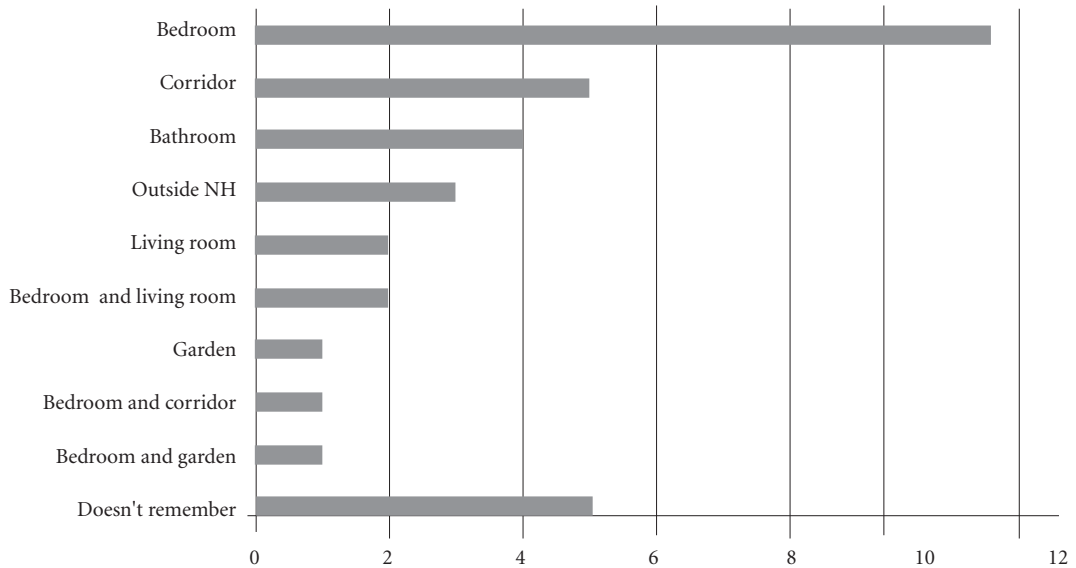

Figure 2. Location of recurrent falls in Nursing homes (NH) in Natal, Brazil, 2016.

Besides environmental factors, various health-related factors have also been shown to be risk factors[4]. With regard to urinary incontinence for example, shown to be a risk factor by this study, people suffering from this condition go to the bathroom more often, increasing the likelihood of falling, particularly at night when lighting is more precarious and vision is impaired.

Decline in mobility on the other hand was shown to be a protective factor because wheelchair or bed bound individuals walk less and are therefore less likely to fall. Most of the studies found an association between mobility impairment and decline in functional capacity, due to loss of physical fitness, muscular atrophy, balance disorder, and dependence in activities of daily living[27].

The findings show that fatigue was an important risk factor for recurrent falls and that the use of beta blockers was an important protective factor. Older persons are more susceptible to muscle fatigue due to decreased muscle strength and sarcopenia. It has been shown that[28] fatigue leads to greater postural oscillation, decreased obstacle negotiation ability, and an increased risk of falling among older persons. Furthermore, some authors have suggested that fatigue should no longer be considered a physical event but rather a sensation or emotion resulting from the interaction between the above aspects and cognitive factors[29,30] explained by the central governor model[31], in which the regulation of the activity of motor neurons that innervate skeletal muscle fibers to maintain homeostasis by central nervous system is predominantly emotional. Other factors associated with fatigue among older persons include low level of life satisfaction and high stress levels[32].

Fatigue was assessed using two of the items from the CES-D according to the frailty criteria proposed by Fried et al.[11], identifying aspects related to mood changes, anxiety, and depression, which can restrict activity due to the fear of falling[33]. While other studies have reported fatigue to be a significant risk factor for falling, with odds ratios ranging between 2.0[5] and 2.12[34], the present study showed it to be a significant risk factor for recurrent falls (OR = 2.89).

In contrast, certain medications have been reported to be protective factors because they prevent or delay the onset of complications of serious diseases or inhibit signs and symptoms that can lead to falls. The present study showed that older persons who used beta blockers where 0.91 times less likely to be recurrent fallers than those who did not use them. Cardiovascular diseases are a major cause of events that lead to falls and therefore the use of medications that protect

Table 1. Physical and mental health characteristics of the institutionalized older persons by fall group. Natal, Brazil, 2016.

Variable	Recurrent fall	Single fall	No fall	p
Previous fall				0.351
Yes	08 (23.5%)	10 (29.4%)	16 (47.1%)	
No	27 (28.1%)	17 (17.7%)	52 (54.2%)	
Frailty				0.535
Yes	20 (31.2%)	13 (20.3%)	31 (48.4%)	
No	15 (22.7%)	14 (21.2%)	37 (56.1%)	
Overweight				0.716
Yes	12 (24.0%)	12 (24.0%)	26 (52.0%)	
No	23 (29.5%)	15 (19.2%)	40 (51.3%)	
Decline in mobility				0.025*
Yes	25 (24.8%)	17 (16.8%)	59 (58.4%)	
No	10 (34.5%)	10 (34.5%)	09 (31.0%)	
Cognitive decline				0.403
Yes	25 (26.9%)	22 (23.7%)	46 (49.5%)	
No	10 (27.0%)	05 (13.5%)	22 (59.5%)	
Daily sleepiness				0.965
Yes	09 (30.0%)	07 (23.3%)	14 (46.7%)	
No	25 (30.9%)	17 (21.0%)	39 (48.1%)	
Symptoms of depression				0.645
Yes	14 (35.0%)	07 (17.5%)	19 (47.5%)	
No	20 (28.6%)	17 (24.3%)	33 (47.1%)	
Fatigue				0.408
Yes	19 (33.9%)	14 (25.0%)	23 (41.1%)	
No	15 (27.8%)	10 (18.5%)	29 (53.7%)	
Number of diseases> 4				0.884
Yes	11 (29.7%)	07 (18.9%)	19 (51.4%)	
No	24 (25.8%)	20 (21.5%)	49 (52.7%)	
Number of medications>5				0.711
Yes	21 (28.0%)	17 (22.7%)	37 (49.3%)	
No	14 (25.5%)	10 (18.2%)	31 (56.4%)	
Functional dependence				0.051
Yes	25 (32.1%)	19 (24.4%)	34 (43.6%)	
No	10 (19.2%)	08 (15.4%)	34 (65.4%)	
Urinary incontinence				0.002*
Yes	13 (32.5%)	14 (35.0%)	13 (32.5%)	
No	17 (22.1%)	10 (13.0%)	50 (64.9%)	
Dizziness				0.136
Yes	15 (40.5%)	08 (21.6%)	14 (37.8%)	
No	15 (25.0%)	10 (16.7%)	35 (58.3%)	

*p <0,05.

Table 2. Risk factors for recurrent falls. Natal, Brazil, 2016.

Variable	Category	Fall yes	Fall no	p*	RR (IC 95%)*	p**	Adjusted RR (CI95%) **
Fatigue	Yes	21 (42.0%)	29(58.1%)	0.010	2.1	0.001	2.9
	No	13 (20.0%)	52 (80.0%)		(1.2-3.8)		(1.6-5.3)
Beta blockers	Yes	03 (10.3%)	26 (89.7%)	0.022	0.3	0.010	0.1
	No	32 (31.7%)	69 (68.3%)		(0.1-0.9)		(0.0-0.5)

* Chi-square or Fisher's exact test; **Logistic regression; RR: Relative risk. Adjusted for the use of antithrombotic medications.

against these events can help fall prevention. Beta blockers have a wide range of indications, including hypertension, angina, arrhythmia, and heart disease[35], and when properly used can be beneficial to fall prevention.

Study limitations include possible memory bias related to the question about the presence of falls and place of occurrence and calibration bias in relation to the possible under-reporting of chronic diseases in medical records. Despite these limitations, this study produced consistent results that provide a comprehensive insight into the factors associated with a common event that causes considerable mortality and morbidity among older persons. Furthermore, the fact that the study encompassed the vast majority of NH in Natal increases its reliability and external validity, given the representativeness of the sample.

Conclusion

Recurrent falls were a common event in the NH that participated in this study. A little over one-quarter of the institutionalized older persons had fallen more than once in one year and fatigue was identified as the main risk factor.

In view of these findings, greater supervision of older persons NH who have already had a fall is required, given the risk of recurrent falls. Continuing training should be provided to health professionals and carers on how to identify older persons at risk and more likely to have recurrent falls. Furthermore, support should be given to older persons who have had a fall, including information and advice on risks and fall prevention, the provision of walking aids, and promotion of global muscle strengthening exercises.

Measures should also be introduced to prevent fatigue, the main risk factor for recurrent falls, with the promotion of multidisciplinary activities involving body and psychotherapy. The presence of fatigue should be promptly identified and treated using rehabilitation exercises to avoid recurrent falls.

Finally, the findings of this study can be used to stimulate discussion in the realms of public health, drawing attention to the risks and consequences of recurrent falls and the importance of identifying elderly fallers and early interventions to prevent recurrence and minimize admission and treatment costs.

Further research with larger samples should be undertaken to identify other risk factors and provide inputs to inform preventative measures. Furthermore, comparative studies should be conducted to identify similarities and differences between community-dwelling and institutionalized older adults and between private and non-profit NH to identify specific risk factors.

Collaborations

LMBM Ferreira, J Jerez-Roig and JRT Araújo participated in all stages of data collection and analysis and in drafting and revising this article. KMOBF Ribeiro participated in the literature review, selection of articles, and critical revision of this article. KC Lima supervised the article proposal and statistical analysis, participated in data interpretation, drafting this article, and in the critical revision of this article.

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Article submitted 10/10/2016
Approved 09/02/2017
Final version submitted 11/02/2017

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