THE ASSOCIATION BETWEEN THE RISK OF FALLS AND CHARACTERISTICS OF GERIATRIC OSTEOPOROTIC PATIENTS

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Summary

Objectives: To assess the association between the risk of falls and characteristics of geriatric osteoporotic patients at the National Geriatric Hospital. ***Subjects and methods:*** A cross-sectional descriptive study on 141 osteoporotic patients treated at the National Geriatric Hospital from August to October 2022. ***Results:*** Based on the FRI-21 questionnaire, more than half of patients (50,4%) had a high risk of falls, and 49.6% of those had a low risk of falls. The results showed that patients with impairment in activities of daily living (ADLs) and instrumental activities of daily living (IADLs) had a higher risk of falls than normal ones ($p < 0.05$). It also revealed the statistically significant difference between depression, the number of medications, and the risk of falls in older osteoporosis patients ($p < 0.05$). However, nutritional status, back pain, and level of pain had no statistically significant association with the risk of falls ($p > 0.05$). The use of multivariable regression showed factors associated with the risk of falls in older patients with osteoporosis such as heart failure (OR = 0.901. 95% CI: 0.835 - 0.973, $p < 0.01$), ADL and IADLs (OR = 4.510. $p < 0.01$), depression (OR = 3,537, $p < 0.01$), and the number of medications (OR = 2.931, $p < 0.01$). ***Conclusion:*** The risk of falls in older patients with osteoporosis following FRI-21 was 50.4%. Our study showed that the associated factors of the risk of falls in older patients with osteoporosis were heart failure, ADL and IADLs, depression, and the number of medications. Therefore, measures should be applied to prevent falls in these patients.

* Keywords: Osteoporosis; Elderlies; Risk of falls.

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INTRODUCTION

Osteoporosis is one of the most common diseases in elderlies in many countries. Osteoporosis is diagnosed based on bone mass density (BMD) measuring at the hip or lumbar spine that is less than or equal to 2.5 standard deviations below the mean BMD of a young-adult reference population (WHO criteria) [1]. Moreover, osteoporosis results in a reduction of the quality or structure of bone and increases the risk of fractures, as suggested by the National Institute of Health (NIH) [2]. The most dangerous complications of osteoporosis are fractures, which are frequently induced by falls because of reduced muscular strength, postural control, or spine kyphosis [3]. As shown in several studies, there is about 30% of older people falling at least once per year, and depending on age, gender, country, and ethnicity, the number could rise to 50% in patients over the age of 80 years and 10 -15% would get injuries afterward [4]. Annually, it is estimated that 3 million older people are treated in emergency departments due to fall injuries [5]. Treatment for these events could dramatically increase the treatment cost, the burden of care, and the risk of secondary complications and considerably decrease their quality of life. Some recent studies demonstrated that osteoporotic elderlies had suffered a higher disability and mortality rate for falls that could lead to multiple difficulties for both them and their families.

In addition, osteoporosis in older persons should be distinguished from the typical post-menopausal, hormone-deficient increase in bone turnover, which is the primary focus of most of the literature in the field. First, with advanced aging, there are clear changes in the ability of the aged marrow such that mesenchymal stem cells are more likely to differentiate into adipocytes rather than osteoblasts or even myoblasts. This leads to the accumulation of fat in the marrow with less bone formation during skeletal remodeling [3]. Second, the loss of muscle mass with aging ("sarcopenia") and the relative decrease in physical activity lead to reduced loading of the aged skeleton, ultimately reduced bone formation and increased resorption [5]. Furthermore, as falls increase dramatically with aging, trauma to an already fragile skeleton is the formula for the extremely high risk for osteoporotic fracture with aging [5]. Based on the evidence mentioned above, we would like to conduct this study: *To assess the association between the risk of falls and the characteristics of geriatric osteoporotic patients at the National Geriatrics Hospital.*

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SUBJECTS AND METHODS

1. Subjects

141 osteoporotic patients were examined or admitted to the National Geriatric Hospital from August to October 2022.

* Inclusion criteria:

- Patients aged $\geq$ 60 years were diagnosed with osteoporosis according to the WHO diagnostic criteria for osteoporosis, which is defined by BMD at the hip or lumbar spine that is less than or equal to 2.5 standard deviations below the mean BMD of a young-adult reference population [6].

- The patients were fully conscious and had the physical and cognitive abilities to do the interview.

- Patients and their families agreed to participate.

* Exclusion criteria:

- Patients with severe conditions like respiratory failure, using a ventilator, etc.

- Patients who did not understand Vietnamese and inability to communicate, participate, or families were unwilling to participate in the study.

2. Methods

* Study design: A cross-sectional descriptive study.

* Variables:

- Demographic characteristics: Gender, age.

- The risk of falls: The risk of falls was assessed using the FRI-21. The FRI-21 is a questionnaire with 21 questions. The answer is ''Yes'' or "No''. Each item received a score of 1 (risk present) or 0 (risk absent), and the sum of all items ranged from 0 (lowest fall risk) - 21 (highest fall risk), with higher scores indicating a higher risk of falls. A cut-off point of 9/10 on the FRI-21 is useful for early detection of the risk of falls.

- Geriatric characteristics

+ Activities of daily living - Katz index:

Clinicians typically use the tool to detect problems in performing activities of daily living and to plan care accordingly. The Index ranks adequacy of performance in the six functions of bathing, dressing, toileting, transferring, continence, and feeding. Subjects are scored yes/no for independence in each of the six functions. Evaluation: A summary score ranges from 0 (impaired function) - 6 (normal function).

+ Instrumental activity daily living - IADL:

Instrumental activity daily living - IADL assesses the more complex ADLs necessary for living in the community. Competence in skills such as shopping, cooking, managing finances, etc. The IADL scale takes 10 - 15 minutes to

administer and contains eight items: The ability to use the telephone, laundry, shopping, food preparation, housekeeping, mode of transportation, responsibility for own medications, and the ability to handle finances. The summary score is from 0 (lowest function, dependent) - 8 (highest function, independent). The higher the score is, the greater the person's abilities are.

+ Nutritional status: Mini Nutritional Assessment short form (MNA-SF):

The Mini Nutritional Assessment short form (MNA-SF) is a short-form version of the full MNA. MNA-SF is an assessment instrument for nutritional problems, and it identifies persons at nutritional risk, provides information needed for intervention planning, and does not require laboratory data. The MNA-SF has 6 questions instead of 18 as MNA and can be administered in approximately 3 minutes. The total score is 14 points. Normal nutritional status is from 12 - 14, risk of malnutrition is 8 - 11, and a score between 0 - 7 indicates that the patient is malnutrition.

+ Depression: Patient Health Questionnaire 9 (PHQ-9):

The PHQ-9 is a self-report scale measuring depression. It includes nine items, which are based on DSM-IV criteria, with regard to how they have felt over the past 2 weeks. Total scores range from 0 - 27 since each of the 9 items can be scored from 0 (not at all) - 3 (nearly every day). with higher scores indicating more severe depressive symptoms. PHQ-9 scores with 0 - 4 as normal, 5 - 9 as mild, 10 - 14 as moderate, and 15 - 19 and 20 - 27 as moderate to severe depression, respectively.

* Data collecting:

Study subjects were interviewed according to a medical record. The risk of falls was assessed using the FRI-21 questionnaire.

* Data processing:

In the process of data coding, entry was done using REDCAP software, and data analysis was done by SPSS version 22. Descriptive statistics were adopted to examine characteristics data: Frequency, percent, and mean. Inferential statistics were used to compare groups using Chi-square and T-test. Statistical significance was defined as any p-value less than 0.05

3. Ethical consideration

The data collected was used for research only. The study results were proposed for improving the community's health, not for other purposes, and to ensure all ethical issues in biological research.

RESULTS

A total of 141 older patients with osteoporosis aged 60 years and older who came to the National Geriatric Hospital for examination and treatment from August 1st to October 15th 2022 were selected for this study. The mean age of the study participants was 73.12 $\pm$ 8.62 years old, with a maximum age of 97 and the minimum age of 60 years old. Patients from 70 - 79 years old accounted for the largest percentage (39%). Among the study participants, female patients accounted for 94.3%, while male patients accounted for a smaller proportion of 5.7%. The female/male ratio was 16.63.

Table 1: Demographic characteristics in the study group (n = 141).

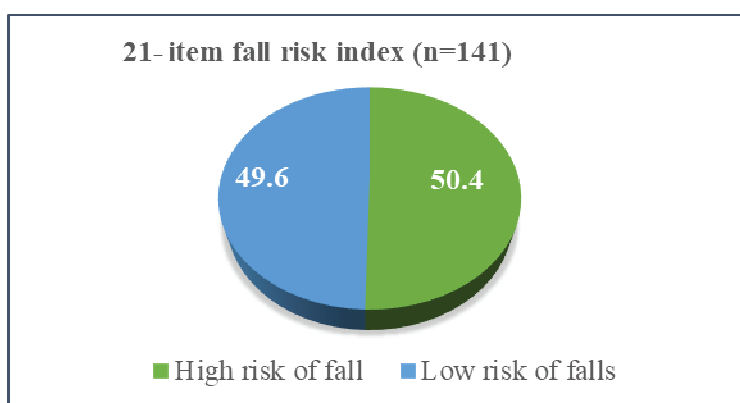| Characteristics		Frequency (n)	Percentage (%)
Age group	60 - 69	50	35.5
	70 - 79	55	39.0
	$\geq$ 80	36	25.5
Gender	Male	8	5.7
	Female	133	94.3
$\overline{X} \pm SD$			
Mean age		73.12 + 8.62	

Figure 1: The risk of falls in the study subjects following the FRI-21.

Based on the FRI-21 questionnaire, more than half of the patients (71 patients, 50,4%) had a high risk of falls, and 49.6% (70 patients) of the patients had a low risk of falls.

Table 2: Geriatric characteristics in the study group (n = 141).

Characteristics		Frequency (n)	Percentage (%)
ADL	Dependent	49	34.8
	Independent	92	65.2
IADLs	Impairment	49	34.8
	Normal	92	65.2
MNA-SF	Malnourished	10	7.1
	Risk of malnutrition	55	39.0
	Normal nutrition	76	53.9
Depression (PHQ-9)	Normal	73	51.8
	Mild	45	31.9
	Moderate to severe	23	16.4
Number of medications	≥ 5	49	34.8
	< 5	92	65.2
$\overline{X} \pm SD$			
Mean medication	3.63 ± 2.46		
Mean ADL	5.16 ± 1.45		
Mean IADLS	7.01 ± 1.67		

In this study, 34.8% of study subjects were dependent on daily living activities, and the number of participants with impaired instrumental activities was 49 (34.8%). Signs of mild to moderate depression were present in 43.1%, moderate to severe depression presented in only 4.3% of patients, and there were no patients with severe depression. Regarding nutritional status, 10 patients (7.1%) suffered from malnutrition. The percentage of patients at risk of malnutrition is relatively high at 39% (n = 55). The number of elderly patients using ≥ 5 drugs was 49 (34.8%), and < 5 drugs was 65.2%. The mean number of medications was 3.63 ± 2.46.

Table 3: The association between the risk of falls and geriatric characteristics.

Characteristics		High risk of falls (n = 71)		Low risk of falls (n = 70)		p
		n	%	n	%	
ADL	Dependent	36	50.7	13	18.6	< 0.01
	Independent	35	49.3	57	81.4	
IADLS	Impairment	36	50.7	13	18.6	
	Normal	35	49.3	57	81.4	
MNA-SF	Malnourished	33	46.5	43	61.4	0.173
	Risk of malnutrition	33	46.5	22	31.4	
	Normal nutrition	5	7	5	7.1	
Depression (PHQ-9)	Normal	26	36.6	47	67.1	0.003
	Mild	28	39.4	17	24.3	
	Moderate to severe	17	23.9	6	8.6	
The number of medications	≥ 5	33	46.5	16	22.9	0.003
	< 5	38	53.5	54	77.1	
		$\overline{X} \pm SD$		$\overline{X} \pm SD$		
The mean number of medications		4.99 ± 2.55		2.76 ± 2.04		< 0.01

The results showed that patients with impairment in ADLs and IADLs had a higher risk of falls than normal ones ($p < 0.05$). The mean number of medications in the group of patients at high risk of falls was higher than that in those at low risk of falls (with $p < 0.05$). It also revealed the statistically significant difference between depression, the number of medications, and the risk of falls in older osteoporosis patients ($p < 0.05$). Nutritional status had no statistically significant association with the risk of falls ($p > 0.05$).

Table 4: The association between risk of falls and back pain and level of back pain.

Characteristics		High risk of falls		Low risk of falls		p
		n	%	n	%	
Back pain	Yes	67	94.4	63	90.0	0.334
	No	4	5.6	7	10.0	
Level of back pain	Mild	20	31.3	29	50.9	0.088
	Moderate	42	65.6	27	47.4	
	Severe	2	3.1	1	1.8	

Back pain and pain level had no statistically significant association with the risk of falls in older osteoporosis patients ($p > 0.05$).

Table 5: Multivariable regression models on some factors related to the risk of falls in older patients with osteoporosis.

Factors	High risk of falls			p
	OR	95%CI		
		Lower	Upper	
Age ≥ 70 years (Ref: < 70 years)	2.480	1.217	5.054	0.012
Heart failure Yes (Ref: No)	0.901	0.835	0.973	< 0.01
Diabetes Yes (Ref: No)	3.057	1.186	7.875	0.017
ADL Dependent (Ref: Independent)	4.510	2.107	9.655	< 0.01
IADLs Impairment (Ref: normal)	4.510	2.107	9.655	
Depression (PHQ-9) Depression (Ref: no depression)	3.537	1.767	7.081	
Number of medications ≥ 5 types (Ref: < 5 types)	2.931	1.416	6.065	

The use of multivariable regression showed the factors associated with the risk of falls in older patients with osteoporosis. They were heart failure (OR = 0.901. 95% CI: 0.835 - 0.973, $p < 0.01$), ADL and IADLs (OR = 4.510. 95% CI: 2.107 - 9.655, $p < 0.01$), depression (OR = 3,537. 95% CI: 1.767 - 7.801, $p < 0.01$), and the number of medications (OR = 2.931. 95% CI: 1.416 - 6.065, $p < 0.01$).

DISCUSSION

The study was conducted at the National Geriatric Hospital with 141 patients aged ≥ 60 years. Patients aged from 70 - 79 years old accounted for the highest percentage (39%). The age group from 60 - 69 years and 80 years were 35.5% and 25.5%, respectively. The mean age of participants was 73.12 years old. In our study, there were 133 female patients (94.3%) and 8 male patients (5.7%). The female/male ratio was dramatically unequal (16/1). This may be because postmenopausal women had a higher risk of osteoporosis than men. As shown above, more than half of the patients (50,4%) had a high risk of falls, and 49.6% had a low risk of falls. These results were similar to the percentage of the high risk of falls in the study of Nitchanant Kitcharanant et al. in 68 men or postmenopausal women aged

> 65 years who were diagnosed with osteoporosis: The ratio of high risk of falls was 55.9% [7].

The percentage of study subjects dependent on daily activities and impaired in daily functional activities (IADLs) was the same (34.8%). This rate is lower than that in the study of Iwarsson et al.: 48% of the patients were dependent and impaired in ADL and IADLs. This can explain by the fact that our study was performed in a city with ages ≥ 60 years, while the study of Iwarsson et al. was performed in rural with ages ≥ 80 years [8].

The Mini Nutritional Assessment Short form (MNA-SF) scale was used to assess the nutritional status of the patients. The patients with malnourished and the risk of malnutrition were 7.1% and 39%, respectively. Normal nutritional status was 53.9%. This finding is different from the study of Pereira Machado R.S. et al. (2011): According to MNA, 8.3% were malnutrition, 55.6% were at risk of malnutrition, and 36.1% were well-nourished [9]. The difference between the body weight and lifestyle of Asians and Europeans can explain this. The number of patients was not enough to explicit the difference between the risk of falls of the malnourished group and the group at risk of malnutrition.

The percentage of patients with symptoms of depression in this study was 48.2%. The patients without signs of depression accounted for 51.8%. This is explained by the elderly patients whose comorbidities increased.

In our study, 1/3 of patients used ≥ 5 drugs accounting for 34.8%, and the mean number of medications was 3.63 ± 2.46. This can explain by the fact that our study subjects were elderly with many comorbidities, so using multiple medications is understandable.

The dependence/impairment in daily functional activities (ADL, IADLs) were statistically significant with the risk of falls in elderly patients with osteoporosis ($p < 0.05$). Patients with significant dependence/impairment in daily activities had a high risk of falls (50.7%). Meanwhile, patients with normal daily activities had a 49.3% increase in the risk of falls. The group of older osteoporosis patients with impaired instrumental activities of daily living and/or dependent on daily activities increased the risk of falls 4.5 times in comparison with normal ones. The differences were statistically significant ($p < 0.05$).

The association between depression and the risk of falls in elderly patients with osteoporosis was statistically significant ($p < 0.05$), and depression increased the risk of falls 3.5 times compared with no depression ($p < 0.01$). According to a study by Barrett Conner et al. (2008), the rate of falls increased in patients with depression [10].

The number of medications was statistically significant with the risk of falls in elderly patients with osteoporosis ($p < 0.05$). Patients who used ≥ 5 drugs had an increased risk of falls 3 times compared with patients who used < 5 drugs. This result is similar to the study of Hong-Ying Pi et al., the risk of falls increased as the number of medications increased [11].

Nutritional status had no statistically significant association with the risk of falls in our study ($p > 0.05$). This can explain by the fact that our study sample size was not large enough.

Multi-variable regression models showed the associated factors of the risk of falls in older patients with osteoporosis were heart failure (OR = 0.901. 95% CI: 0.835 - 0.973, $p < 0.01$), ADL and IADLs (OR = 4.510. 95% CI: 2.107 - 9.655, $p < 0.01$), depression (OR = 3,537. 95% CI: 1.767 - 7.801, $p < 0.01$), and the number of medications (OR = 2.931. 95% CI: 1.416 - 6.065, $p < 0.01$).

CONCLUSION

The risk of falls in older patients with osteoporosis following FRI-21 was 50.4%. Our study showed that the dependence on ADL and iADL, depression, and the number of medications were significantly associated with a higher risk of falls in older patients with osteoporosis. Moreover, it showed that the associated risk factors for falls in older patients with osteoporosis were heart failure, ADL and IADLs, depression, and the number of medications. Therefore, measures should be applied to prevent falls in these patients to reduce the consequences after a fall and improve their quality of life.

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