ORIGINAL ARTICLE

Association between the total of falls reported and the number of home ergonomic barriers

Associação entre o total de quedas relatadas e o número de barreiras ergonômicas domiciliares

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ABSTRACT

Objective: To investigate the association between the total number of falls in the last year and the number of home ergonomic barriers (HEB). **Method:** Cross-sectional study, Volunteers aged ≥60 years were included in the study. The history of falls and the number of HEBs were evaluated via a questionnaire. vulnerability through the Vulnerable Elders Survey 13 (VES-13) and fear of falling observed by the Falls Efficacy Scale - International-Brazilian (FES-I-BR). Data normality was verified with the Kolmogorov-Smirnov test, the correlation between total falls and the number of ergonomic barriers was verified with the Spearman test and the association between ergonomic barriers and groups with and without a history of falls, in the last year, through bivariate logistic regression and the chi-square test, the significance level of p≤ 0.05 was adopted. **Results:** Of the 123 individuals evaluated, 48% had a history of falls, with a mean of 3.83±1.96. The lack of support bars was considered protective [OR= 0.30; p= 0.042] and the absence of uniform floors and well-fixed mats were considered as risk factors for falls [OR= 3.71; p= 0.004]. Elderly people with a history of falls with ≥ 04 HEB, presented a greater risk of falls [OR= 5.98 p<0.0001]. **Conclusion:** The amount ≥ 04 HEB is associated with a history of falls, the absence of handrails is a protective factor, and uneven or slippery floors are risk factors for falls.

Keywords: Accidental Falls, Architectural Accessibility, Ergonomics, Aged

RESUMO

Objetivo: Investigar a associação entre o número total de quedas no último ano e o número de barreiras ergonômicas domiciliares (BED). **Método:** Estudo transversal, voluntários com idade ≥60 anos foram incluídos no estudo. A história de quedas e o número de BED foram avaliados por meio de um questionário, a vulnerabilidade através do Vulnerable Elders Survey 13 (VES-13) e o medo de cair observado pela Falls Efficacy Scale - International- Brazilian (FES-I-BR). A normalidade dos dados foi verificada com o teste de Kolmogorov-Smirnov, a correlação entre total de quedas e a quantidade de barreiras ergonômicas foi verificada com teste de Spearman e associação entre as barreiras ergonômicas e os grupos com e sem histórico de quedas no último ano, através da regressão logística bivariada e pelo teste de Qui-quadrado, o nível de significância de p≤ 0,05 foi adotado. **Resultados:** Dos 123 indivíduos avaliados, 48% tinham histórico de quedas, com média de 3,83±1,96. A falta de barras de apoio foi considerada protetora [OR= 0,30; p= 0,042] e a ausência de pisos uniformes e tapetes bem fixados foram considerados fatores de risco para quedas [OR= 3,71; p= 0,004]. Idosos com histórico de quedas com ≥ 04 BED, apresentaram maior risco de quedas [OR= 5,98 p<0,0001]. **Conclusão:** A quantidade ≥ 04 BED está associada a histórico de quedas, a ausência de corrimão é fator de proteção e pisos irregulares ou escorregadios são fatores de risco para quedas.

Palavras-chaves: Acidentes por Quedas, Acessibilidade Arquitetônica, Ergonomia, Idoso

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Submitted: January 10, 2022
Accepted: July 13, 2022

How to cite
Ferreira MJC, Dibai DB, Santos AS, Carneiro AS, Soares KVBC, Rêgo AS, et al. Association between the total of falls reported and the number of home ergonomic barriers. Acta Fisiatr. 2022;29(3):171-176.

10.11606/issn.2317-0190.v29i3a195477

INTRODUCTION

The aging of human beings has been accentuated due to the progress of science in the health area in terms of preventive procedures, timely identification for the treatment of chronic non-communicable diseases (NCDs), immunization against viral diseases and the elaborated acquired rights by organic laws such as the "Statute of the Elderly" placing people classified as elderly in a transitory demographic dynamic that is superior to those of other age groups.[1-3]

In Brazil, it is estimated that there will be a growth of 34 million people aged 60 or over in 2020, with a probability of increasing to 30% of this population by 2050, ranking Brazil 6th in terms of elderly population globally.[4]

In addition to demographic changes, there is also an epidemiological transition due to advances in the incidence of chronic, degenerative, and disabling diseases.[5]

Among the disabling factors, falls are responsible for the loss of independence and autonomy due to the aggravation related to traumas developed by the accident, and in some cases, more serious consequences such as death.[6] Furthermore, the vulnerability of the elderly increases, promoting the loss of organic balance and increasing the risk of new accidents.[7]

Among Brazilian elderly people, falls presented a worrying quantity; 30% have reported they had fallen in the last year. This reaches 50% among elderly people aged 80 years or more, ranking third in terms of morbidity in the grouping of factors in 2007 and first in terms of hospitalizations in 2008, for both sexes.[8]

According to the Brazilian Ministry of Health, falls were the most commonly reported reason for urgent and emergency care. In São Luís (MA), the elderly represent 65.6% among all age groups, with women being the main victims of falls in the home. Among the occurrences of registered falls, the highest proportion was in the capital of Maranhão (39.6%) and the lowest proportion was in the capital of the State of Roraima (15.6%). Home was the location most cited by victims.[9]

Unplanned residences are responsible for the increased frequency of falls among the elderly.[10] Home ergonomic barriers (HEB) represent 75% of the causes of accidents,[11] with the bedroom, living room, and bathroom being the most commonly cited places.[12] In addition to HEBs, factors such as poor lighting, slippery or uneven floors, risky behaviors such as climbing chairs or stairs, and some activities of daily living are also related to accidents among the elderly.[13]

It is therefore necessary to identify the risks to life related to domestic accidents with the aim of implementing prevention and mitigation strategies for conditions related to falls.[14]

OBJECTIVE

The current study investigates the association between the total number of falls in the last year and the amount of ergonomic barriers at home. Furthermore, this study determines the presence of HEB as predictors or risk factors for falls in the elderly.

METHODS

This is an observational, descriptive, and analytical cross-sectional study. It investigates the research variables that followed the procedures, steps, and guidelines of the STROBE Statement.

Study participants were individuals aged 60–90 years, of both sexes attending a comprehensive healthcare center for the elderly in São Luís-MA, Brazil.

Volunteers who participated at least three times a week in physical, intellectual, and social activities developed by professionals in the social group and classified as elderly (≥60 years) were included.

Those who did not perform and/or did not complete the evaluative questionnaires proposed to identify vulnerability and fear of falling, and those who did not perform the physical activities proposed by professionals in the social group were excluded.

This study met the requirements proposed by Resolution No. 466 of December 12, 2012 of the National Health Council (CNS) and was approved by the Research Ethics Committee of Universidade Ceuma by the Academic program Stricto Sensu Masters in Environment with the opinion No. 2.851.570/2018.

Sociodemographic data, such as the number of falls in the last year and the occurrence of fractures, the presence of HEB in the bathroom, bedrooms, kitchen, stairs, adequacy of rooms, and lighting, were evaluated through a questionnaire prepared using the guidelines for filling out the booklet for elderly Brazilians.[15]

Vulnerability was assessed using the Vulnerable Elders Survey 13 (VES-13) questionnaire, which consists of four evaluative dimensions: age, health perception, limitations, and physical incapacities.[16] The questionnaire items were scored from zero to ten points. The elderly were classified as vulnerable if they obtain a score of ≥3 according to the sum of the.[16-18]

Fear of falls was assessed using the Falls Efficacy Scale: International-Brazilian (FES-I-BR) questionnaire validated for the Portuguese language and adapted for the Brazilian population.[19] The FES-I-BR consists of 16 questions related to daily needs with four possible answers: (I) lack of concern, (II) a little worried, (III) very worried, and (IV) extremely worried about falling, and each is represented by a score from 1 to 4, respectively. The classification of fear of falling is obtained by adding up the scores (16 points= no concern, 17 to 22= a little worried, 23 to 31= very concerned, 32 to 64= extremely concerned).[19-21]

Data were tabulated and organized using Microsoft Excel for Windows, and statistical analysis was performed using IBM Statistical Package for Social Sciences (SPSS 20.0) software for Windows. The calculation of the sample size of the number of elderly people evaluated about falls in São Luís was performed using the statistical program Power Analysis & Sample Size (PASS 15 - 2017), observing the following parameters: prevalence of falls in elderly people 72.3%[22] significance level (α) of 5%, test power of 80%, tolerable error (standard error) of 7%, with a minimum sample size of 114 plus 5% of possible losses. Sampling was characterized by the non-probabilistic type.

Numerical variables were distributed as mean and standard deviation, and classifying variables were presented in terms of frequency. As normality of the Kolmogorov–Smirnov test was not found, correlation analysis was performed using the Spearman test (ρ) and a logistic regression between the

ergonomic risk factors with the dependent variable classified with a history of falls (WHOF) and no history of falls (NHOF).

Association analysis was performed between the classifying variables of the WHOF and NHOF elderly groups with the ergonomic barriers that represented a predictive factor or risk for falls using the Chi-square test of independence ($\chi 2$). In all association, correlation, and logistic regression tests, the adopted level of significance (α) was 5%; that is, the results were considered statistically significant when $p < 0.05$.

RESULTS

Among the n= 180 elderly registered in the group of coexistence of the center of integral health care of the investigated elderly, 123 individuals of both genders considered eligible to participate were evaluated, with mean body mass weight of 62.47±9.96 kg and average height 1.51±0.07 cm. According to Table 1, the number of elderly WHOF was n= 59 (48%) and NHOF n= 64 (52%).

The WHOF volunteers had a mean BMI of 27.10±4.65 kg/m² and the classification as eutrophic n= 16 (27.1%) and the elderly NHOF an average BMI of 27.55±4.46 kg/m² and with ideal weight n= 20 (31.3%). In the VES-13 classification, both the elderly WHOF n= 36 (61%) and the elderly NHOF n= 46 (71.9%) had a higher value as non-vulnerable elderly.

In relation to fear of falling as assessed by the FES-I-BR, both the elderly WHOF n= 22 (37.3%) and the elderly NHOF n= 24 (37.5%) are very concerned about falling. Regarding the number of HEB, the elderly WHOF n= 36 (61 %) and NHOF n= 29 (45.3%) indicated there are between 4–6 HEB in their homes. A significant value was observed in the distribution of medians between the number of HEB with the classification of the history of falls (U= 1404.5; p<0.05).

Table 1. Sociodemographic data of elderly women at a Center for Integral Health Care for the elderly in São Luís, Maranhão, Brazil

	Fall history classification						U	p-value
	WHOF n= 59 (48%)			NHOF n= 64 (52%)				
	N (%)	Average (sd)	median	N (%)	Average (sd)	median		
Characteristics age group								
60 - 74 years old	49 (83.1)	70.02 (6.42)	69	52 (81.3)	69.95 (7.31)	68.5	1827	0.757
75 - 89 years old	10 (16.9)			11 (17.2)				
≥ 90 years old				1 (1.6)				
BMI classification								
malnourished	6 (10,2)	27.10 (4.65)	26,65	4 (6.3)	27.55 (4.46)	27	1368	0.692
nutritional risk	6 (10,2)			5 (7.8)				
eutrophic	16 (27,1)			20 (31.3)				
overweight	15 (25,4)			10 (15.6)				
obese	11 (18,6)			14 (21.9)				
Classification of the VES-13								
vulnerable	23 (39.0)	2.80 (2.80)	2	18 (28.1)	1.97 (2.37)	1	1593	0.125
not vulnerable	36 (61.0)			46 (71.9)				
FES-I-BR classification								
absence of concern	1 (1.7)	27.17 (9.66)	26	2 (3.1)	27.06 (8.95)	25	1854	0.863
a little worried	20 (33.9)			18 (28.1)				
very worried	22 (37.3)			24 (37.5)				
extremely worried	16 (27.1)			20 (31.3)				
BED number								
None	4 (6.8)	4.32 (183)	4	3 (4.7)	3.44 (1.94)	4	1405	0.013
1 - 3 BED	14 (23.7)			27 (42.2)				
4 - 6 BED	36 (61.0)			29 (45.3)				
7 or more BED	5 (8.5)			5 (7.8)				

(WHOF) With a history of falls; (NHOF) No history of falls; (sd) standard deviation; (U) Mann-Whitney Test; (BMI) Body Mass Index; (VES-13) Vulnerable Elders Survey 13; (FES-I-BR) Falls Efficacy Scale – International-Brazilian; (BED) Ergonomic Home Barriers

From the total 10 HEB analyzed, an average of 3.83±1.96 HEB was observed among WHOF elderly and an average of 3.89±1.92 HEB among NHOF elderly n= 75 (66.7%) of the participants highlighted the existence of at least four ergonomic home barriers.

The main HEBs mentioned were a lack of support bars in the locomotion areas n= 105 (85.4%), lack of firm and bilateral handrail on the stairs, n= 83 (67.5%), and impeded locomotion areas n= 55 (44.7%). The presence of a handrail in the locomotion area was considered a protective factor against falls, and the absence of uniform floors and well-fixed mats were considered as risk factors for falls. In addition, 4≥ HEB was considered a factor for the increased chance of falls (Table 2).

An association was observed between the classification of the history of falls with the absence of uniform floors and well-fixed mats in the locomotion area [χ^2= 7.88; p= 0.005]; however, there was no association between the WHOF and NHOF groups with the absence of support bars in the area of [χ^2= 2.95; p= 0.086], as reported in Table 3.

A significant, weak, and positive correlation was observed between the total number of falls in the last year and the number of ergonomic barriers in the homes of the elderly (ρ= 0.192; p<0.05), and between the total fear of falling score and the vulnerability score (ρ= 0.287; p<0.01). However, there was no correlation between fear of falling and the number of BED (ρ= -0.006; p> 0.05), as indicated in Table 4.

Table 2. Home ergonomic barriers identified by the elderly with a history of falls (n= 59) and without a history of falls (n= 64), São Luís, Maranhão, Brazil

		WHOF		NHOF		Total				
		N	%	N	%	N	%	OR	IC 95% OR	p
Clear locomotion areas	Yes	32	47.1	36	52.9	68	55.3	1.035	0.46 - 2.32	0.934
	No	27	49.1	28	50.9	55	44.7			
Presence of support bars in the locomotion area	Yes	12	66.7	6	33.3	18	14.6	0.299	0.09 - 0.96	**0.042**
	No	47	44.8	58	55.2	105	85.4			
Uniform floors and well-secured rugs in the locomotion area	Yes	32	39	50	61	82	66.7	3.706	1.52 - 9.06	**0.004**
	No	27	65.9	14	34.1	41	33.3			
Sufficient lighting	Yes	51	47.2	57	52.8	108	87.8	0.865	0.24 - 3.13	0.825
	No	8	53.3	7	46.7	15	12.2			
Accessible switches	Yes	55	49.1	57	50.9	112	91.1	0.727	0.17 - 3.05	0.663
	No	4	36.4	7	63.6	11	8.9			
Non-slip floor shower area	Yes	43	50.6	42	49.4	85	69.1	0.725	0.28 - 1.87	0.507
	No	16	42.1	22	57.9	38	30.9			
Easy opening box or a very firm curtain	Yes	49	50.5	48	49.5	97	78.9	0.664	0.25 - 1.78	0.417
	No	10	38.5	16	61.5	26	21.1			
Low cabinets, no stairs needed	Yes	42	48.3	45	51.7	87	70.7	0.694	0.28 - 1.74	0.438
	No	17	47.2	19	52.8	36	29.3			
Stairs with non-slip floor	Yes	29	50	29	50	58	47.2	1.086	0.42 - 2.81	0.865
	No	30	46.2	35	53.8	65	52.8			
Stairs with handrail on both sides and firm	Yes	19	47.5	21	52.5	40	32.5	1.36	0.48 - 3.85	0.563
	No	40	48.2	43	51.8	83	67.5			
Number of ergonomic risk factors	≥ 4	48	64	27	36	75	50.7	5.98	2.63-13.6	**< 0.0001**
	≤ 3	11	22.9	37	77.1	48	33.3			

Table 3. Associations of ergonomic barriers with elderly WHOF and NHOF, São Luís, Maranhão, Brazil (N= 123)

HEB		WHOF	SHDQ	Total	χ^2	p-value
Support bars walking area	Yes	12 (66.7%)	6 (33.3%)	18 (14.6%)	2.95	0.086
	No	47 (44.8%)	58 (55.2%)	105 (85.4%)		
Uniform floor and fixed mats	Yes	32 (39.0%)	50 (61.0%)	82 (66.7%)	7.88	**0.005**
	No	27 (65.9%)	14 (34.1%)	41 (33.3%)		
Total		59 (48.0%)	64 (52.0%)	123 (100%)		

(HEB) Home ergonomic barriers; (WHOF) With a history of falls; (NHOF) No history of falls; χ^2= Chi-square test of independence

Table 4. Correlation between fear of falling, vulnerability, total number of falls and BED. São Luís, Maranhão, Brazil (N= 123)

Variables	ρ	p-value
Fear of falling x Vulnerability Score	0,287**	0.001
Fear of falling x HEB number	-0,006	0.946
Fear of falling x Total falls in the last year	-0,004	0.961
Vulnerability Score x HEB Number	0,067	0.463
Vulnerability Score x Last Year's Total Falls	0,107	0.238
Number of HEB x Total falls in the last year	0,192*	0.033

*(HEB) Home ergonomic barriers; ρ= Spearman's Correlation; **p<0.01; *p<0.05*

DISCUSSION

The main study objective was to investigate the association between the total number of falls in the previous year and the amount of HEB. Elderly people with a history of falls and no reports of falls were observed, most of whom were classified as vulnerable, with fear of falling, 48% reported having fallen in the last year, and the presence of HEB in their homes. In Brazil, according to the Surveillance of Violence and Accidents (VIVA: 2009, 2010, 2011), there were 42,958 calls to urgent and emergency services. This survey was conducted in 24 capitals and in the Federal District, and falls represented 34.1% of the number of visits, 56.6% of which occurred within homes.[9]

In the aforementioned study, 59 (48%) of the respondents reported having fallen in the previous year and having at least four ergonomic barriers at home, a worrying fact since about 75% of falls among the elderly occur in their own homes and locations. The highest incidence was in the bedroom, followed by the kitchen and bathroom, representing a risk of fractures, loss of autonomy, and death.[11]

Most of the elderly included in this research were concerned about falling, and some even reported being extremely concerned when cleaning the house or when traveling on slippery surfaces. Thus, we suggest that the elderly participants can identify that the lack of handrails and uniform floors and fixed mats in the locomotion area can favor falls in the home environment.

Similar to the study by Morsch et al.[5] we identified stairs without a handrail and the presence of loose rugs in the home environment as risk factors related to the fear of falling, in addition to observing an association between the absence of fixed rugs in the home with a history of falls. However, as in Lopes et al.[23] and Cruz et al.[4] we also observed a correlation between fear of falling and a slippery surface.

In fact, the number of HEB is directly associated with the number of falls, especially the absence of uniform floors and well-fixed mats in locomotion areas. A risk factor for new occurrences representing an increased chance of falls in elderly of 1.39% are identified as floors that cause slipping and tripping among those who live in homes with this type of surface, highlighting the need for better adaptation of the home environment for the elderly.[12] Therefore, home accidents are mainly associated with the risk of walking on slippery or uneven

surfaces, barriers such as furniture in inappropriate locations, and poor lighting.[12,24,25]

Although studies in developed countries point to relatively more extensive domestic modifications than in developing countries,[10] simple adaptations in the homes of elderly Brazilians, such as the installation of firm and bilaterally adjusted grab bars in bathrooms and on stairs and the removal of risk factors in locomotion areas to avoid tripping or slipping are measures that must be taken to avoid future falls and mitigate the fear of falling.[24]

The fear of falling was found to be positively correlated with the level of vulnerability of the elderly, and the greater the fear of falling, the more vulnerable the elderly. Therefore, vulnerability reflects how much the elderly are subject to decline and deterioration in their clinical and functional status, putting their autonomy and independence at risk or even risk of death.[17,18,26]

To direct assistance to frail elderly people to identify and mitigate the risks of new accidents, it is necessary to identify vulnerability through a comprehensive and multidisciplinary geriatric assessment carried out with the purpose of including the diagnosis to organize interventions for the management of the causes of falls.[18,26]

In addition to finding an association between ergonomic barriers with the number of falls in the last year of the elderly in the investigated health center, this study revealed that ergonomic barriers at home, fear of falling, and vulnerability are risk factors. To the best of our knowledge, this is the first study in the state of Maranhão with this population and theme, and the limitations include the fact that the BEDs were self-reported, being subject to the possibility of bias in the memory.

These results reinforce the need for constant guidance and prevention to avoid falls and their complications. In future studies, the relationships between behavioral, physiological, and environmental factors with the physical and functional capacity of elderly people could be evaluated by comparing or associating people's HEB with their per capita income and social isolation, in addition to associating HEB with a risk of fragmentation of physical, functional, and cognitive capacity.

CONCLUSION

The total number of self-reported falls in the last year reached 48% among the participants, and a total of ≥4 HEB are associated with a history of falls and present risks for new occurrences, and the fear of falling and vulnerability are positively correlated. It was observed that the main HEB is the absence of a handrail in the locomotion area considered as a protection factor against falls and the uneven floors and loose mats considered as risk factors for falls, highlighting the need for environmental adaptations in the homes of the elderly for the prevention of falls, the preservation of autonomy, independence, and quality of life.

ACKNOWLEDGMENT

The authors thank the collaborators and the administrative team of the Center for Comprehensive Health Care for the Elderly, the participants for their efforts, the 2nd academic cycle Master's Program in Environment at the University Ceuma (UNICEUMA), and the Foundation of Amparo for the Scientific and Technological Research and Development of Maranhão (FAPEMA) for providing research achievements in São Luís, MA, Brazil.

FINANCING

The research was carried out using the resources made available by the postgraduate program of the Master's in Environment at CEUMA University.

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