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Factors associated with recurrent falls in a cohort of older adults

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Abstract Objective: *To analyze the factors associated with recurrent falls in community-dwelling older adults from Cuiabá.* Methods: *This is an epidemiological, prospective, concurrent cohort study with a two-year follow-up. In-home surveys were conducted in 2012 and 2013. The data were treated by the software Epi Info and SPSS. Bivariate analysis investigated associations between risk factors and recurrent falls by calculating the relative risk (RR) of the cumulative incidences with a confidence interval of 95% (95%CI). Multiple analysis with Poisson regression included all variables with $p < 0.20$ in the crude analyses. The significance level of 5% ($p < 0.05$) was adopted as significant association for remaining in the final model.* Results: *Most older adults (77.6%) had recurrent falls. The variables significantly associated with recurrent falls were older adult's income of up to two minimum salaries (RR = 1.62; 95%CI 1.04-1.77), absence of arthritis or arthrosis (RR = 1.32; 95%CI 1.10-1.48), having regular to very bad self-perceived health (RR = 1.44; 95%CI 1.12-2.04), and having visual impairment (RR = 1.23; 95%CI 1.01 -1.69).* Conclusions: *Falls in older adults are associated with low education levels, regular to very bad self-perceived health, visual impairment, and recurrent falls.*

Key words *Accidents by falls, Older adults, Risk factors*

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Introduction

Falls are a serious public health problem with direct implications on the quality of life and well-being of older adults[1,2]. The risk of falls increases significantly with age, making this geriatric syndrome one of the great public health problems because of its high incidence, morbidity, and mortality, and the social and economic costs of the consequent injuries[3-5]. Roughly 30% of community-dwelling adults fall yearly, 50% of these have recurrent falls, and this proportion increases between 32% and 42% in individuals aged more than 70 years[1].

Fall is defined as a nonintentional dropping to a lower level without possibility of correction in due time and determined by multifactorial circumstances that compromise stability[6]. These circumstances stem from intrinsic and extrinsic factors. Intrinsic factors include age-related physiological changes; poor balance and gait; visual and auditory impairment; and presence of diseases. The extrinsic factors include environmental risks, such as poor lighting and slippery floor; risk behaviors, such as climbing chairs or ladders; and behaviors related to activities of daily living[2,6]. However, most falls result from the interaction of all these factors.

Falls have significant consequences because of the vulnerability of older adults in addition to the factors cited above, such as: less mobility and functionality, higher disease susceptibility, bruising, contusions, fractures, institutionalization, fear of falling again, and repercussion on the lives of family members. Moreover, there is evidence of a strong association between mortality in older adults who experienced falls and fall-related injuries, since these are long lasting, even after treatment[3,7-10].

In 2011 in Brazil there were 373,105 fall-related hospitalizations in the Unified Healthcare System (SUS). Women aged 60 years or more fall more than men in the same age group, with fall rates of 43.6 per 10 thousand women and 35.7 per 10 thousand men. Accidental falls prevail at 49.8% of the total, followed by falls from standing at 34.4%. In 2010 24,760 people aged more than 60 years died of falls in Brazil[11].

Considering that a higher occurrence of falls is common in older adults and that they compromise health, reduce quality of life, and increase public spending with inpatient and outpatient care, recurrent falls worsen the health condition of older adults even more. Since most falls occur outside institutions and hospitals, the objective of this study was to analyze the factors associated with recurrent falls in community-dwelling older adults.

Methods

This is an epidemiological, concurrent, closed cohort study based on a sample of the project "Life and health conditions of older adults from the municipality of Cuiaba-MT"[12].

In the initial project, the sample size was determined considering a confidence coefficient of 95% ($z = 1.96$); sampling error of 5%; and proportion of value of 0.5 ($p = 0.5$). The urban population contained 43,096 older adults. The number of census tracts that would be included by district by cluster sampling was given by the formula

$$c_i = \frac{N_i}{C_i} * n_i ,$$

where *ci* is the number of census tracts, *Ni* is the number of older adults, *Ci* is the number of tracts, and *ni* is the number of older adults in the sample of each district. Eleven of the 355 census tracts of Cuiaba were selected, and based on probability criteria with a sample size correction of 50%, the sample should include 573 older adults.

The present study selected all older adults who had had a fall in the three months prior to data collection, totaling 109 participants. These individuals were interviewed again exactly one year after the first in-home survey conducted by the main researcher from January to March 2013. Between the two surveys six older adults died, so the final sample consisted of 103 participants.

The exposure variables included sociodemographic information (gender, age group, marital status, income, and education level) and health status (self-reported diseases, use of medications, self-perceived health, changes in gait and balance, visual and auditory impairments, and level of physical activity). The Katz et al. Index[13] assessed the functional skills of the older adults, and Lawton & Brody Scale[14] assessed the instrumental activities of daily living. Recurrent falls between the two surveys was the outcome variable.

The questionnaires were coded and digitized twice. Digitalization errors were compared and corrected by the software Data Compare. The data were treated by the programs Epi Info version 7.0 and SPSS version 20.0. Descriptive, bivariate, and multiple analyses were conducted.

Descriptive analysis determined the absolute and relative frequencies of the variables. Bivariate analysis investigated associations between the risk factors and recurrent falls by calculating the relative risk of the cumulative incidences (confidence interval of 95%).

Multiple analysis with Poisson regression included all variables with associations with p-value < 0.20 in the crude analyses. The variables gender and marital status were maintained for better model adjustment. The significance level of 5% ($p<0.05$) was adopted as a significant association for remaining in the final model.

This project was approved by the local Research Ethics Committee and complied with the guidelines of Resolution 466/2012 of the National Health Council (CNS).

Results

The study sample had a prevalence of recurrent falls of 77.6%. Table 1 shows the sociodemographic variables of the older adults who experienced recurrent falls. Most were females (65%) aged more than 70 years (63.8%). Almost half (47.5%) had partners, 53.7% had up to three years of formal education, and 93.7% had a family income of up to two minimum salaries.

In the bivariate analysis between recurrent falls and sociodemographic variables, recurrent falls was associated with up to seven years of formal education (RR = 1.53; 95%CI 0.95-2.49) (Table 2).

Recurrent falls was also associated with regular to very bad self-perceived health (RR = 1.80; 95%CI 0.86-3.78) (Table 3).

Tables 4 and 5 show the distribution of older adults who experienced recurrent falls according to the presence of some diseases and the results of the multiple Poisson model, respectively. The following variables remained associated with recurrent falls: income of up to two minimum salaries (RR = 1.62; 95%CI 1.04-1.77), absence of arthritis or arthrosis (RR = 1.32; 95%CI 1.10-1.48), having regular to very bad self-perceived health (RR = 1.44; 95%CI 1.12-2.04), and having visual impairment (RR = 1.23; 95%CI 1.01-1.69).

Table 1. Distribution of older adults by sociodemographic data. Cuiaba-MT, 2013.

Variable	Frequency (n)	Percentage (%)
Recurrent falls		
Yes	80	77.6
No	23	22.4
Gender		
Male	28	35.0
Female	52	65.0
Age group		
60 – 69 years	29	36.3
70 – 79 years	35	43.8
80 years or more	16	20.0
Marital status		
Married/Has partner	38	047.5
Widowed	32	40.0
Single	6	07.5
Separated/Divorced	4	05.0
Years of formal education		
More than 7.1	8	10.0
3.1 to 7	29	36.2
1 to 3	14	17.5
Illiterate	29	36.2
Income		
More than 2 MS	5	6.3
1 to 2 MS	59	73.7
Less than 1 MS	10	12.5
No income	6	07.5

MS = minimum salaries.

Discussion

This is one of the few Brazilian studies that focused on recurrent falls in community-dwelling older adults, demonstrating the great importance of this phenomenon in this population. Most of the study older adults (77.6%) experienced recurrent falls. The odds of recurrent falls[15,16] were higher in females aged more than 70 years and with low education level. Studies have evidenced that being female is a risk factor for recurrent falls, since women lose more bone mass and have less lean mass and muscle strength than men[17-21].

More than three-fourths of the studies in a literature review[22] indicated that older women are at greater risk of falls[23] than older men because of their better functional status. Older women perform numerous house chores more frequently and intensely than men, either because they believe house chores are culturally a female role or because they consider that performing such activities spares them from being categorized as older women.

The literature agrees that the prevalence of falls increases with age as senescence promotes progressive and functional changes that may

Table 2. Bivariate analysis of the association between recurrent falls and sociodemographic variables. Cuiaba-MT, 2013.

Variables	Recurrent falls		RR (95%CI)	p-value
	n/N	%		
Gender				
Male	28/39	71.79	1.0	0.262
Female	52/64	81.25	1.13 (0.90-1.42)	
Age group				
Up to 69 years	16/19	84.2	1.0	0.451
70 years or more	64/84	76.2	0.90 (0.72-1.14)	
Marital status				
Married	38/51	74.5	1.0	0.682
Divorced	4/6	66.7	0.89 (0.50-1.61)	0.976
Single	6/8	75.0	1.00 (0.65-1.55)	0.271
Widowed	32/38	88.2	1.13 (0.91-1.40)	
Income				
> 2 minimum salaries	5/9	55.6	1.0	0.097
Up to 2 minimum salaries	75/94	79.8	1.44 (088-1.34)	
Years of formal education				
7 or more	8/15	53.3	1.0	0.015*
Up to 7	72/88	81.8	1.53 (0.95-2.49)	

RR: relative risk; 95%CI: 95% confidence interval.

Table 3. Bivariate analysis between recurrent falls and health conditions. Cuiabá-MT, 2013.

Variables	Recurrent falls		RR (IC 95%)	p -value
	n/N	%		
Self-perceived health				
Excellent-Good	4/9	44.44	1.0	0.014*
Regular-Very bad	74/92	80.43	1.80 (0.86-3.78)	
Changes in gait				
No	36/48	75.00	1.0	0.541
Yes	44/55	80.00	1.06 (0.86 - 1.31)	
Changes in balance				
No	33/46	71.74	1.0	0.196
Yes	47/57	82.46	1.15 (0.92-1.45)	
Visual impairment				
No	16/24	66.67	1.0	0.142
Yes	64/79	81.01	1.21 (0.89 - 1.64)	
Auditory impairment				
No	48/64	75.00	1.0	0.406
Yes	32/39	82.05	1.09 (0.89 - 1.34)	
Physically active				
Yes	11/17	64.71	1.0	0.168
No	69/86	80.23	0.80 (0.55 - 1.16)	

RR: relative risk; 95%CI: 95% confidence interval.

compromise the performance of motor activities and hinder one's adaptation to the environment, which may explain recurrent falls[24-26]. Falls are the main cause of injuries and need of medical care in older adults. Older adults aged 80 years or more have much higher fall-related mortality rates than older adults aged 65 to 79 years[27]. Some studies suggest that the fear of experienc-

Table 4. Bivariate analysis between recurrent falls and self-reported diseases. Cuiaba-MT, 2013.

Variables	Recurrent falls		RR (95%CI)	p-value
	n/N	%		
Hypertension				
Yes	64/80	80.00	1.0	
No	16/23	63.57	1.15 (0.86- 1.54)	0.291
Diabetes				
Yes	26/32	81.25	1.0	
No	54/71	76.06	1.06 (0.86 - 1.31)	0.553
Osteoporosis				
Yes	16/21	76.19	1.0	
No	64/82	78.05	0.97 (0.74 - 1.27)	0.856
Arthritis/Arthrosis				
Yes	13/14	92.86	1.0	
No	67/89	75.28	1.23 (0.9 - 1.48)	0.075
Heart disease				
Yes	13/19	68.42	1.0	
No	67/84	79.76	0.85 (0.62 - 1.18)	0.284
Rheumatism				
Yes	1/3	33.33	1.0	
No	79/100	73.00	0.42 (0.08 - 2.09)	0.062

RR: relative risk; 95%CI: 95% confidence interval.

Table 5. Multiple Poisson model of variables associated with recurrent falls in older adults from the municipality of Cuiaba-MT, 2013.

Variables	RR (95%CI) crude	RR (95%CI) Adjusted
Income		
> 2 minimum salaries	1.00	1.0
Up to 2 minimum salaries	1.44 (0.88-1.34)	1.62 (1.04-1.77)
Arthritis/Arthrosis		
Yes	1.0	1.0
No	1.23 (1.02 - 1.48)	1.32 (1.10-1.48)
Self-perceived health		
Excellent – Good	1.0	1.0
Regular – Very bad	1.80 (0.86-3.78)	1.44 (1.12-2.04)
Visual impairment		
No	1.0	1.0
Yes	1.21 (0.89 - 1.64)	1.23 (1.01 -1.69)

Adjusted for gender and marital status.

ing new falls with more severe consequences can prevent distinguishing different age groups by the prevalence of recurrent falls[28,29].

Most older adults who experienced recurrent falls had low income, often from their low retirement pensions. People who live in low-income communities, such as the study sample, experience all environment-related difficulties and face a higher risk of falls, which may stem from the poor environment in which they live, including poor housing conditions and infrastructure[2-30]. The interaction of these factors may be responsible for the higher recurrence of falls in older adults.

Older adults with low education level experienced more recurrent falls in bivariate analysis,

even though this association was not significant in the final predictive model. This effect may have been attenuated by the possible confounder low income. Low education level combined with low income can contribute to social vulnerability and result in a higher recurrence of falls[31]. On the other hand, people with higher education level and income are concerned with their own health, so they practice physical activities that help to maintain their physical and organic integrity, which lead to better postural control[32].

Studies on the risk factors for falls in older adults found that arthritis and arthrosis are frequently associated with falls, contrary to the present finding[33-35]. Some studies have found that an increase in chronic diseases occurs simultaneously with loss of functional capacity, and higher immobility and physical dependence[1,36]. Meanwhile, arthrosis, arthritis, and other musculoskeletal disorders result in joint stiffness and pain, leading to unsteady gait, poor balance, and higher probability of falling[37].

A study that investigated the association between the risk factors for falls and arthritis found that people with arthritis are at greater risk of falls, regardless of age, since they also have less muscle strength, postural instability, pain, and fatigue[38], contrary to the present finding. However, when older adults fall, they tend to reduce their daily activities either because they fear falling again or because their family members and caregivers become protective, which can reduce the risk of new falls[39].

There is no consensus in the literature regarding recurrent falls. A study on falls and recurrent falls in a group of community-dwelling older adults from Itu (SP) did not find these associations. Falls probably induce older adults or their caregivers to be more attentive and careful to prevent new falls[40].

Another study finding was the association between bad self-perceived health and recurrent falls in bivariate analysis. A study of community-dwelling older adults found recurrent falls to be associated with bad self-perceived health, depression symptoms, and social isolation[41]. Other studies indicated that illiterate older adults or those with low education level, similar to the study sample, tend to have worse self-rated health than older adults with higher education levels[1,7]. In this sense, falls lead to the loss of autonomy and independence in activities of daily living, feelings of frailty and insecurity, fewer social activities, and low self-esteem[2].

Self-reported visual impairment was associated with recurrent falls in the final model, even though this association did not occur in bivariate analysis. An age effect may probably justify this difference, since very old adults are more likely to have visual impairment. A study in the municipality of Amparo (SP) found a correlation between number of falls and higher visual impairment as individuals with poor vision were older than those with normal vision[40]. Another study followed community-dwelling adults aged 65 years or more and found that the effect of visual impairment on the daily performance of older adults was an important predictor of falls and recurrent falls[41].

Despite the significant aspects related to recurrent falls in older adults and the associated factors found by the present study, one cannot exclude a possible memory bias as the occurrence of falls was self-reported. Older adults who experienced falls with more severe consequences may have remembered the details more often than older adults with no or mild fall-related consequences. However, the direction and magnitude of these associations may reveal important risk factors that may help to prevent falls in community-dwelling older adults.

This study was one of the first to assess recurrent falls in community-dwelling older adults by following a cohort of older adults. The study results reinforce the importance of preventing recurrent falls and all its negative health outcomes. Understanding the causes of recurrent falls may allow primary healthcare to create educational interventions and activities that minimize their occurrence. Health professionals must remain attentive to these factors in order to create effective interventions that reduce these events in the community.

Conclusion

This study found that low education level, regular to very bad self-perceived health, and visual impairment were associated with recurrent falls in older adults. The present results corroborate other studies, but new studies are appropriate and indicated at this time given the higher life expectancy and participation of older adults in the community.

Collaborations

DROM Abreu, RCS Azevedo, AMC Silva, AAO Reiners and HCA Abreu participated equally in all stages of preparation of the article.

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