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Clinical and epidemiological profile of elderly patients evaluated at a tertiary hospital after same-level falls

Perfil clínico e epidemiológico de idosos avaliados em hospital terciário após quedas do mesmo nível

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ABSTRACT

Introduction: Aging leads to various biochemical, morphological, and functional changes, including gait alterations, visual impairment, and reduced muscle strength. These factors increase the risk of unintentional falls, which may result in contusions, fractures, psychological trauma, and even death. In 2018, falls accounted for 12,000 deaths among older adults in Brazil.

Objective: To analyze the clinical and epidemiological profile of older adults who sustained fractures due to same-level falls and to assess risk factors for osteoporosis and fractures.

Methods: Cross-sectional observational study including patients aged ≥60 years admitted to a tertiary hospital following a fall. Cases involving high-energy trauma mechanisms were excluded. Patients were equally divided into a fractured group (FG) and a non-fractured control group (CG). Risk factors were assessed, and the risk of osteoporosis and fractures was estimated using validated calculators.

Results: The sample included 100 patients (mean age ± 71.78 years; mean BMI ± 25.89 kg/m²), predominantly female. A significant difference was observed in sarcopenia assessment: fractured individuals had lower calf circumference, waist circumference, and handgrip strength values. No significant differences were found regarding fall questionnaire responses or the use of medications associated with osteoporosis and falls. Significant differences were observed between FG and CG concerning the risk of hip fractures and major fractures, as evaluated by the FRAX tool. The IOF One-Minute Osteoporosis Risk Test was not effective in distinguishing between groups.

Conclusion: Contrary to expectations, variables such as BMI, smoking, physical inactivity, comorbidities, oral glucocorticoid use, and previous falls did not differentiate the groups. However, in addition to age and fracture history, sarcopenia and hyperthyroidism emerged as important predictors of fractures following these events.

KEYWORDS: Bone fracture. Aged. Osteoporosis. Sarcopenia. Accidental falls.

RESUMO

Introdução: O envelhecimento acarreta diversas alterações bioquímicas, morfológicas e funcionais. Destacam-se alteração de marcha, dificuldades visuais e redução da força muscular. Esses fatores aumentam o risco de quedas não intencionais, que podem resultar em contusões, fraturas, trauma psicológico e até óbito. Em 2018, quedas ocasionaram 12.000 mortes entre idosos no Brasil.

Objetivo: Análise do perfil clínico e epidemiológico de idosos que sofreram fraturas por quedas do mesmo nível e avaliação dos fatores de risco para osteoporose e fraturas.

Método: Estudo observacional de corte transversal, com pacientes ≥ 60 anos atendidos em hospital terciário após queda. Foram excluídos mecanismos de trauma de alta energia. Os pacientes foram divididos equitativamente em grupo fraturado (GF) e grupo controle não fraturado (GC). Avaliou-se fatores de risco e calculou-se risco de osteoporose e fratura com calculadoras validadas.

Resultados: A amostra incluiu 100 pacientes (idade ± 71,78 anos e IMC médio ± 25,89 kg/m2), sendo a maioria mulheres. Observou-se diferença significativa na avaliação de sarcopenia: indivíduos fraturados apresentaram menores valores de circunferência da panturrilha, circunferência da cintura e medida de preensão palmar. Não foram encontradas diferenças significativas nas respostas ao questionário de quedas e no uso de medicamentos associados à osteoporose e quedas. Houve diferenças significativas entre os GF e GC em relação ao risco de fraturas de quadril e fraturas maiores, avaliados pela ferramenta FRAX. O Teste de Risco de Osteoporose de Um Minuto da IOF não foi útil para distinguir os pacientes dos grupos.

Conclusão: Ao contrário do suposto esperado, variáveis como IMC, tabagismo, sedentarismo, presença de comorbidades, uso de glicocorticoides orais e o número de quedas prévias não foram capazes de distinguir os grupos. No entanto, além da faixa etária e histórico de fraturas, sarcopenia e hipertireoidismo emergiram como importantes preditores de fraturas após esses eventos.

PALAVRAS-CHAVE: Fraturas ósseas. Idoso. Osteoporose. Sarcopenia. Acidentes por quedas.

Central Message

The study shows that variables traditionally considered as risk factors for fractures in the elderly, such as body mass index (BMI), smoking, sedentary lifestyle, and some comorbidities, were not able to distinguish fractured patients from those who did not suffer fractures after falls of the same level. However, factors such as sarcopenia and hyperthyroidism emerged as relevant predictors for osteoporotic fractures, highlighting the need for prevention strategies that include the assessment of muscle strength and the control of hormonal disorders.

Perspective

The findings challenge the traditional view on risk factors for fractures in the elderly, suggesting that fall prevention should go beyond the conventional approach focused only on bone density and the presence of comorbidities. The identification of sarcopenia as a relevant factor reinforces the importance of muscle rehabilitation programs and adequate endocrine follow-up in the prevention of fractures. These results may contribute to the formulation of more effective clinical guidelines for the management of fracture risk in the elderly population.

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INTRODUCTION

Elderly people are more prone to falls due to the higher incidence of risk factors, such as visual difficulties, decreased muscle mass, weakness and increased use of medications. In addition, falls in this age group substantially increase the risk of fractures, since they occur in a group of people with a higher incidence of comorbidities, such as osteoporosis.[1]

It is estimated that about a third of individuals aged 60 and over fall at least once a year.[2] The risk is more significant when in octogenarians and nonagenarians, where the annual incidence of falls can reach 50%.[3] In addition, the data still point to falls as the main cause of fractures in the elderly, especially in those with osteoporosis. In Brazil, in 2018, there were about 12,000 deaths from falls in people over 60 years of age, 84% of whom were over 70 years of age.[4]

Based on these reflections, the following question arose in this study: Why do some patients fracture as a result of falls from the same level while others do not? What factors contribute to both the risk of falling and the risk of fracture? What are the clinical findings that can result in fracture?

Fractures resulting from falls from the same level are caused by specific clinical factors, among the risk factors include previous fracture due to frailty, hip fracture due to frailty in a first-degree relative (mother or father), tobacco use, use of glucocorticoids, diagnosis of rheumatoid arthritis, secondary osteoporosis (caused by different diseases) and use of 3 or more units of alcoholic beverage per day.[5]

Unintentional falls occur due to the sum of risk factors, and it is difficult to restrict the fall event to a single factor or a causal agent. The reasons for falls may be related to age, gender, prolonged hospitalization, debilitating diseases, generalized muscle weakness, unsteady gait, confusion or disorientation, incontinence, history of previous falls, visual deficit or linked to the use of medications with hypnotic action, sedative, vasodilators, diuretics and antidepressants, among others.[6]

Because most fractures result from falls, the etiology of fractures and fractures is partially overlapped. The factors associated with falls (recurrent and with injuries), determined by retrospective studies, the circumstances and consequences of these events, indicated in prospective designs, have been widely studied and reported in the literature. It is considered essential to increase knowledge about the problem, its characteristics and consequences.

The objective of this study was to analyze the clinical and epidemiological profile of patients aged 60 years or older who suffered fractures after falls at the same level, treated at a reference teaching hospital. Part of the detailed approach to the profile, integrating proven risk factors for the development of osteoporosis and fractures, we sought to identify which of these factors are most relevant in the context. Thus, it is intended to contribute to the improvement of strategies for the prevention and management of these fractures, providing evidence that can guide health policies and more effective clinical practices for the elderly population.

METHOD

This was a cross-sectional observational study conducted from March 2022 to March 2023, approved by the Research Ethics Committee of the Mackenzie Evangelical University Hospital, Curitiba, PR, Brazil, under protocol 5,307,196 in accordance with the guidelines established in Resolution No. 466/2012 and Resolution No. 510/2016 for research involving human beings. The research was conducted at the Mackenzie Evangelical University Hospital mentioned above, covering both patients hospitalized due to fractures after low-energy trauma and those hospitalized for other causes, but with a history of falls at the same level.

Men and women aged 60 years or older, who had a history of falls from the same level, with mental fitness to perform the tests and questionnaires were included. The exclusion criteria were the presence of communication difficulties, clinical conditions that prevented participation, not accepting to participate in the evaluation or not filling out the Informed Consent Form. The researchers were previously trained by the study coordinator, in order to standardize data collection.

Eligible patients underwent a comprehensive evaluation, which included the collection of demographic data, such as gender and age, and the application of a questionnaire from the Brazilian Osteoporosis Manual. This questionnaire assessed the risk of falls, addressing the occurrence, frequency and consequences of falls in the last 12 months, in addition to investigating the feeling of insecurity and imbalance when walking.[7] In addition, they were asked about the possible causes of falls, such as slips, trips, loss of balance, muscle weakness, dizziness, convulsions, hypotension, among others. Regarding the risk factors for osteoporosis and the characterization of the population studied, the patients' continuous use medications were recorded and the International Osteoporosis Foundation (IOF) One-Minute Osteoporosis Risk Test was applied.[8] This test considers several factors, including a family history of osteoporosis, fractures and dorsal kyphosis, BMI less than 19 kg/m^2, history of falls, use of corticosteroids, loss of height, previous diagnosis of rheumatoid arthritis, history of early menopause or cessation of menstruation, oophorectomy, sexual impotence, and lifestyle habits (intake of milk and dairy products, physical activity, smoking and time of exposure to the sun). The risk of fracture at 10 years was assessed using the online tool FRAX9, without bone densitometry.

Anthropometric data such as weight, height measurement, BMI calculation (weight/height^2), waist and calf waist were evaluated. In the clinical evaluation, the handgrip test/strength (HGS) was evaluated by measuring the maximum isometric force exerted on a

hydraulic hand dynamometer in kilogram/force (Kgf), following the recommendation of the American Society of Hand Therapists (ASHT). For this, the Jamar® analog hydraulic dynamometer (Lafayette Instrument, USA) was used.

Statistical analysis

The collected data were tabulated and analyzed in statistical software. To describe the categorical variables, contingency tables were constructed. To describe the quantitative variables, descriptive measures were calculated as mean, minimum, maximum and standard deviation. To compare the groups, the Chi-square test (or Fisher's exact test, for lower frequencies) was applied, considering $p < 0.05$ as significant. The entire dataset that supports the results of this study is available upon request to the corresponding author Felippe Bohnen de Jesus.

RESULTS

The study sample consisted of 50 fractured patients (FG) and 50 unpaired control patients (CG). The mean age of the FG was 75.38 ± 9.46 years and of the CG 68.18 ± 6.57 years (p = 0.0001). The clinical characteristics of the groups evaluated are described in Table 1.

TABLE 1 — Demographic and clinical data of the fractured and control groups

Variables	Control group (n,%)	Fractured group (n,%)	p-value*
Gender Male Female	29 (58%) 21 (42%)	36 (72%) 14 (28%)	0,14
Has already undergone bone densitometry	9 (18%)	22 (44%)	0,005
Hyperthyroidism	0 (0%)	7 (14%)	0,006
Diabetes mellitus	6 (32%)	23 (46%)	0,15
Chronic kidney disease	2 (4%)	1 (2%)	0,56
Prostate or breast cancer	2 (4%)	1 (2%)	0,56
COPD	3 (6%)	2 (4%)	0,65
Celiac disease or inflammatory bowel disease	2 (4%)	0 (0%)	0,15

*Pearson's Chi-square test

When using the questionnaire to assess the risk of falls from the Brazilian Osteoporosis Manual, no statistical difference was observed between the groups (p = 0.98). Both groups had a similar number of decreases, and have similar perceptions of imbalance and insecurity

TABLE 2 — Assessment of the Risk of Falls in the CG and FG

Variables		Control group	Fractured group	p-value*
Number of falls in the last year	1 time 2 times 3 times > 3 times	27 (54%) 13 (26%) 6 (12%) 4 (2%)	26 (52%) 12 (24%) 6 (12%) 6 (4%)	0,98
Do you lack the balance or instability to stand and sit?	yes	25 (50%)	31 (62%)	0,23
Are you unsure or worried about falling?	yes	23 (46%)	27 (54%)	0,42

*Pearson's Chi-square test

The One-Minute Osteoporosis Risk Test (IOF) indicated that the majority of the CG (60%) obtained a score lower than 5, presenting a low risk of osteoporosis. On the other hand, in the FG, the majority (54%) obtained 5 points or more, i.e., revealing a high risk of osteoporosis, in agreement with the history of atraumatic fractures in adulthood. In addition, in the FG, the hyperthyroidism comorbidity was more prevalent (p <0.00001).

In the analysis of the correlation between osteoporosis medications and the occurrence of falls in the groups studied, no statistically significant difference was identified in the use of these medications in relation to fractures (p = 0.81). For example, 52% of participants in both groups did not use chronic medications. Although the use of glucocorticoids for more than 3 months was more prevalent in the FG, this difference was not statistically significant (p = 0.749). In addition, the use of medications such as proton pump inhibitors (PPIs), selective serotonin reuptake antidepressants (SSRIs), and anticonvulsants was more frequent in the CG.

As shown in Table 3, among the clinical risk factors evaluated in the FRAX-Brazil calculator, the items age and history of previous fracture were the only different and higher items in the FG when compared to the CG (p = 0.0001 and p = 0.00001, respectively).

TABLE 3 — Evaluation of clinical risk factors from the 10-year fracture risk calculator (FRAX-Brazil) in CG and FG

Variables	Control Group	Fractured Group	p-value*
Average age (years)	68,18	75,38	0,0001
BMI (kg/m²)	26,78	25	0,39
Previous fracture	0 (0%)	25 (50%)	0,00001
Parents with hip fracture	5 (10%)	5 (10%)	1
Smoking Chain	15 (30%)	9 (18%)	0,16
Glucocorticoids	5 (10%)	6 (12%)	0,75
Rheumatoid arthritis	8 (16%)	4 (8%)	0,22
Secondary osteoporosis**	8 (16%)	12 (24%)	0,32
Alcohol 3 doses or more units daily	9 (18%)	3 (6%)	0,065
Have you ever had bone densitometry?	9 (18)	22 (44%)	0,005

*Pearson's Chi-square test

As a result of the FRAX calculator, the high risk for major and hip fractures was higher in the FG, present in 48% (p = 0.00001) and 60% (p = 0.00001) of the patients, respectively (Table 4).

TABLE 4 — Evaluation of clinical risk factors from the fracture risk calculator in 10 years (FRAX-Brazil) in the CG and FG

Major fractures	Control group	Fractured group	p-value*
High risk	50 (10%)	24 (48%)	0,00001
Medium risk	27 (54%)	26 (52%)	
Low risk	18 (36%)	0 (0%)	
Hip fracture			
High risk	10 (20%)	30 (60%)	0,00001
Medium risk	22 (44%)	19 (38%)	
Low risk	18 (36%)	1 (2%)	

*Pearson's Chi-square test; **Secondary osteoporosis: type 1 diabetes, osteogenesis imperfecta, untreated hyperthyroidism, hypogonadism or early ovarian failure (<45 years), chronic malnutrition or malabsorption, and liver disease

Compared to the CG, the FG group had lower values for calf circumference (p = 0.012), handgrip (p = 0.015), and waist circumference (p = 0.034), as shown in Table 5.

TABLE 5 — Evaluation of sarcopenia in CG and FG

Variable	Group	Average	n	DP*	Minimum	Maximum
Palmar grip	Control	23.68	50	10.09	3	48
	Fracture	18.90	50	10.67	0	55
Calf circumference	Control	33.01	50	4.73	19	43
	Fracture	31.08	50	4.11	22	40
Waist circumference	Control	98.68	50	12.00	70	127
	Fracture	93.43	50	13.21	70	132

* SD=standard deviation

DISCUSSION

When analyzing the demographic data collected, it was observed that the mean age of the FG (75.38 years) is significantly higher compared to the mean age of the CG, of 68.18 years. (p = 0.0001). This data collaborates with studies that indicate that the risk of fracture in most skeletal sites accelerates with aging regardless of BMD.[10,11] It was found that the risk of fracture was not preceded by a greater number of falls, as the groups have similar incidences.

Applying the IOF One-Minute Osteoporosis Risk Test, it was found that most patients without fractures (60%) scored less than 5 points on the questionnaire, presenting a low risk of osteoporosis. In the FG, it is observed that most individuals (54%) scored 5 points or more, revealing a high risk of osteoporosis. However, when comparing the groups, this data was not statistically significant.

This data becomes critical when related to another demographic data: most fractured patients (56%) had never undergone bone densitometry, i.e., despite being considered at high risk for osteoporosis, they had never undergone a diagnostic examination before the occurrence of fractures. Despite this, the FG still performed more bone densitometry than the CG (p = 0.005).

In view of the exploratory and descriptive nature of this study, which sought not only to understand issues related to the predisposing factors for fractures in the elderly, but also to describe the clinical profile of the sample to be studied, some risk factors for osteoporosis stood out. Among them, the presence of previous hyperthyroidism in the FG stands out, affecting 14% of the patients, in collaboration with the study published by Blum et al.[12] in 2015, which investigated the association of subclinical hyperthyroidism has been associated with a 36% increase in the risk of hip fracture, a 28% increase in the risk of any fracture, and a 16% increase in the risk of fracture outside the spine, compared to normal thyroid condition, and is associated with low bone density in both men and women.[12]

Regarding the non-modifiable risk factors of the IOF test, the most frequently found were the occurrence of a previous fracture (50%), more than one fall in the last year (48%) and the loss of more than 3 cm in height after the age of 40 (48%). In addition, 30% of the women interviewed claimed to have had menopause before the age of 45 and about 69% of the men experienced symptoms related to low testosterone, such as impotence and lack of libido.

Regarding risk factors related to lifestyle habits, in the FG the main risk factors included lack of intake of dairy products or calcium tablets (28%), exercise quota of less than 30 minutes per day (22%) and sun exposure of less than 10 min per day or not using vitamin D supplements (24%). These results corroborate those found by Lin et al.[13,] and published in 2020, in which after using the IOF One-Minute Osteoporosis Risk Test for 455 institutional caregivers, with a mean age of 43.5 ± 11.5 years (range = 20-76 years), the same risk factors were demonstrated as the most frequently reported.[13]

Through the fracture risk assessment instrument (FRAX), it can be observed that FG has a higher risk of developing major and hip fractures in the next 10 years. Individuals classified as high risk for major fractures are approximately 48% in the FG and only 10% in the CG. In relation to hip fractures, the difference is even more pronounced, with 60% against 20%.

In the evaluation of handgrip strength with the use of a dynamometer - a validated method for the evaluation of sarcopenia - the FG presented significantly lower values (mean of 18.9kgf). According to the consensus of the Asian Sarcopenia Working Group (AWGS) 2019, low muscle strength is defined as handgrip strength <28 kgf for men and <18 kgf for women.[14]

In the absence of other available methods for assessing sarcopenia, calf circumference measurement may be used. The AWGS 2019 update proposes screening of calf circumference (<34 cm in men and <33 cm in women) to facilitate early identification of people at risk of sarcopenia.[15] In the study, the FG had significantly lower values than the CG (p = 0.012), with a mean of 31.08 cm, at risk for sarcopenia.

In a 2-year longitudinal study, and published in 2022, Yoo et al.[16] selected 926 non-sarcopenic elderly people and divided them according to the presence of obesity (based on BMI, waist circumference (WC) and body fat percentage). The groups of obese and non-obese individuals were compared according to the parameters of sarcopenia. It was observed that the reduction in appendicular skeletal muscle mass was significantly lower in the obese group with high WC in men and women (p < 0.[01).] However, elevated WC was associated with a low incidence of sarcopenia only in women.[16]

In parallel with this study, the data obtained showed that the CG had higher WC values when compared to the FG (p = 0.034). Considering that the mean waist circumference (WC) in the CG was 98.68 cm, it is important to relate it to the cutoff points established by the Nutrition Screening Initiative/NSI to identify central obesity: 88.[7] cm for women and 96 cm for men.[17] Based on these data, it is possible to explore the possibility of a protective effect exerted by obesity against sarcopenia, which may, consequently, have decreased the risk of fractures in this group.

The specific clinical factors described in the literature[17-19] that favor fractures resulting from falls at the same level, such as previous fracture due

to frailty, hip fracture due to frailty in a first-degree relative (mother or father), tobacco use, use of glucocorticoids, diagnosis of rheumatoid arthritis, secondary osteoporosis (caused by different diseases) and use of 3 or more units of alcoholic beverage per day, in the population studied, no risk factors were shown to clinically differentiate FG from control. An observational, cohort study carried out with 143 individuals showed results that are in line with these: there were no statistically significant differences in age, weight, height, number of coexisting diseases, types of diseases (diabetes mellitus, hypertension) and number of medications between the groups with and without falls. The authors do not deny that the low relevance of the parameters may be a reflection of a limited sample.[20]

One of the limitations of this study, which can affect the representativeness of the sample, lies in the unpredictable nature of the profile of patients available for study in the established period, which made it impossible to match the CG and FG according to the patients' gender. Thus, it was decided to prioritize a larger sample group to the detriment of matching according to the gender of the members. In addition, the limited demand for fractured patients that the teaching hospital received in the period was also a limiting factor. It is believed that, despite the considerable sample size presented in this study, an even larger sample group would possibly be able to point out other risk factors that were shown to be statistically irrelevant here.

CONCLUSION

The analysis of the profile of patients aged 60 years or older treated at a tertiary referral hospital after falls from the same level showed that, contrary to what is expected and plausible, variables such as BMI, smoking, sedentary lifestyle, presence of comorbidities (rheumatoid arthritis, diabetes mellitus, chronic renal failure, COPD), use of oral corticosteroids, and the number of previous falls were not able to distinguish FG from CG. However, in addition to the well-documented influence of age group and history of previous fractures, factors such as sarcopenia and hyperthyroidism have emerged as important predictors of fractures after low-energy trauma.

Authors' contributions

Felippe Bohnen de Jesus – Conceptualization, Research, Writing (original draft), Writing (review and editing)

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