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# Falls associated factors in older adults assisted by Family Health Strategy: cross-sectional study

## *Fatores associados a quedas entre idosos adscritos à Estratégia Saúde da Família: estudo transversal*

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**ABSTRACT**
To identify fall-associated factors among the elderly enrolled in Family Health Strategy (FHS). Cross-sectional, exploratory, population-based study conducted with a sample of 571 elderly. Data were collected using a semi-structured instrument and validated tests GDS-Scale, FESI-Brasil, TUG test, and SPPB. Associations were determined by Logistic Regression Models. Regarding the occurrence of falls in the previous year, 139 (26%) reported at least one fall. Falls were associated with a greater number of comorbidities (OR1.56 95%CI 1.007-2.430), use of a walking aid (OR2.18 95%CI 1.054-4.556), hearing loss report (OR1.61 95%CI 1.036-2.495), negative practice of regular physical exercise (OR0.571 95%CI 0.359-0.895), presence of pain (OR1.650 95%CI 1.073-2.558), and low self-efficacy in relation to falls (OR1.568 95%CI 1.010-2.442). At the end of the study, six factors associated with falls were identified among elderly people enrolled in FHS, which should be included in the evaluation of this population.

**Keywords:** Accident of falls. Aged. Cross-sectional study. Family health strategy.

**RESUMO**
Este estudo objetivou identificar fatores associados a quedas entre idosos adscritos à Estratégia de Saúde da Família (ESF). Estudo transversal observacional exploratório de base populacional, realizado com amostra de 571 idosos. A coleta de dados foi realizada por instrumento semiestruturado e testes validados GDS-Scale, FESI-Brasil, TUG test, e SPPB. As associações foram determinadas por Modelos de Regressão Logística. Em relação à ocorrência de quedas no ano anterior, 139 (26%) relataram ter sofrido queda. Foram associados a quedas maior número de comorbidades (OR1,56 IC95%1,007-2,430), uso de dispositivo auxiliar de marcha (OR2,18 IC95%1,054-4,556), relato de alteração auditiva (OR1,61 IC95%1,036-2,495), negativa de prática regular de exercício físico (OR0,571 IC95%0,359-0,895), presença de dor (OR1,650 IC95%1,073-2,558), e baixa autoeficácia em relação a quedas (OR1,568 IC95%1,010-2,442). Foram identificados ao final do estudo seis fatores associados a quedas entre idosos adscritos à ESF, que devem ser inseridos na avaliação desta população.

**Palavras–chave:** Acidentes por quedas. Estratégia saúde da família. Estudo transversal. Idosos.

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**INTRODUCTION**

Falls are considered an important adverse event in older adults health due to their deleterious consequences for this population. It is known that one third of the world population over 60 years old reports at least one fall in the last 12 months.[1] In the United States, 12% community dwelling older adults reported a fall, with a total estimated 80 million falls in one year.[2] In Spain, among institutionalized older adults, 23.77% are affected by falls.[3]

National data indicate that 27.6% Brazilian older adults are fallers, and in the Southeast, this percentage ranges from 26.1% in the older adults aged 60 to 69 years to 38.1% in older adults aged 80 or over.[4] In the state of Minas Gerais, a longitudinal study in the urban area of the city of Uberaba, carried out between 2014 and 2016, identified 37.1% incidence of falls, with 20% recurrent falls.[5] Among the older adults enrolled in the Family Health Strategy (FSH) in the city of Belo Horizonte, 59.3% had already suffered falls.[6]

The fall definition used in the present study considers unintentional displacement of the body to fall below its initial position, with inability to correct posture in a timely manner.[7] They can be markers of functional decline, loss of independence and autonomy, in addition to indicating some silent pathology.[8,9,10]

Falls are multifactorial events, related to diverse and independent etiologies.[1,4,5,8,9] Etiological factors can be classified as intrinsic and extrinsic, which combine in different ways in determining the risk of the event.[7] An exploratory study carried out in Sweden identified, based on models adjusted for sex and age, as factors associated with falls heart disease with symptoms (OR = 1.88 95% CI 1.17-3.04), osteoarthritis (OR 1.54 95% CI 1.14 - 2.10), use of neuroleptic drugs (OR = 3.30 95% CI 1.15 - 9.43), vertigo (OR 1.36 95% CI 1.04-1.78), nocturia (OR 1.75 95% CI 1.12 - 2.75), slow gait speed (OR 1.77 CI 95 % 1.28 - 2.46), and presence of adaptations in the domestic environment (OR 1.45 95% CI 1.10 - 1.91).[1] Another exploratory study, carried out in Brazil, in the state of Minas Gerais, found an association between falls and number of diseases (OR 1.15 95% CI 1.05 - 1.24), self-efficacy for falls (OR 1.03 95% CI 1.00-1.05), poor functional performance assessed by the Short Physical Performance Battery (SPPB) (OR 0.80 95% CI 0.70 - 0.90) and dependence on Basic Acitivities of Daily Living (BADL) (OR 2.41 95% CI 1.20- 4.83).[5] On the other hand, the study carried out with older adults registered at the FHS in Belo Horizonte evaluated the homes of the older adults, but found no association between falls and the environmental barriers identified in floor, lighting, organization of space and height of furniture in each room of the houses visited ($p > 0.05$).[6]

The knowledge of such factors is fundamental for the design of effective prevention strategies, which consider them in their entirety.[11]. In the context of Primary Health Care (PHC) and the work process of Family Health Teams (FHT), the "Handbook for Older Adults" is a fundamental tool in the design of such preventive strategies. The material presents fields for recording risk factors identified in the assessment of the older adults, a place for recording the occurrence of falls and also guidelines for making the home environment safer for them.[12] In the context of the FHS work, the assessment of the risk of falls in older adults members of the community can be carried out through questions, simple tests and observations of the environment.[13] The identification of factors associated with falls is essential for planning prevention strategies, in order to minimize the risk of falls and, consequently, avoid dependence and decrease the morbidity and mortality of the older adults.[14]

In view of the growing number of older adults who benefit from the assistance offered by FHT professionals and the need for research within this reality, the aim of this study was to identify factors associated with falls among older adults enrolled in the FHS.

## METHODOLOGY

### STUDY DESIGN AND SAMPLE

This is a cross-sectional, observational, population-based study carried out with older adults in the municipality of Alfenas, state of Minas Gerais. The study design followed the provisions of the guide Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).[15]

The study sample consisted of older adults enrolled in the FHS, based on a survey carried out in 2014. The municipality had 4,005 older adults enrolled, which represented approximately 70% resident older population. The number of older adults evaluated was defined based on a sample calculation from a pilot study, considering $\alpha = 0.05$ and power of 80%. The final sample was calculated from the insertion of the values obtained in the pilot study in a pre-programmed spreadsheet in Excel software for proportional population-based samples. To carry out the pilot study, 10 older adults were evaluated in each of the 14 FHS in the municipality. The number of evaluations determined by the sample calculation in each FHS is proportional to the older adult population assigned to each one, in search of maintaining the representativeness of the distribution of this population.

The sample included older men and women, aged 60 years or over and residing in the community. The exclusion criteria were scores below 13 (low education), 18 (medium education) and 23 (high education) on the Mini Mental State Examination (MMSE),[16] being wheelchair user or bedridden, preventing the performance of the proposed tests.

After performing the sample calculation and defining the criteria and including and excluding, 571 older adults were visited at home, divided among the FHS, identified by letters: FHS A 49; FHS B 31; FHS C 32; FHS D 54; FHS E 52; FHS F 78; FHS G 49; FHS H 50; FHS I 25; FHS J 18; FHS L 43; FHS M 30; FHS N 24; and FHS O 36. Twenty-nine were excluded for identification of probable cognitive impairment by the MMSE and 5 for not having performed the functional tests. Exclusions were distributed among the units, without affecting the proportionality of the sample among the 14 FHS in the municipality.

### EVALUATION PROCEDURES

Data were collected at the older adult's home, without prior appointment, by trained evaluators. The interview and testing took about 90 minutes and was completed in a single visit. As the questionnaire was composed of some personal questions of the elderly, he/she him/herself should answer, without influence from the caregiver or family member, when present.

Older adults who received the visits of the interviewers were chosen at random from a list composed of all the ones assigned to each FHS and, in case of refusal, other one were selected for replacement until reaching the total necessary for each territory. Upon arriving at the site, the evaluators went to the Basic Health Units (BHU) and located the randomly selected households on the territory map with the help of the FHT, and then went to the locations. Data were collected between 2014 and 2016.

### DEPENDENT VARIABLE

The history of falls was assessed by the self-report in the last 12 months. Older adults were divided into categories of non-fallers (0 falls) or fallers (1 or more falls).

### INDEPENDENT VARIABLES

The socio-demographic variables considered were color/race, education, income and living alone, assessed according to the information given by the older aduts.

In relation to clinical variables, the presence of comorbidities, use of medication, sensory changes

related to vision and hearing, feet evaluation, lifestyle habits such as smoking, alcohol consumption and physical exercise, presence of pain and depression screening were evaluated.

For the evaluation of comorbidities, the elderly self-report was considered in relation to the medical diagnosis of arterial hypertension, diabetes, Parkinson's disease, labyrinthitis, urinary and/or fecal incontinence, osteoporosis, osteoarthrosis and cerebrovascular accident (CVA). For each comorbidity, the older adults answered "yes" or "no" and then the number of comorbidities was computed from the sum of the number of "yes" responses.

The use of medication was assessed by recording all medication used by the older adults at the time of the interview, after being asked to show the examiner the boxes, packs or medical prescriptions. At the end, the number of medications checked was computed.

Sensory changes related to vision and hearing were assessed by the older adults self-report of difficulty seeing and/or hearing, and not using corrective orthoses. If the older adult used some correction equipment and did not report difficulty in seeing or hearing, it was not considered an alteration.

Feet were evaluated by asking the older adult to have the evaluator observe their feet to record changes in calluses, ulcers or wounds, ingrown toenails, onychogryphosis, claw toes, hammer toes and hallux valgus. At the end, the number of changes identified was computed.

Lifestyle habits regarding smoking and alcohol consumption were assessed by self-reporting of cigarette and alcohol consumption more than twice a month. The performance of physical exercises was assessed by the self-report of activities with the body in order to increase energy expenditure on a regular basis. All three variables had the possibility of answering "yes" or "no".

The presence of pain was considered when the older adults reported pain in one or more parts of the body, for more than a week, at any intensity.

Depression screening was assessed using the Geriatric Depression Scale (GDS). The scale consists of 15 questions with the possibility of answering "yes" or "no", with a value of 1 point each in the final score of the instrument. Older people with a score greater than 5 are considered to have positive depression screening.[17]

The assessment of overweight or obesity was performed by the Body Mass Index (BMI), and its classification according to specificities for the older adults population.[18] The measurement of body mass was performed by asking the older adult to climb on a portable GTech scale, without shoes, and keep in an upright stance, looking ahead, until the value in kilograms (kg) appears on the display. Height was measured in meters (m) with the older adult positioned with their backs to a smooth wall, without furniture or objects, using a standard measuring tape. BMI was calculated using the formula mass/height$^2$, in the unit of measurement kg/m$^2$.

Self-reported functional capacity was assessed by affirming the performance of Activities of Daily Living (ADL) independently. The use of transport, walking in the neighborhood, preparing their own meals, tidying up the house, dressing, going up and down stairs, lying and getting out of bed, bathing were considered.

The use of a walking aid was considered by the older adult's report of the use of crutches, canes or walkers. The evaluator's observation was also considered when the auxiliary device was used to perform the proposed functional tests.

Functional performance was assessed by the Short Physical Performance Battery (SPPB). Such a battery includes balance tests in standing position with feet together, tandem and semi-tandem, walking speed for 4 meters at the usual speed and time to sit and stand five times from an armless chair. At the end of the battery, a score is provided where higher values indicate better performance.[19]

Self-efficacy related to falls was assessed by applying the Falls Efficacy Scale (FES_I-Brazil). The questionnaire contains 16 questions that assess the older adults concern about the possibility of falling

when performing activities with a greater or lesser degree of challenge to balance. The higher the score, the worst the self-efficacy.[20]

Handgrip strength and gait speed were assessed according to the Frailty Phenotype protocol.[21] Grip strength was measured by the Jamar® handgrip dynamometer, with the elderly person sitting on a chair with a back, a dynamometer held in the dominant hand, elbow close to the trunk, flexed at 90º. When asked, the older adults should tighten the device with maximum force. The test was repeated three times, and the values were averaged. Gait speed was assessed by calculating the time spent by the older adults to walk 4.6 meters at usual speed three times, and averaging the values.[21]

Fall risk screening was performed using the Timed up and go test (TUG). In this test, the older adults should get up from a chair, walk for 3 meters to the point determined by the evaluator, return and sit down again. Time is recorded and the shorter the time spent, the lower the risk of falls.[22]

Self-rated health was studied through four questions about perception and satisfaction in relation to own health and comparison with that of other older adults of the same age. The answer options were "good" and "bad", for each question.

The assessment of environmental factors to identify barriers was carried out through direct observation of the home. At the end of the interview, the evaluators asked the older adults for permission to walk around the house and register the presence of stairs, the absence of non-slip floors and/or the presence of slippery floors, height and arrangement of furniture, possible adaptations, presence of objects scattered on the floor, light switch close to the bed, adequate lighting between rooms and in access to home. The older adults were also asked about the habit of wearing slippers. At the end of the observation, the number of barriers identified was computed.

## CONTROL VARIABLES

Control variables were male and female sex and age in years.

## ETHICAL CONSIDERATIONS

The study was approved by the Research Ethics Committee of UNIFAL-MG, in March 2014, by Protocol Number 564941. All the older adults signed an Informed Consent Form (ICF).

## STATISTICAL ANALYSIS

The description of the sample was made by percentage measures, since the explanatory variables and the outcome variable are binary categorical. Pearson chi-square test ($\chi^2$) was applied to compare the frequencies of groups of fallers and non-fallers older adults individuals. Age in years was analyzed by means and standard deviations. As the variables were analyzed as binary, data normality was tested by the Kolmogorov-Smirnov test only for age, with normal distribution ($p>0.05$).

For the distribution of the older adults in the categories of binary explanatory variables, the 20 Percentile of continuous variables was calculated: number of comorbidities, number of medications, number of ADLs able to perform, number of changes in the feet identified, number of environmental barriers, strength of hand grip, walking speed and SPPB, FESI and TUG scores. Values obtained were considered cutoff points for assigning the older adults to the groups.

The association of each explanatory binary variable with the outcome variable, individually, was checked by Binary Logistic Regression, being a crude model elaborated for each variable separately. In adjusted models, association was tested by Multiple Logistic Regression, containing the variables that demonstrated association in the binary model. The age variable was inserted as continuous in the regression models, and even though it was not significant, sex was inserted in the models as a control variable. After fitting the final model, which determined the explanatory variables that were associated with the outcome, the predicted probability of the elderly having suffered falls in the last 12 months was evaluated according to each associated factor based on the adjusted model.

The fit the final models was assessed by the Hosmer-Lemeshow Goodness of Fit test.

All analyses were performed using the statistical package R version 3.4.1, considering the significance level $\alpha = 0.05$.

## RESULTS

Five-hundred-thirty-seven older adults enrolled in the FHS participated in the study. Regarding the occurrence of falls in the previous year, 139 (26%) reported having suffered a fall in the previous year and 398 (74%) denied occurrence of the event. Table 1 lists the percentage of socio-demographic and clinical data in the sample.

The description of the sample according to the assessment of the functional ability for ADL, functional tests and assessment of environmental barriers is described in Table 2.

**Table 1.** Description of socio-demographic and clinical variables among total sample, fallers and non-fallers (n=537)

| Variable | Total Sample (537) | Non – Fallers (398) | Fallers (139) | p |
|---|---|---|---|---|
| Age | 70,75 ±6,85 | 70,38 ±6,75 | 71,81±7,04 | 0,03* |
| Sex: | | | | |
| Famale: | 353 (60%) | 233 (59%) | 92 (66%) | 0,13 |
| Male: | 212 (40%) | 165 (41%) | 47 (34%) | |
| Education: | | | | |
| < 3 years | 238 (44%) | 170 (43%) | 68 (49%) | 0,34 |
| > 3 years | 299 (56%) | 228 (57%) | 71 (51%) | |
| Color/Race: | | | | |
| White | 349 (65%) | 252 (63%) | 97 (70%) | 0,20 |
| Non-White | 188 (35%) | 146 (37%) | 42 (30%) | |
| Income: | | | | |
| < 2 salaries | 410 (76%) | 295 (74%) | 115 (83%) | 0,05* |
| > 2 salaries | 127 (24%) | 103 (26%) | 24 (17%) | |
| Living Alone: | | | | |
| Yes | 156 (29%) | 118 (27%) | 38 (27%) | 0,68 |
| No | 381 (71%) | 280 (73%) | 101 (73%) | |
| Number of comorbidities: | | | | |
| < 4 comorbidities | 352 (29%) | 280 (70%) | 72 (52%) | |
| > 4 comorbidities | 185 (71%) | 118 (30%) | 67 (48%) | 0,00* |
| Number of medications used: | | | | |
| < 4 medications | 344 | 264 (66%) | 80 (57%) | 0,07 |
| > 4 medications | 193 | 134 (34%) | 59 (43%) | |
| Visual Sensory Changes: | | | | |
| No | 58 (11%) | 47 (12%) | 11 (8%) | 0,26 |
| Yes | 479 (89%) | 351 (88%) | 128 (92%) | |
| Hearing Sensory Changes: | | | | |
| No | 386 (72%) | 297 (75%) | 89 (64%) | 0,02* |
| Yes | 151 (28%) | 101 (25%) | 50 (36%) | |
| Changes on feet: | | | | |
| < 4 changes | 467 (87%) | 347 (87%) | 120 (86%) | 0,91 |
| > 4 changes | 70 (13%) | 51 (13%) | 19 (14%) | |
| Smoking: | | | | |
| No | 461 (86%) | 341 (86%) | 120 (86%) | 0,96 |
| Yes | 76 (14%) | 57 (14%) | 19 (14%) | |
| Alcohol consumption: | | | | |
| < 1x/month | 481 (89%) | 353 (87%) | 128 (92%) | 0,33 |
| > 2x/month | 56 (11%) | 45 (13%) | 11 (8%) | |
| Physical Exercice: | | | | |
| No | 337 (63%) | 234 (59%) | 103 (74%) | 0,00* |
| Yes | 200 (37%) | 164 (41%) | 36 (26%) | |
| Presence of Pain: | | | | |
| No | 241 (45%) | 195 (49%) | 46 (33%) | 0,00* |
| Yes | 296 (55%) | 203 (51%) | 93 (67%) | |
| Depressive screening: | | | | |
| Negative | 434 (80%) | 333 (84%) | 101 (72%) | 0,00* |
| Positive | 103 (20%) | 65 (16%) | 38 (28%) | |
| Body Mass Index: | | | | |
| Euthrophic | 312 (58%) | 230 (58%) | 82 (56%) | 0,88 |
| Overwheigt/Obesity | 225 (42%) | 168 (42%) | 57 (44%) | |

Comorbidities, Medication, Feet changes: Percentil(20); Positive Depressive Screening GDS>5; Overwheigt IMC>27,5 kg/m$^2$,

**Table 2.** Description of functional ability, functional tests, self-rated health and assessment of environmental factors among total sample, fallers and non-fallers (n=537)

| Variable | Total Sample (537) | Non – Fallers (398) | Fallers (139) | p |
|---|---|---|---|---|
| Total of ADL: | | | | |
| < 5 acitivities | 24 (4%) | 13 (3%) | 11 (8%) | 0,04* |
| > 5 activities | 513 (96%) | 385 (97%) | 128 (92%) | |
| Use of walking aid: | | | | |
| No | 500 (93%) | 380 (95%) | 120 (86%) | 0,00* |
| Yes | 37 (7%) | 18 (5%) | 19 (14%) | |
| Self-rated health: | | | | |
| Bad/Regular | 248 (46%) | 168 (42%) | 80 (57%) | 0,00* |
| Good | 289 (54%) | 230 (58%) | 59 (43%) | |
| Compared self-rated health: | | | | |
| Bad/Regular | 128 (24%) | 80 (20%) | 48 (35%) | 0,00* |
| Good | 409 (76%) | 318 (80%) | 91 (65%) | |
| Health satisfaction: | | | | |
| Bad/Regular | 155 (21%) | 77 (19%) | 38 (27%) | 0,63 |
| Good | 422 (79%) | 321 (81%) | 101 (73%) | |
| Compared health satisfaction: | | | | |
| Bad/Regular | 90 (24%) | 59 (15%) | 31 (25%) | 0,06 |
| Good | 447 (76%) | 339 (85%) | 108 (75%) | |
| Self-efficacy related to falls | | | | |
| Hight self-efficacy | 271(50%) | 222 (56%) | 49 (35%) | 0,00* |
| Low self-efficacy | 266(49%) | 176 (44%) | 90 (65%) | |
| Handgrip strength | | | | |
| Low | 251 (47%) | 173 (43%) | 78 (56%) | 0,01* |
| Hight | 286 (53%) | 225 (57%) | 61 (44%) | |
| Functional Performance | | | | |
| Low | 227 (42%) | 150 (38%) | 77 (55%) | 0,00* |
| Moderate/Hight | 310 (58%) | 248 (62%) | 62 (45%) | |
| Gait Speed: | | | | |
| Low | 102 (19%) | 62 (16%) | 40 (29%) | 0,00* |
| Good/Hight | 435 (81%) | 336 (84%) | 99 (71%) | |
| Timed Up and Go: | | | | |
| Positive Falls Risk | 206 (38%2) | 133 (33%) | 73 (52%) | 0,00 |
| Negative Falls Risk | 331 (62%) | 265 (67%) | 66 (48%) | |
| Total of Enviromental Barriers: | | | | |
| < 5 barriers | 341 (64%) | 249 (62%) | 92 (66%) | 0,50 |
| > 6 barriers | 196 (36%) | 149 (38%) | 47 (34%) | |

ADL: Acitivities of Daily Living; Low Self – efficacy for falls FES-I >21; Low Functional Performance SPPB <7; Low Handgrip strength <23,35; Low Gait Speed < 0,51 m/s; Positive Falls Risk TUG > 12,4s, (Cutt-off points determined by sample 20 Percentile)

Variables that obtained p <0.20 were considered for the Binary Logistic Regression models. Variables that were associated with falls in the individual models were included in the final adjusted model. Table 3 lists the results of the analysis of crude models, which were not associated with the occurrence of falls and were not included in the adjusted model (Table 3).

**Table 3.** Variables without falls association in Crude Logistic Regression Models

| Variable | Coefficient | Wald | OR | CI95% |
|---|---|---|---|---|
| Income: | | | | |
| < 2 salaries | Ref. | Ref. | Ref. | Ref. |
| > 2 salaries | -0,514 | 0,041 | 0,597 | 0,358-1,965 |
| Number of medications used: | | | | |
| < 4 medications | Ref. | Ref. | Ref. | Ref. |
| > 4 medications | 0,373 | 0,064 | 1,452 | 0,976-2,155 |
| Total of ADL: | | | | |
| < 5 acitivities | Ref. | Ref. | Ref. | Ref. |
| > 5 activities | -0,934 | 0,026 | 0,392 | 0,171-1,915 |
| Self-rated health: | | | | |
| Bad/Regular | Ref. | Ref. | Ref. | Ref. |
| Good | -0,618 | 0,001 | 0,538 | 0,363-1,794 |
| Compared self-rated health: | | | | |
| Bad/Regular | Ref. | Ref. | Ref. | Ref. |
| Good | -0,740 | 0,000 | 0,476 | 0,311-1,733 |
| Depressive screening: | | | | |
| Negative | Ref. | Ref. | Ref. | Ref. |
| Positive | 0,656 | 0,004 | 1,927 | 0,212-3,037 |
| Handgrip strength | | | | |
| Low | Ref. | Ref. | Ref. | Ref. |
| Hight | -0,508 | 0,010 | 0,601 | 0,406-1,886 |
| Functional Performance | | | | |
| Low | Ref. | Ref. | Ref. | Ref. |
| Moderate/Hight | -0,719 | <0,001 | 0,480 | 0,328-1,719 |
| Gait Speed: | | | | |
| Low | Ref. | Ref. | Ref. | Ref. |
| Good/Hight | -0,438 | <0,001 | 0,456 | 0,290-1,723 |
| Timed Up and Go: | | | | |
| Positive Falls Risk | Ref. | Ref. | Ref. | Ref. |
| Negative Falls Risk | -0,790 | <0,001 | 0,453 | 0,305-1,671 |

Crude Models included just one independent variable and falls, considering age and sex as control variables

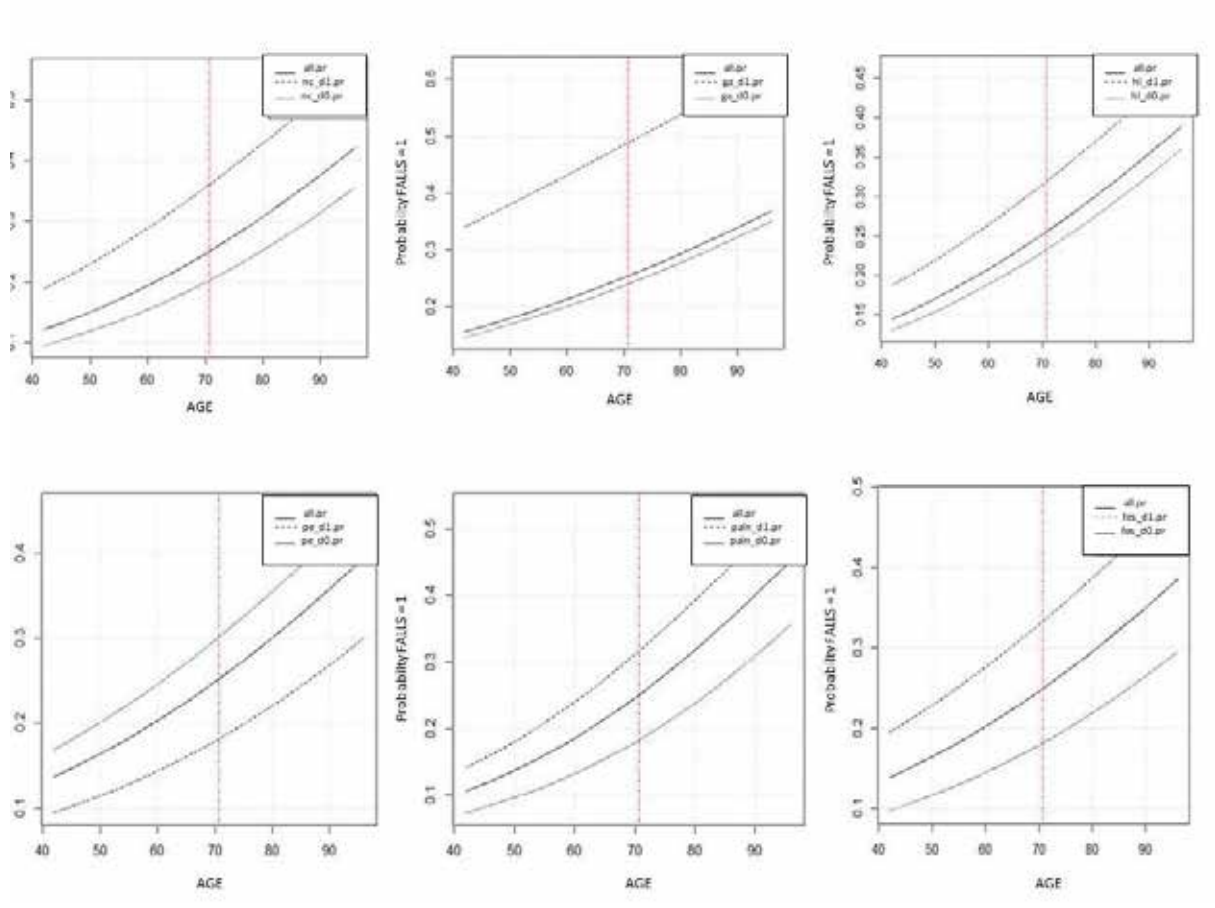
Variables that were inserted in the final adjusted model were reports of comorbidities, use of a walking aid, hearing changes, regular physical exercise, presence of pain and self-efficacy in relation to falls. The odds ratio values in the crude models of these variables and the final adjusted models are presented in Table 4.

Based on the final adjusted model, the predicted probabilities as a function of age were calculated for each variable in the model associated with falls, as illustrated in Figure 1. For all the variables considered, the probability of the older adult having fallen increased with increasing age, being higher in older adults with hearing impairment, who did not practice regular physical exercises, who presented poor self-efficacy for falls, used a walking aid, reported pain somewhere in the body and reported medical diagnosis of more than four comorbidities. The greatest difference in the predicted probability of falls between the groups was verified among those who use or not use a walking aid.

**Table 4.** Crude Logistic Regression Models and Adjusted Final Regression Model

| | Crude Model[1] | | | | Adjusted Model[2] | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | Coefficient | Wald | OR | CI95% | Coefficient | Wald | OR | CI95% |
| Number of comorbidities: | | | | | | | | |
| < 4 comorbidities | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| > 4 comorbidities | 0,792 | <0,001 | 2,208 | 1,485-3,284 | 0,448 | 0,045 | 1,566 | 1,007-2,430 |
| Use of walking aid: | | | | | | | | |
| No | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| Yes | 1,206 | 0,004 | 3,342 | 1,694-6,620 | 0,738 | 0,0347 | 2,189 | 1,054-4,556 |
| Hearing Sensory Changes: | | | | | | | | |
| No | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| Yes | 0,520 | 0,071 | 1,652 | 1,088-2,492 | 0,477 | 0,032 | 1,611 | 1,036-2,495 |
| Physical Exercice: | | | | | | | | |
| No | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| Yes | -0,695 | 0,001 | 0,498 | 0,321-0,759 | -0,558 | 0,016 | 0,571 | 0,359-0,895 |
| Presence of Pain: | | | | | | | | |
| No | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| Yes | 0,663 | 0,001 | 1,942 | 1,302-2,927 | 0,501 | 0,023 | 1,650 | 1,073-2,558 |
| Self-efficacy related to falls | | | | | | | | |
| Hight self-efficacy | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| Low self-efficacy | 0,840 | <0,001 | 2,316 | 1,558-3,475 | 0,450 | 0,045 | 1,568 | 1,010-2,442 |
| Hosmer_Lameshow GOF[3]: 0,979 | | | | | | | | |

1: Crude Models included just one independent variable and falls, considering age and sex as control variables 2: Adjusted Model including all associated variables in crude models, and age and sex as control variables; 3: Hosmer-Lameshow Goodness-of-Fit: fit of final model.




FALLS = 1 = Faller; vertical line = mean of sample age; central continuous line = falls predicted probability just due age;
nd_d 1= older adults whith more than 4 comorbidities, nd_d 0= older adults whith until 4 comorbidities;
da_d1= use of walking aid, da_d0 = not use of walking aid;
aa_d1 = positiva hearing loss, aa_d0 = negative hearing loss;
af_d1 = practice of physical exercice, af_d0 = no practice of phisycal exercice;
dor_d1 = with related pain, dor_d0 = without related pain;
fes_d1 = low self-efficacy in relation of falls, fes_d0 = hight self-efficacy in relation of falls;

**Figure 1.** Predicted Probability of falls occurence in function of age for associated variables in final model.

## DISCUSSION

Falls in the last 12 months were associated with the diagnosis of more than four comorbidities (OR1.56 95%CI 1.007-2.430), use of a walking aid (OR2.18 95%CI 1.054-4.556), report of hearing impairment (OR1.61 95%CI 1.036-2.495), negative practice of regular physical exercise (OR0.571 95%CI 0.359-0.895), presence of pain (OR1.650 95%CI 1.073-2.558), and low self-efficacy in relation to falls (OR1.568 95%CI 1.010-2.442). Such variables also increased the predicted probability of falls due to age, in an analysis based on the final adjusted model. The mean age was higher in faller older adults (p = 0.03).

The present study revealed that older - older people were more likely to fall, since age was associated with the occurrence of falls, as reported in other studies.[5,14] The study by Soares (2014) presented age as a risk factor only for recurrent falls (OR = 2.30; 95% CI 1.12-4.72). However, in the present study, recurrent falls were not considered separately in the analyses, even so, the association with age is maintained.[23] Since the association appears regardless of the number of falls, the influence of age on falls is reinforced in this population. The study by Siqueira (2011) also observed that, in all regions of Brazil, the

prevalence of falls was higher in the older adults over 80 years of age. The northern region of the country had the lowest prevalence of falls, with 15.3% in the elderly aged 60-69 years, 18.0% between 70 and 79 years, and 30.5% above 80, with such prevalence being different from the southeast region, location of the municipality of the present study, except for the older age group ($p > 0.05$).[4]

The number of comorbidities reported by the older adults was associated with the occurrence of falls, and also increased their probability of occurrence. This result corroborates Gale (2018) in England, where the number of comorbidities was associated with the occurrence of falls in men (RR 1.10 95% CI 1.06 - 1.14) and women (RR 1.07 95% CI 1.04 - 1.01).[24] Such coincidence of results reinforces the importance of investigating the presence of comorbidities in the assessment of the older adults, especially in PHC.

As for the use of a walking aid, the results of this study showed an association between the use of a walking aid and the occurrence of falls. The use of the device increased the probability of the older adults having fallen in the last 12 months, being the variable where there was a greater difference in the probability of having fallen among older adults who use and who do not use some walking aid. Such an association was also reported in a study in Saudi Arabia, where the use of canes (OR 1.54 95%CI 1.15 - 2.05) and walkers (OR 2.43 95% CI 1.28 - 4.62) associated with the occurrence of falls among the older adults.[25] The purpose of the walking aid is to enable the promotion of functional independence and facilitate the performance of ADLs. However, in cases where there is no indication or when the use is inappropriate or there has not yet been adaptation to the use, the device may have the opposite effect and contribute to unsafe locomotion and risk of falls.[26] Another possibility described is that the use of the auxiliary device allows greater freedom of movement and safety and could encourage the individual to take more risks in relation to the barriers of the environment, increasing, also for this reason, the probability of falling.[26]

The reduction in hearing acuity was associated with the occurrence of falls in the present study. A North American study also identified this association, by assessing the highest annual percentage of increased prevalence of falls among older adults with hearing impairment (9.7% 95%CI 7.0 - 12.4), greater than the percentage of increase observed among older adults without hearing loss (4.4% 95%CI 2.6 - 6.2).[27] According to the same study, hearing loss and falls can be related because hearing provides acoustic information about the environment, and, when reduced, impairs the identification of environmental irregularities, which may result in falls.[27]

In this study, not practicing physical exercise was associated with the occurrence of falls, increasing their probability of occurrence. A systematic review composed of 34 articles that studied the association between physical exercise, the occurrence of falls and injuries from falls, concluded that the practice of physical exercises, regardless of type or time, reduces the occurrence of falls between 32 and 40% and injuries[28]. Thus, it can be suggested that regular physical exercise influences the occurrence of these accidents and can be an alternative for prevention.

The presence of pain was associated with the occurrence of falls in the last 12 months. This was also observed in the English study, where the presence of pain, regardless of the intensity, increased the risk of the older adults suffering falls among men (HR 1.15 95%CI 1.09 -1.21) and women (HR 1.09 95%CI 1.04 - 1.13).[24] The relationship between the presence of pain and falls can be explained by the consideration that pain increases the feeling of instability and the fear of falling.[29]

Fear of falling is measured by self-efficacy in relation to falls, and, in agreement with the possible explanation for the association of falls with pain[29], it was also associated with falls among the older adults participants in this study. The low self-efficacy for falls, which is related to the fear of falling, can lead to the restriction of activities[20]. It is suggested that older adults with low self-efficacy for falls avoid performing

ADL for fear of falling and, therefore, suffer falls as a result of inactivity, as reported in a study where older adults with low self-efficacy for falls were 3.41 times more likely to fall when compared to older adults with normal self-efficacy[30]. Such an association was also found in Brazil, where impaired self-efficacy was also associated with the occurrence of at least one fall in the last 12 months (OR = 1.77; 95%CI 1.10-2.83).[23]

A limitation of this study is the existence of a possible memory bias, since much information was based on self-report, and also on the use of structured questions and non-validated questionnaires for some variables, such as ADL. The cross-sectional design of the study does not allow the inference of causality, only estimates of greater probabilities of occurrence of falls as a function of explanatory variables.

Among the strengths are the identification of factors associated with falls that can be easily assessed in the context of care for the older adults by professionals linked to the FHT, which can have an impact on actions aimed at preventing the event. The population-based sample, with representativeness, also allows generalization of results to other PHC contexts.

## CONCLUSION

The exploratory assessment of the occurrence of falls in the older adults enrolled in the FHS in search of associated factors detected an association of falls with older age, the diagnosis of four or more comorbidities among those investigated, use of walking aid, report of hearing impairment, negative practice of regular physical exercise, presence of pain and low self-efficacy in relation to falls. The presence of these factors increased the likelihood of the older adults having suffered a fall in the past 12 months.

Such factors associated with the occurrence of falls, presented by the final model of this study, can be identified and addressed by FHT professionals. The potential of a factor associated with falls to increase the likelihood of the elderly to suffer falls reinforces the importance of its assessment, as part of the routine of preventing falls and recurrent falls, and the health surveillance of the older adults population.

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