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# Prevalence of falls and associated factors in elderly individuals

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## ABSTRACT

**OBJECTIVE:** To estimate the prevalence of falls in elderly individuals and to analyze associated factors.

**METHODS:** Cross-sectional study with 420 elderly subjects (aged 60 years or older) living in the city of Juiz de Fora (Southeastern Brazil) in 2010. A household survey was conducted and the occurrence of falls in the 12 previous months was described. For the analysis of factors associated with the outcome, a theoretical determination model with three hierarchical blocks was built. The variables were adjusted among each other within each block; those with level of significance  $\leq 0.20$  were included in the Poisson regression model and adjusted to the immediately higher level, with 5% significance level.

**RESULTS:** The prevalence of falls among the elderly was 32.1% (95%CI: 27.7; 36.9). Among those who experienced falls, 53% had a single fall and 19% had fractures as a consequence. Most of the falls (59%) occurred at the elderly person's home. The occurrence of falls was associated with old age, female sex, need of help for locomotion and self-reported diagnosis of osteoporosis.

**CONCLUSIONS:** Falls are frequent among the elderly. Knowledge of the factors associated with the occurrence of this event can aid the development of prevention strategies and adequate health services.

**DESCRIPTORS:** Aged. Accidental Falls. Risk Factors. Cross-Sectional Studies.

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## INTRODUCTION

Population aging is a worldwide phenomenon. The increase in the proportion of the elderly population occurs rapidly and abruptly mainly in developing countries, like Brazil. Simultaneously to these transformations, changes occur in the morbidity and mortality profile of the population, which generates a concern about the quality of life and wellbeing of the elderly.<sup>19,21</sup>

In 1960, the number of elderly individuals was 3 million in Brazil. It rose to 7 million in 1975 and to 21 million in 2008. In this year there was 9.4 million people aged 70 years or older in the country (4.9% of the overall Brazilian population).<sup>21,a</sup> According to the synthesis of social indicators of 2009, presented by *Instituto Brasileiro de Geografia e Estatística* (IBGE – Brazilian Institute of Geography and Statistics), the proportion of elderly people increased from 8.8% to 11.1% between 1998 and 2008. The relative growth of this population

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<sup>a</sup> Instituto Brasileiro de Geografia e Estatística. Síntese de indicadores sociais – 2009. Rio de Janeiro: IBGE; 2009 [cited 2009 Oct 10]. Available from: [http://www.ibge.gov.br/home/presidencia/noticias/noticia\\_visualiza.php?id\\_noticia=1476&id\\_pagina=1](http://www.ibge.gov.br/home/presidencia/noticias/noticia_visualiza.php?id_noticia=1476&id_pagina=1)

in age groups was also significant. The age group of 80 years or older exceeded the others, reaching almost 70% or approximately 3 million people.<sup>a</sup>

Falls among the elderly are worthy of attention and have become a public health problem due to the high frequency with which they occur, the morbidity and mortality deriving from this event, to the high social and economic cost arising from the injuries caused and because they are events that can be prevented.<sup>3,4,15,19</sup> They are responsible for a decline in the functional capacity and in the quality of life of the elderly and for an increase in the risk of institutionalization. These factors can affect the family caregivers, who assume a new routine and special care due to the rehabilitation or adaptation of the individual after the fall.<sup>4,12,14</sup>

Prevention and health promotion measures are important instruments to reduce the occurrence of these events and to minimize the secondary complications.<sup>15,17</sup> Approximately 30% of the elderly fall once a year according to the Ministry of Health,<sup>b</sup> a result that is similar to that of studies carried out in Brazil with elderly individuals living in the community.<sup>12,19</sup>

The aim of the present study was to estimate the prevalence of falls in elderly individuals and to analyze associated factors.

## METHODS

Cross-sectional, observational and epidemiological study carried out with 420 elderly individuals aged 60 years or older from the north zone of the city of Juiz de Fora (Southeastern Brazil) in 2010. It is a representative sample of the population of Juiz de Fora, as this is the region with the largest territorial availability in the urban area and the second most populous of the municipality. It concentrates the highest amount of neighborhoods, subnormal settlements and social programs. This study is part of the project Health Survey in the Municipality of Juiz de Fora/MG (in preparation).<sup>c</sup>

The participants were selected by stratified random sampling and by multiple-stage cluster sampling. The primary sampling units were the census tracts. To the draw, the tracts were grouped into strata defined according to the different healthcare modalities in which the tract's population was enrolled, subdivided into primary care (Family Health Strategy or traditional), secondary care, and uncovered area. The selection of the census tracts was performed with probabilities that were proportional to their size (dwelling population

according to data from the 2000 Demographic Census) in an independent way in each stratum.

To calculate the size of the sample, the national prevalence of elderly people who experienced falls, pointed by the literature (30%),<sup>12,d</sup> was considered. We considered 5% of maximum desired error, 95% of level of confidence, correction for finite populations, effect of the sampling plan equal to 1.5 (considering possible stratification and clustering effects, depending on the adopted selection procedure) and possible losses due to refusal (approximately 30%). Initially, it was calculated that the size of the sample should be of 601 elderly individuals.

The population basis that was used was built by means of previous screening (quick count) in the urban census tracts of the region selected for the sample. The screening was performed by sampling: one out of every five households was selected by systematic sampling to identify the existence of elderly people living there. Information referring to the neighboring households (two located on the left and two on the right) were surveyed in the selected households.

Based on the method of quick count per sampling, it was estimated that 602 individuals aged 60 years or older would be located in the households of the region to compose the study's sample, a number close to the desired size of the sample. During the administration of the questionnaire, 559 people in this age group were identified. Losses totaled 11, including death, change of address or impossibility to locate the elderly person after three attempts of contact in different days and times. Refusals totaled 86 individuals. Of the 462 interviewed elderly people, 42 were excluded because they met the exclusion criteria.

The questionnaire used for home survey was standardized and pre-tested. The Mini-Mental State Examination (MMSE)<sup>2</sup> was used as an instrument to screen possible cognitive alterations, which determined the need or not of another respondent. In the case of another respondent, sociodemographic questions and the outcome of interest were approached. Elderly individuals whose behavior in the MMSE suggested cognitive impairment and who were not accompanied by relatives and/or caregivers were excluded.

The utilized question was: "Did you fall at least once last year?". Those who answered yes were asked the number of falls, the place where it happened, the occurrence of fracture resulting from the fall and the anatomic

<sup>b</sup> Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. Envelhecimento e saúde da pessoa idosa. Brasília (DF): 2006

<sup>c</sup> Universidade Federal de Juiz de Fora, Núcleo de Assessoria Treinamento e Estudos em Saúde. Inquérito de saúde no Município de Juiz de Fora-MG: relatório técnico.

<sup>d</sup> Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. Envelhecimento e saúde da pessoa idosa. Brasília: Ministério da Saúde; 2006. 192p.

place of the fracture. The adopted definition of fall was: “a non-intentional event whose result is the individual’s change of position to a lower level in relation to his/her initial position”.<sup>11</sup>

Absolute and relative frequencies were described, as well as the prevalence of the outcome. The chi-square test ( $\chi^2$ ) was used to analyze the association with the independent variables and with the dependent variable in the bivariate analysis. Poisson regression was used to analyze the independent variables associated with the outcome, controlled by possible confounding factors (adjusted PR) in the multiple analysis. The significance level was tested using the Wald tests for heterogeneity and linear trend.

For the analysis of the factors associated with the occurrence of the fall (presence or not in the 12 previous months), a theoretical determination model was built with three hierarchized blocks of variables (Figure), adjusted among themselves within each block. Variables with level of significance  $\leq 0.20$  were included in the Poisson regression model and adjusted to the immediately higher level.<sup>22</sup>

The independent variables were grouped into the three blocks: block 1 (demographic and socioeconomic characteristics: age, sex, marital status, home arrangement, level of schooling, socioeconomic level – Classification of *Associação Brasileira de Empresas de Pesquisa* (Brazilian Association of Research Companies)); block 2 (elderly person’s health: self-rated health, vision and hearing; presence of reported morbidity; walking difficulty; need of help for locomotion; use of device

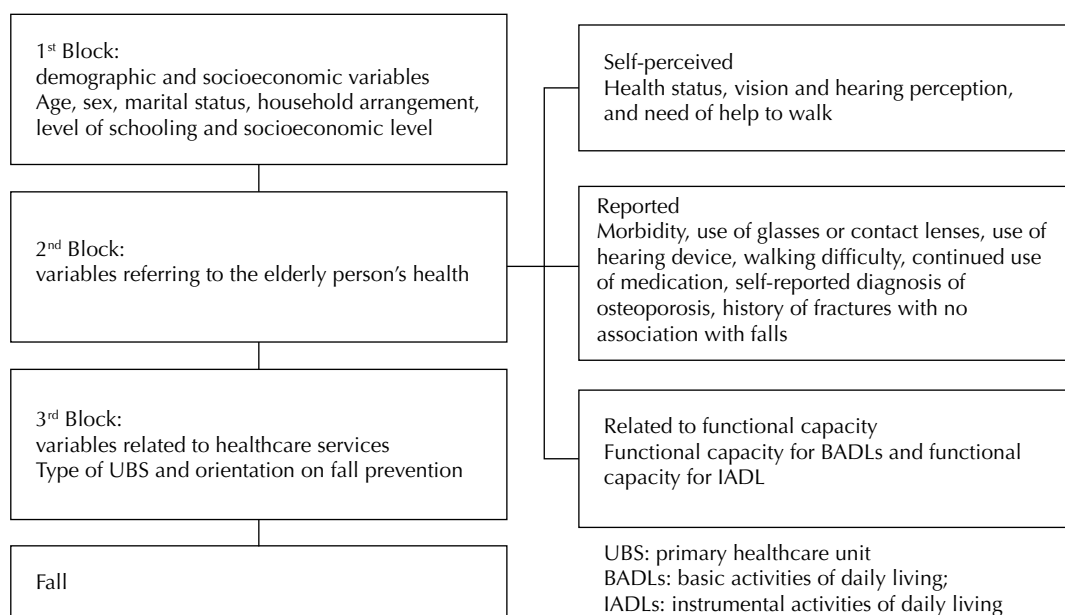
to correct visual and hearing deficit; number of drugs reported for continuous use; self-reported diagnosis of osteoporosis; history of fractures with no association with the fall; functional capacity for the performance of the basic activities of daily living by means of the Modified Katz Scale, and functional capacity for the performance of instrumental activities through the Lawton and Brody Scale; block 3 (health services: type of *Unidade Básica de Saúde* (UBS – Primary Healthcare Unit) of the area in which the elderly person lives and orientation on fall prevention.

The software SPSS version 14.0, was used, in its module “complex samples”, which considers characteristics of the sampling plan and level of significance of 5%, and also STATA 9.2, also considering the sampling plan (module *survey data analysis*).

The Ethics Committee of Universidade Federal de Juiz de Fora approved the study (Opinion no. 277/2009) and the participants signed a consent document.

### RESULTS

In the study, 420 questionnaires were analyzed, 324 answered by elderly individuals and 96 by other respondents. The sample was composed of 65% of women, 47% of the interviewees were married or lived in a stable union, 88% lived with someone, 58% belonged to class C (lower middle-class). The mean age was 69.7 years (SD = 6.9) and the mean level of schooling was 3.9 years (SD = 3.4). Almost two thirds (65%) said they did not have walking difficulties and 89% said they did not need help for locomotion. Poor



**Figura.** Modelo teórico de investigação dos efeitos das variáveis independentes sobre a queda em blocos hierarquizados.

**Table 1.** Characteristics of the sample according to independent variables. Juiz de Fora, Southeastern Brazil, 2010.

Variable	Presence of fall		Absence of fall	
	n	%	n	%
Age (years)				
60 to 70	62	46	162	57
71 to 80	49	36	93	33
Above 80	24	18	30	10
Sex				
Male	101	75	171	60
Female	34	25	114	40
Marital Status				
Married or stable union	58	43	141	49
Widowed	61	45	96	34
Separated or divorced	12	9	27	10
Single	4	3	21	7
Household arrangement				
Lives alone	13	10	36	13
Lives with someone	122	90	249	87
Level of schooling (years)				
Illiterate	31	23	59	21
1 to 4	78	58	154	54
5 to 7	11	8	42	15
8 to 10	5	4	17	6
11 or more	10	7	13	4
Socioeconomic level				
A or B	22	16	54	19
C	76	56	166	58
D or E	37	28	65	23
Self-rated health <sup>a</sup>				
Excellent/ Very good/ Good	38	39	111	49
Regular/ Poor	59	61	116	51
Self-rated vision <sup>a</sup>				
Excellent/ Very good /Good	29	30	100	44
Regular/ Poor	68	70	127	56
Self-rated hearing <sup>a</sup>				
Excellent/ Very good /Good	63	65	161	71
Regular/ Poor	34	35	66	29
Need of help to walk <sup>a</sup>				
No	97	81	227	93
Human help	6	6	11	5
Auxiliary device	13	13	6	2
Drugs reported for continuous use <sup>a</sup>				
None	8	8	50	22
1 to 4 drugs	69	71	141	62
More than 4 drugs	20	21	36	16

To be continued

Table 1 continuation

Variable	Presence of fall		Absence of fall	
	n	%	n	%
Self-reported diagnosis of osteoporosis <sup>a</sup>				
No	28	29	102	45
Yes	38	39	48	21
I don't know	31	32	77	34
History of fractures with no association with the fall <sup>a</sup>				
No	85	88	201	89
Yes	12	12	26	11
Functional capacity for the performance of BADLs (Modified Katz Scale) <sup>a</sup>				
Independent	96	99	220	97
Dependent	1	1	7	3
Functional capacity for the performance of IADLs (Lawton and Brody Scale) <sup>a</sup>				
Independent	90	93	211	93
Dependent	7	7	16	7
Orientation on prevention of falls <sup>a</sup>				
Yes	22	23	81	36
No	75	77	146	64
Type of UBS				
Uncovered area	13	10	32	11
UBS with ESF	76	56	159	56
Traditional UBS	23	17	36	13
Polyclinic	23	17	58	20

BADLs: basic activities of daily living; IADLs: instrumental activities of daily living; UBS: *Unidade Básica de Saúde* (Primary Care Unit); ESF: *Estratégia Saúde da Família* (Family Health Strategy).

<sup>a</sup> Variables investigated only when the respondent was the elderly person.

or regular self-rated health was reported by 54% of the individuals, 60% reported poor or regular vision and 31%, poor or regular hearing.

More than half (56%) lived in areas whose healthcare modality was UBS with implemented *Estratégia Saúde da Família* (ESF – Family Health Strategy). It was found that 82% of the sample mentioned the need to use at least one drug continually. The majority was independent, according to the functional capacity assessment for basic activities of daily living (Modified Katz Scale, 98%) and instrumental activities of daily living (Lawton and Brody Scale, 93%) (Table 1).

The prevalence of falls was 32.1% (95%CI = 27.7;36.9). Of those who experienced falls, 53% fell only once and 19% had fracture as a consequence (32% in the upper limbs, 47% in the lower limbs, 10% in the ribs and/or vertebrae, 8% in the face and 3% in the hip). More than half of the falls (59%) occurred in their own home.

The falls were more frequent in women ( $p = 0.02$ ), in individuals older than 80 years ( $p = 0.04$ ), in those who needed help for locomotion ( $p = 0.001$ ), in those who reported morbidity ( $p = 0.004$ ), and in those with diagnosis of osteoporosis ( $p = 0.001$ ). The falls were associated with poor or regular self-rated health and vision, walking difficulty, higher number of drugs and with not having received orientation to prevent falls (Table 2).

Four variables remained associated with falls in the multiple regression model. Among the variables of the most distal level (block 1), the following variables constituted risk factors: age higher than 80 years (adjusted PR = 2.68; 95%CI 1.0;7.22) and female sex (adjusted PR = 1.89; 95%CI 1.04;3.47). In block 2,

the following constituted risk factors: need of help for locomotion through human aid (adjusted PR = 3.7; 95%CI 1.2; 11.34) or through an auxiliary device (adjusted PR = 5.8; 95%CI 1.32;11.34) and self-reported diagnosis of osteoporosis (adjusted PR = 2.1; 95%CI 1.07;3.96). Among the variables of the most proximal level (block 3), none presented statistical significance after the adjusted analysis.

## DISCUSSION

The prevalence of falls in the studied population was 32.1%, similar to what has been pointed by the Brazilian literature. In a cohort in São Paulo (Southeastern

**Table 2.** Occurrence of falls according to demographic, socioeconomic variables and variables referring to the elderly person's health. Juiz de Fora, Southeastern Brazil, 2010.

Variable	%	Crude PR (95%CI)	p	Adjusted PR (95%CI)	p
<b>BLOCK 1: Demographic and socioeconomic variables</b>					
Age (years)			0.040		0.029
60 to 70	25	1		1	
71 to 80	34	1.52 (0.91;2.50)		2.29 (0.89;5.86)	
Above 80 years	55	3.60 (1.46;8.86)		3.66 (1.47;9.10)	
Sex			0.020		0.012
Male	22	1		1	
Female	35	1.93 (1.14;3.26)		1.99 (1.16;3.40)	
<b>BLOCK 2: Variables referring to the elderly person's health</b>					
Self-rated health			0.108		0.310
Excellent/ Very good/ Good	26	1		1	
Regular/ Poor	34	1.49 (0.92;2.41)		1.36 (0.75;2.48)	
Self-rated vision			0.010		0.050
Excellent/ Very good/Good	20	1		1	
Regular/ Poor	34	2.11 (1.19;3.74)		1.78 (1.01;3.15)	
Need of help to walk			0.001		0.010
No	27	1		1	
Human help	35	1.47 (0.53;4.11)		3.35 (1.13;9.90)	
Auxiliary device	68	5.83 (2.14;15.88)		4.37 (1.05;18.20)	
Reported morbidity			0.004		0.140
No	11	1		1	
Yes	33	4.06 (1.55;10.61)		2.40 (0.75;2.48)	
Walking difficulty			0.001		0.100
No	43	1		1	
Yes	23	2.44 (1.49;3.99)		1.66 (0.91;3.00)	
Drug of continuous use			0.100		0.800
None	14	1		1	
1 to 4 drugs	33	3.06 (1.37;6.81)		1.44 (0.46;4.48)	
More than 4 drugs	36	3.47 (1.38;8.76)		0.92 (0.47;1.80)	
Self-reported diagnosis of osteoporosis			0.001		0.008
No	22	1		1	
Yes	44	2.88 (1.59;5.24)		2.33 (1.24;4.36)	

**Table 3.** Multiple regression analysis in hierarchized blocks for the occurrence of the fall event among elderly individuals. Juiz de Fora, Southeastern Brazil, 2010.

Variable	Crude PR (95%CI)	p	Adjusted PR (95%CI)	p
<b>BLOCK 1</b>				
Age (years)		0.040		0.014
60 to 70	1		1	
71 to 80	1.52 (0.91;2.50)		1.91 (0.69;5.30)	
Above 80	3.6 (1.46;8.86)		2.68 (1.0;7.22)	
Sex		0.020		0.004
Male	1		1	
Female	1.93 (1.14;3.26)		1.90 (1.04;3.47)	
<b>BLOCK 2</b>				
Self-rated vision		0.010		0.061
Excellent/ Very good/Good	1		1	
Regular/ Poor	2.11 (1.19;3.74)		1.70 (1.0;7.22)	
Need of help to walk		0.001		0.004
No	1		1	
Human help	1.47 (0.53;4.11)		3.68 (1.20;11.34)	
Auxiliary device	5.83 (2.14;15.88)		5.80 (1.32;11.34)	
Reported morbidity		0.004		0.065
No	1		1	
Yes	4.06 (1.55;10.61)		2.58 (0.94;7.07)	
Walking difficulty		0.001		0.268
No	1		1	
Yes	2.44 (1.49;4.0)		1.40 (0.77;2.52)	
Self-reported diagnosis of osteoporosis		0.001		0.008
No	1		1	
Yes	2.88 (1.59;5.24)		2.06 (1.07;3.96)	
<b>BLOCK 3</b>				
Orientation on prevention of falls		0.030		0.092
Yes	1		1	
No	1.89 (1.09; 3.27)		1.66 (0.921;2.30)	

Brazil), 31% of the elderly experienced a fall in the year before the interview.<sup>12</sup> Siqueira et al<sup>19</sup> calculated a 34.8% prevalence of falls in elderly individuals aged 65 years or older, belonging to seven Brazilian States in a cross-sectional research, differing from the present study regarding the participants' minimum age. Higher prevalences have been reported in the literature;<sup>4,14</sup> however, the differences may be attributed to the studies' design and to the adopted methodologies, or because they were point estimates that have margins of error.

More frequent occurrence of falls in women confirmed other studies.<sup>4,12,19,20</sup> However, the mechanisms to elucidate this phenomenon are not clear and are controversial. Some factors are admitted as causes: lower amount of lean body mass and of muscular force compared to men of the same age; higher loss of bone mass due to the reduction in estrogen, increasing the probability of osteoporosis; higher prevalence of chronic diseases;

greater exposure to domestic activities and to riskier behavior.<sup>8,12,18</sup>

Advanced age was associated with higher number of falls and with increase in the risk of this event, as has been pointed by the literature.<sup>6,9,18,19</sup> The process of biological aging encompasses structural and functional alterations that are progressively accumulated with the increase in age. Such alterations may impair the performance of motor skills, hinder the individual's adaptation to the environment and predispose him/her to fall.<sup>1,20</sup> As age advances, a decrease in muscular force and elasticity is observed, as well as a decline in stability and in the dynamics of the joints, and alterations to the sensory, vestibular, somatosensory, and nervous systems. These changes imply an impairment in postural control mechanisms, changing the individual's posture, gait and balance.<sup>1,7,20</sup> Advanced age is closely related to conditions that predispose to falls.

Falls are more frequent among those with diagnosis of osteoporosis, as the presence of this pathology is associated with female sex and advanced age.<sup>5,13</sup> In addition, there is the difficulty in identifying if the fracture, in case it happens, was the cause or the consequence of the fall. According to Lebrão & Laurenti,<sup>8</sup> the higher occurrence of falls among women may be a factor indicating that fractures that precede the fall would be more frequent in this sex.

Osteoporosis has a strong relationship to falls, fractures and to decline in the individual's functional capacity and quality of life.<sup>4,13,15</sup> Individuals with osteoporosis can present postural alteration, gait disturbance and body unbalance, which favors the occurrence of falls.<sup>15</sup> The increase in the mortality and morbidity that derive from osteoporosis is related to the high economic costs that come from hospitalizations, outpatient care, institutionalization and premature death.<sup>13,15</sup>

Among the studied elderly individuals, 11% needed human help or an auxiliary device for gait. Studies have shown that there is a relation between the utilization of a device to aid the gait and the presence of falls.<sup>10,16</sup> The need of help for locomotion, either by another person or by an auxiliary device, may be associated with greater impairment of the gait pattern and of the postural control mechanisms, and it may be considered an indicator of the elderly person's frailty.<sup>1,3,6</sup>

The aim of assistive technology is to enable the promotion of functional independence and facilitate the performance of the activities of daily living. However, in cases in which there is no indication, in which there is inadequate utilization and/or failures in the process of utilization and adaptation, it may have the opposite effect and contribute to unsafe locomotion and risk of falls.<sup>10</sup> The use of the auxiliary device gives greater freedom of locomotion and safety and might impel the

individual to risk him/herself more in relation to the environment's barriers, making him/her become more exposed to risk factors for falls.<sup>18</sup>

In the present study, 19% of the falls resulted in some kind of fracture, a proportion that is higher than the one found by Siqueira et al.<sup>19</sup> This difference may be attributed to the high percentage of women with self-reported diagnosis of osteoporosis in our sample. Studies<sup>4,14</sup> with different methodologies have found frequency of fractures between 24% and 64%. The largest part of the falls (59%) occurred at home, like in other studies.<sup>3,4,14,19</sup> This shows the importance of the home environment and extrinsic factors for the occurrence of falls and to the ways of preventing them, like adequate lighting, non slip floor, adequate disposition of the furniture and objects, absence of rugs, use of a support to seat while showering and some non-skid resource, grab bars to facilitate the access to stairs and steps, and others.<sup>4,6,9,14,19</sup>

The sampling process was carefully performed in the study and similar results have been pointed by the literature.<sup>12,19</sup> In this sense, the present study has great independence and, even if the sample were expanded, there would be little variation.

Demographic and epidemiological changes imply understanding and meeting the demand of the elderly population in a new way, based on integrality of care, with emphasis on prevention and health promotion. Falls and their impact are considerably important for the individuals' life, for the high economic and social costs and for the burden of the health services. The recognition of vulnerable groups becomes necessary, as well as the understanding of the fall event and the preventive action of its occurrence in an interdisciplinary team, considering its multifactorial nature.

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