

Fragility fracture: risk factors in a retrospective cohort

Fratura por fragilidade: fatores de risco em uma coorte retrospectiva

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ABSTRACT

Objective: To evaluate the risk factors for fragility fractures (FF) in patients admitted to a tertiary teaching hospital in the municipality of Diamantina, Minas Gerais. **Methods:** Sociodemographic, health, lifestyle (smoking, alcohol consumption, sun exposure, physical activity level, eating habits), mobility, and dependence level data were collected from the medical records of patients aged 50 years or older, hospitalized with FF, from April to September 2020. **Results:** A total of 52 patients were hospitalized with FF, 60% had a diagnosis of proximal femur fracture. Only 17.3% of the patients had a previous diagnosis of osteoporosis. The most prevalent risk factors for FF were female gender, cognitive deficit, sarcopenia, dynapenia, family history of osteoporosis or fracture due to fall, low sun exposure, insufficient consumption of milk and dairy products, physical inactivity, and dependence on basic and instrumental activities of daily living. When comparing the groups with proximal femoral fractures and other fractures, the group with proximal femoral fractures showed a higher frequency of individuals with advanced age (≥ 80 years), cognitive deficit, low weight, sarcopenia, smoking, physical inactivity, and mobility limitation, whereas the group with other fractures presented a higher frequency of family history of osteoporosis or fracture due to fall. **Conclusion:** The results demonstrated an underdiagnosis of osteoporosis in the studied population. Many modifiable risk factors for osteoporosis and falls have been identified. Interventions toward these risk factors should be considered in order to prevent FF.

Keywords: Fractures, Accidental Falls, Osteoporosis, Risk Factors

RESUMO

Objetivo: Avaliar os fatores de risco para fratura por fragilidade (FF) em pacientes internados em um hospital terciário de ensino, no município de Diamantina, Minas Gerais. **Métodos:** Dados sociodemográficos, de saúde, estilo de vida (tabagismo, consumo de álcool, exposição ao sol, nível de atividade física, hábitos alimentares), mobilidade e nível de dependência foram coletados dos prontuários de pacientes com 50 anos ou mais, internados com FF, no período de abril a setembro de 2020. **Resultados:** Um total de 52 pacientes foram internados com diagnóstico de FF, sendo 60% com diagnóstico de fratura proximal de fêmur. Somente 17,3% dos pacientes possuíam diagnóstico prévio de osteoporose. Os fatores de risco mais frequentes para FF foram sexo feminino, déficit cognitivo, sarcopenia, dinapenia, histórico familiar de osteoporose ou fratura por queda, baixa exposição ao sol, consumo insuficiente de leite e derivados, inatividade física e dependência nas atividades básicas e instrumentais de vida diária. Quando comparados os grupos com fratura proximal de fêmur e outras fraturas, o grupo com fratura proximal de fêmur apresentou maior frequência de indivíduos com idade avançada (≥ 80 anos), déficit cognitivo, baixo peso, sarcopenia, tabagismo, inatividade física e limitação na mobilidade, ao passo que o grupo com outras fraturas apresentou maior frequência de histórico familiar de osteoporose ou fratura por queda. **Conclusão:** Os resultados demonstraram um subdiagnóstico da osteoporose na população estudada. Muitos fatores de risco modificáveis para osteoporose e quedas foram identificados. Intervenções direcionadas para estes fatores de risco devem ser consideradas de forma a prevenir as FF.

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Palavras-chaves: Fraturas, Acidentes por Quedas, Osteoporose, Fatores de Risco

INTRODUCTION

Osteoporosis is a chronic and progressive osteometabolic disease characterized by low bone mineral density and microarchitectural deterioration of bone tissue.¹ It is a silent disease with consequent fragility fractures (FF), due to low-impact traumas, often falls from standing height or less, that would not usually result in fracture.²

FF occurs globally every 3 seconds, with a high socioeconomic impact on morbidity, mortality, and costs. It may lead to loss of autonomy, reduced quality of life, and need for specialized care.² Low bone mineral density is a modifiable risk factor for FF, which increases the risk of almost all types of fractures in the older adult population.² Regardless of bone mineral density, some studies have found that aging is the principal risk factor for FF, because it cannot be modified and is associated with a higher risk of falls.³⁻⁵ Sex is the second most important risk factor for FF, considering that both osteoporosis and fractures are more common in women.^{6,7} In addition to the risk factors mentioned above, a meta-analysis study found that the risk of any FF is twice as high in the population aged 50 years or more, when there is a history of a previous fracture.⁸

The most common FF are fractures of the distal extremity of the radius, of the vertebrae; of the proximal region of the femur, humerus, and tibia; ankle, and pelvis.⁹ Data from the Unified Health System (SUS), in the triennium of 2008-2010, indicated an expense of R\$ 288,986,335.¹⁵ with 3,252,756 procedures related to the treatment of osteoporosis in the older adults in Brazil.¹⁰ Hip fractures, in particular, are among the health conditions that frequently require prolonged health care in an aging society.¹¹ The Brazilian population is aging; it is estimated that by 2060, the percentage of people aged 65 years or more will increase from 9.2% to 25.5%. In other words, 1 in 4 Brazilians will be an older adult.¹²

The risks of FF are country-specific. Therefore, prevention strategies should be adapted to the needs and resources of each region.¹³

OBJECTIVE

This study aimed to evaluate the risk factors for FF in patients admitted to the Nossa Senhora da Saúde Hospital (NSSH), located in the municipality of Diamantina, Minas Gerais, Brazil. This municipality is the reference in the area of health for the Jequitinhonha and Mucuri Valleys, a region characterized by low social and economic indicators.¹⁴

METHODS

This is a retrospective study, including all patients aged 50 years or older, admitted with FF at the NSSH – Diamantina/MG, from April to September 2020. These patients were attended by a team of professionals enrolled in the multiprofessional residency in the health of older adults at the Universidade Federal dos Vales do Jequitinhonha e Mucuri. The team is responsible for a specific evaluation. The following information was retrieved from the medical records: sociodemographic, health, and cognitive status, assessed using the Mini-Mental State Examination,¹⁵ mobility, dependence level in activities of daily living (ADL), evaluated using the Katz scale,¹⁶ dependence level in instrumental activities of daily living (IADL), assessed using the Lawton & Brody scale,¹⁷ handgrip strength (evaluated

in the dominant or unaffected limb, in the case of upper limb fractures, using the JAMAR dynamometer and considering the mean value of three measurements), anthropometric data (calf circumference, to assess sarcopenia; weight and height, to calculate body mass index), lifestyle data (smoking, alcohol consumption, physical activity level, evaluated by means of the Human Activity Profile,¹⁸ and eating habits, assessed using a food frequency questionnaire), length of stay, and location of the fracture. This study was approved by the Research Ethics Committee of the Universidade Federal dos Vales do Jequitinhonha e Mucuri (4.838.608).

In order to classify the participants in this study, the following scores were considered cognitive impairment in the mini-mental state examination: ≤ 13 for illiterate individuals, ≤ 18 for those with less than 8 years of schooling, and ≤ 26 for those with 8 or more years of schooling.¹⁵ Body mass index < 18.5 , $18.5 - 24.9$, $25 - 29.9$, and ≥ 30 kg/m² were considered underweight, adequate weight, overweight, and obesity, respectively. Patients with calf circumference < 33 cm, female, and < 34 cm, male, were classified as sarcopenic,¹⁹ and those with handgrip strength < 17.4 kg, female, or < 25.8 kg, male, were considered dynapenic.²⁰ A non-daily consumption of milk and dairy products was considered insufficient.²¹ Older adults with a score < 53 in the Human Activity Profile were classified as physically inactive.¹⁸ Older adults with dependence in at least one item on the Katz scale and a score > 5 on the Lawton & Brody scale were classified as dependent in ADL and IADL, respectively.

Data were presented as means, standard deviations, and absolute and relative frequencies. The normality in data distribution was verified by the Shapiro-Wilk test. To identify differences between the proximal femoral fractures group and other fractures group, the chi-square test of independence was used for categorical variables and the Mann-Whitney U test for variables with nonnormal distribution

RESULTADOS

The study included 52 patients admitted with FF. Two participants had more than one fracture resulting from the same fall, namely proximal humerus/proximal femur and proximal humerus/patella. Three patients were readmitted in the same period, two due to hip arthroplasty dislocation and one with a diagnosis of proximal femoral fracture contralateral to the first fracture. The highest percentage of fractures was in the proximal femoral region (60.0%) (Table 1).

Regarding the place of origin, only 15.4% of the patients resided in the city of Diamantina. The others were from 23 different municipalities in the Jequitinhonha and Mucuri Valleys.

Table 1. Bone fragility fracture, Nossa Senhora da Saúde Hospital, Diamantina-MG (n= 52)

Fracture location	n (%)
Proximal femur	33 (60.0)
Femur diaphysis	1 (1.8)
Tibial diaphysis	1 (1.8)
Radius distal or radius/ulna distal	7 (12.7)
Malleolus or medial and lateral malleolus	6 (10.9)
Humerus (proximal or distal)	5 (9.1)
Patella	2 (3.6)

Regarding the place of origin, only 15.4% of the patients resided in the city of Diamantina. The others were from 23 different municipalities in the Jequitinhonha and Mucuri Valleys. The mean age of the patients was 75.8 (12.6) years, ranging from 52 to 100 years. Most were female (78.9%), widowed (50.0%), retired (88.5%), had an income ≤ 1 minimum wage (65.4%), and the black population (brown and black race/color) represented 78.9% of the participants. When analyzing only the subgroup with proximal femoral fracture, most were illiterate (56.3%). The group with proximal femoral fracture showed a significantly higher frequency of individuals with advanced age, low education, and retired compared to the other group. The sociodemographic, non-modifiable factors identified as a risk for FF were female gender (in both groups) and advanced age (≥ 80 years) in the subgroup with proximal femoral fracture (62.4%) (Table 2).

Table 2. Sociodemographic characteristics of the older adults admitted with fragility fracture at the Nossa Senhora da Saúde Hospital, Diamantina-MG

Variables	Total (N= 52) n (%)	Proximal femoral fractures (N= 32) n (%)	Others fractures (N= 20) n(%)
Female	41 (78.9)	24 (75.0)	17 (85.0)
Age group, years *			
50 – 59	9 (17.3)	2 (6.3)	7 (35.0)
60 – 69	9 (17.3)	3 (9.4)	6 (30.0)
70 – 79	11 (21.2)	7 (21.9)	4 (20.0)
≥ 80	23 (44.2)	20 (62.4)	3 (15.0)
Race/Color			
Brown/Black	41 (78.8)	23 (71.9)	18 (90.0)
White	11 (21.2)	9 (28.1)	2 (10.0)
Marital status			
Married	20 (38.5)	9 (28.1)	11 (55.0)
Single/Divorced /Separated	6 (11.5)	4 (12.5)	2 (10.0)
Widowed	26 (50.0)	19 (59.4)	7 (35.0)
Schooling *			
Illiterate	23 (44.2)	18 (56.3)	5 (25.0)
Complete/incomplete elementary school	22 (42.3)	13 (40.6)	9 (45.0)
Complete/incomplete high school	4 (7.7)	0 (0.0)	4 (20.0)
Higher education	3 (5.8)	1 (3.1)	2 (10.0)
Retired *	46 (88.5)	31 (96.9)	15 (75.0)
Paid work	4 (7.7)	1 (3.1)	3 (15.0)
Income			
≤ 1 minimum wage	34 (65.4)	17 (53.1)	17 (85.0)
2-3 minimum wages	16 (30.8)	13 (40.6)	3 (15.0)
≥ 4 minimum wages	2 (3.8)	2 (6.3)	0 (0.0)
Institutionalized	1 (1.9)	1 (3.1)	0 (0.0)
Living alone	9 (17.3)	3 (9.4)	6 (30.0)

* $p < 0,05$

Regarding the health conditions and hospitalization, it is important to report that only 9 (17.3%) of the patients had a previous diagnosis of osteoporosis. Of these, only 7 (13.5%) reported having a bone densitometry scan. During hospitalization, 23.1% of the patients presented delirium, and 19.2% required care in the Intensive Care Unit, all with proximal femoral fracture and aged 73 years or over. The average hospitalization period was 7.0 (5.2) days, ranging from 2 to 30 days, and one of the patients died before the surgical procedure due to lung cancer. The most prevalent comorbidity was hypertension (75.0%). The most prevalent modifiable risk factors for FF in all fracture types were: cognitive impairment (53.8%), sarcopenia (57.5%), and dynapenia (59.0%). The proximal femoral fracture group had a significantly higher frequency of individuals with cognitive impairment, low weight, and sarcopenia, all modifiable risk factors for osteoporosis and falls, whereas the group with other fractures had a higher frequency of individuals with a family history of osteoporosis or fracture due to fall, a non-modifiable risk factor (Table 3).

Table 4 shows data on lifestyle, mobility, and dependence level of the patients with FF. The modifiable risk factors for FF that had the highest frequency in all fracture types were: low sun exposure (55.8%), insufficient consumption of milk and milk products (69.8%), physical inactivity (65.4%), and dependence in ADL (51.0%) and AIDL (84.6%). Smoking, physical inactivity, and mobility limitation were risk factors with a significantly higher frequency in the group with proximal femoral fracture.

DISCUSSION

FF is associated with osteoporosis and falls,² two preventable conditions. Osteoporosis, when diagnosed early, can be treated, and the gold standard for the diagnosis is bone densitometry.²² The treatment reduces the fracture risk by approximately 50%.² Souza et al.²³ evaluated 44 patients with FF admitted to a tertiary hospital in the municipality of Juiz de Fora/MG and observed, as in the present study, that few patients (1.76%) had undergone bone densitometry. It may be the reason for the lack of previous diagnoses observed in the present study and described in the literature.^{23,24}

Advanced age and female gender are recognized risk factors for FF.²⁻⁷ In the current study, FF was more frequent in individuals aged 80 years or older, especially among those with proximal femoral fracture, and in women, who accounted for 78.9% of the total patients with FF. The predominance of women over men was in a ratio of 3.7:1, and the mean age of the participants was 75.8 years, data similar to previous studies.^{25,26} Calcium deficiency is an important risk factor for osteoporosis.² Vitamin D, in turn, plays an essential role in calcium absorption; it is produced in the skin when exposed to the sun's ultraviolet rays for at least 10 to 15 minutes a day.²

According to dietary recommendations, daily calcium needs vary with age, and 1,200 mg is recommended for older adults of both sexes.²¹ The Brazilian Ministry of Health recommends an intake of three portions of milk or dairy products, or both a day.²⁷ This amount is sufficient to meet 75% of the daily calcium needs.²⁸ Most of the patients in this study reported low sun exposure and insufficient consumption of milk and dairy products.

Table 3. Health characteristics of the older adults admitted with fragility fracture at the Nossa Senhora da Saúde Hospital, Diamantina-MG

Variable	Total (N= 52) n (%)	Proximal femoral fractures (N= 32) n (%)	Other fractures (N= 20) n (%)
Comorbidities, mean (SD)	3.1 (2.1)	3.3 (2.2)	2.6 (1.7)
Heart disease	12 (23.1)	9 (28.1)	3 (15.0)
Hypertension	39 (75.0)	23 (71.9)	16 (80.0)
Diabetes mellitus	12 (23.1)	7 (21.9)	5 (25.0)
Dislipidemia	13 (25.0)	7 (21.9)	6 (30.0)
Pulmonary disease	8 (15.4)	6 (18.8)	2 (10.0)
Stroke	6 (11.5)	5 (15.6)	1 (5.0)
Depression/anxiety	12 (23.1)	5 (15.6)	7 (35.0)
Musculoskeletal disease	14 (26.9)	8 (25.0)	6 (30.0)
Thyroid disease	8 (15.4)	7 (21.9)	1 (5.0)
Gastrointestinal disease	10 (10.2)	7 (21.9)	3 (15.0)
Dementia	6 (11.5)	6 (18.8)	0 (0.0)
Other diseases, mean (SD) †	0.2 (0.4)	1,3 (0.5)	0.1 (0.3)
Medications, mean (SD)	3.9 (2.8)	4,1 (2.9) ††	3.5 (2.3)
Early menopause (<40 years)	1 (1.9)	0 (0.0)	1 (5.0)
Cognitive impairment †††*	28 (53.8)	21 (65.6)	7 (35.0)
Urinary incontinence	18 (34.6)	14 (43.8)	4 (20.0)
Severe visual impairment	8 (15.4)	6 (18.8)	2 (10.0)
Hearing deficiency	6 (11.5)	5 (15.6)	1 (5.0)
BMI, kg/m ² *	a	b	c
< 18.5	3 (6.1)	3 (9.7)	0 (0.0)
18.5 – 24.9	19 (38.8)	15 (48.4)	4 (22.2)
25 – 29.9	18 (36.7)	11 (35.5)	7 (38.9)
≥ 30	9 (18.4)	2 (6.5)	7 (38.9)
Sarcopenia*	23 (57.5)^d	20 (71.4) ^e	3 (25.0) ^f
Dynapenia	23 (59.0)^g	14 (73.7) ^h	9 (45.0)
Family history of osteoporosis or fracture due to fall*	35 (67.3)	15 (46.9)	20 (100.0)
Recurrent fall history in the last year	25 (48.1)	13 (40.6)	12 (60.0)
Fragility fracture history	20 (38.5)	13 (40.6)	7 (35.0)

SD– standard deviation; BMI– body mass index; †Neurocysticercosis, anemia, prostatic hyperplasia, prostate cancer, chronic kidney disease, Parkinson's disease, psychotic disorder, epilepsy; †† 1 patient was using phenobarbital; †††including patients diagnosed with dementia; ^a N= 49; ^b N= 31; ^c N= 18; ^d N= 40; ^e N= 28; ^f N= 12; ^g N= 39; ^h N= 19; * p < 0,05

Table 4. Lifestyle, mobility, and dependence level characteristics of the older adults admitted with fragility fracture at the Nossa Senhora da Saúde Hospital, Diamantina-MG

Variable	Total (N= 52) n (%)	Proximal femoral fractures (N= 32) n (%)	Other fractures (N= 20) n (%)
Smoking*			
Never smoked	36 (69.2)	18 (56.3)	18 (90.0)
Smoked and stopped/Smokes	16 (30.8)	14 (43.7)	2 (10.0)
Sun exposure			
Everyday	23 (44.2)	14 (43.8)	9 (45.0)
Sometimes or never	29 (55.8)	18 (56.2)	11 (55.0)
Alcohol consumption			
Never	39 (75.0)	25 (78.1)	14 (70.0)
2 to 3 times a week	3 (5.8)	1 (3.1)	2 (10.0)
4 or more times a week	4 (7.7)	3 (9.4)	1 (5.0)
From 2 to 4 times a month	6 (11.5)	3 (9.4)	3 (15.0)
Insufficient milk and milk products consumption	30 (69.8)^a	18 (64.3) ^b	12 (80.0) ^c
Physically inactive*	34 (65.4)	27 (84.4)	7 (35.0)
Housebound*	21 (40.4)	21 (65.6)	0 (0.0)
ADL Dependence	26 (51.0)^d	18 (58.1) ^e	8 (40.0)
IADL dependence	44 (84.6)	29 (90.6)	15 (75.0)

ADL– activities of daily living; IADL – instrumental activities of daily living; ^a N= 43; ^b N= 28; ^c N= 15; ^d N= 51; ^e N= 31; * p < 0,05

Dependence in IADL was observed in both groups of this study, 90,6% in the proximal femoral fracture group and 75% in the other fractures group. Huffman et al.²⁹ evaluated 888 individuals and reported that those diagnosed with osteoporosis were more likely to have difficulty in ADL.

Also, the group with proximal femoral fracture showed a higher frequency of individuals housebound (65.6%) and with dependence in ADL (58.1%). These data are worrisome. The literature reports that the majority of the individuals with proximal femoral fracture do not recover their previous level of function, and 30% lose their independence.²

It was possible to observe that most patients with proximal femoral fracture showed cognitive impairment and were aged 80 years or older. It is known that the incidence of dementia increases with age, particularly among those over 85 years of age.² A systematic review study reported in older adults with proximal femoral fracture a prevalence of dementia of 19.2% (95%CI: 11.4% to 30.6%) and cognitive impairment of 41.8% (95%CI: 37.0% to 46.8%),³⁰ similar to the present study. Strategies to prevent fractures and enhance the postoperative rehabilitation of these patients are necessary.

Bortoli et al.³¹ assessed 33 older adults receiving medical treatment in the Neurogeriatric and Cognitive Impairment outpatient clinic of the Clinical Hospital of the Universidade Federal do Paraná (HC-UFPR). They concluded that the more severe the cognitive impairment, worse the balance, and higher the risk of falls.

The prevalence of sarcopenia was significantly higher in the group with proximal femoral fracture, as in a previous study conducted in Colombia.³² A systematic review and meta-analysis study demonstrated a higher risk of falls and fractures in sarcopenic individuals compared to non-sarcopenic individuals.³³ There is growing evidence that bone and muscle tissue interact, not only because of the mechanical effect but because osteoporosis and sarcopenia have many common risk factors.³⁴ Currently, osteoporosis and sarcopenia are recognized as a single entity, osteosarcopenia, a predictor of falls, fractures, and mortality in older adults.³⁵ In addition, a study carried out in a falls and fractures clinic in older adults showed an association between sarcopenia, considering low muscle mass, low muscle strength, and low gait speed, with dependence in IADL and mobility limitation,³² conditions highly prevalent in the population of the present study.

In this study, most patients (65.4%) were physically inactive, and this risk factor was significantly more frequent in the group with proximal femoral fracture (84.4%), a fact already reported in the literature.²⁶ Studies show a higher prevalence of falls in sedentary older adults and that physical activity contributes to good bone quality, decreasing the risk of osteoporosis, improving balance, gait, and muscle strength, preventing falls,^{36,37} and consequently, fractures.

It is important to point out that family history of osteoporosis or fracture due to fall, a recognized risk factor for osteoporosis,² was significantly higher in the group with other fractures. Considering that the individuals in this group were younger, this suggests that family history of osteoporosis or fracture due to fall may be a major risk factor for presenile osteoporosis. Recurrent history of falls was present in both groups. It increases the risk of FF and is associated with other risk factors for osteoporosis. Falls and, consequently, fear of

falling can lead to physical inactivity, impaired mobility, resulting in social isolation, reduced self-esteem, anxiety, and depression.² Thus, individuals with history of falls, even without a history of fractures, require evaluation and treatment to prevent new falls and future fractures.

Notably, FF was more prevalent in individuals with self-reported brown/black race/color, albeit there is consensus in the literature that white race is an important risk factor for osteoporosis. This fact reinforces the multifactorial nature of osteoporosis. Moreover, it depicts the demographic profile of the Brazilian population, in which the black population is the majority.³⁸

It is crucial to reinforce that the present study was conducted in a region characterized by low social and economic indicators, as previously described. Corroborating this fact, 65.4% of the participants had income lower than or equal to one minimum wage, and 44.2% were illiterate. This context is associated with a lack of access to health services, such as the absence of screening and monitoring osteoporosis using bone densitometry, inefficiency in the treatment of health conditions that contribute to functional disability, leading to mobility limitation and dependence in ADL and IADL, lack of health education programs guiding about lifestyle habits related to the prevention of osteoporosis.

Furthermore, low education increases the risk of cognitive impairment in advanced ages, and low income makes it difficult to adopt an adequate diet and acquire medications for the treatment of osteoporosis and other related health conditions. These issues should be considered in the development of strategies aimed at the prevention of FF in this region.

CONCLUSION

The present work identified a high percentage of individuals with no diagnosis of osteoporosis prior to the FF and several modifiable risk factors for osteoporosis and falls, many of which can be addressed in primary care.

Public policies are necessary to expand the diagnosis of osteoporosis and introduce the appropriate treatment before the first fracture. Also, policymakers should increase the scope of health education programs targeting lifestyle-related risk factors such as low sun exposure, physical inactivity, and inadequate eating habits.

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