

RISK OF FALL AND RELATED FACTORS IN OSTEOPOROSIS PATIENTS AT THE NATIONAL GERIATRIC HOSPITAL

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This study was conducted to assess the association between risk of fall and relating factors in osteoporosis patients at the National Geriatrics Hospital. This is a cross-sectional study on 141 osteoporotic patients aged ≥ 60 years old examined or treated at the National Geriatric Hospital. Data were collected by using designed tools including characteristics of these patients. We entered data on Redcap and used SPSS version 22.0 for analysis. The mean age and standard deviation were 73.12 (8.62) with female patients accounted for majority with 94.3%. The mean age of patients with high risk of falls was higher than patients with low risk of falling (with $p < 0.05$). Heart failure and diabetes mellitus were associated with the risk of falls in older patients with osteoporosis ($p < 0.05$). The mean Charlson Index and mean number of diseases in the group of patients at high risk of falls were higher than in the group of patients with low risk of falls (with $p < 0.05$). The study showed that advanced age, heart failure, diabetes, and depression were significantly associated with a higher risk of falls in older patients with osteoporosis.

Keywords: Osteoporosis, elderly, risk of fall.

I. INTRODUCTION

Osteoporosis is a common bone disease of older adults and is a major public health problem worldwide. Following the World Health Organization (WHO) criteria, osteoporosis is defined by bone mass density (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.¹ In addition, the National Institute of Health (NIH) defines osteoporosis as a bone disease that develops when bone mineral density and bone mass decrease, or when the quality or structure of bone changes.² This could lead to a decrease

in bone strength which increase the risk of fractures.² Fracture is most commonly induced by falling due to muscle weakness, spine kyphosis, or decreased postural control.³⁻⁵ Falls predominantly occur in people over the age of 65 years. Approximately 30% of older people fall at least once per year, depending on age, gender, country and ethnicity, increasing to 50% of those over the age of 80 years and 10 - 15% will suffer injuries as a result.⁶ Each year, there are 3 million older people are treated in emergency departments for fall injuries.⁷ This leads to an increase in the treatment cost, the burden of care, the risk of secondary complications and reduces quality of life. A recent study showed that the disability and mortality rate for falls increases dramatically in the elderly with osteoporosis and it causes many difficulties for both patient and family.

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Therefore, we decided to conduct this research to assess the association between risk of fall and relating factors in osteoporosis patients at the National Geriatrics Hospital.

II. METHODS

1. Study subject

Patients were examined or admitted in National Geriatric Hospital from August to October in 2022.

Inclusion criteria

- Patients aged 60 years or older were diagnosed with osteoporosis according to the WHO diagnostic criteria for osteoporosis.⁸

- The patient is 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.

- Patients did not understand Vietnamese and unable to communicate, to participate or family unwilling to participate in the study.

2. Study design

This is a cross-sectional study.

Sampling: Random sampling.

Sample size

This is cross-sectional study. The sample size of determine prevalence of malnutrition in older dementia patient based on the formula for estimating a ratio:

$$n = Z_{(1-\alpha/2)}^2 \cdot \frac{p(1-p)}{d^2}$$

n: the smallest sample to study have significance.

$Z_{(1-\alpha)} = 1.96$ with 95% confidence intervals.

$p = 0.51$ (fall rate in older patients with osteoporosis following the research result of

Raimunda Beserra da Silva in 2010.⁹)

$d = 0.1$ is random error.

The research sample size was calculated as $n = 96$.

Location: National Geriatric Hospital.

Time: The research was conducted from August to October in 2022.

Variables

- Demographic characteristics: gender, age.

- Fall risk: The risk of fall was assessed by using the 21-item Fall risk index.

- 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 (low fall risk) to 21 (high fall risk), with higher scores indicating a higher risk of falls. A cut-off point of 9/10 on the 21-item FRI-21 is useful for early detection of fall risk.⁹⁻¹⁰

- Depression: 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 to 27, since each of the 9 items can be scored from 0 (not at all) to 3 (nearly every day). With higher scores indicating more severe depressive symptoms. PHQ-9 scores with 0 - 4 being normal, 5 - 9 being mild, 10 - 14 being moderate, 15 - 19 being moderate to severe, and 20 - 27 being severe depression.¹¹

Data analysis

The process of data coding, entry was done by using Redcap software and data analysis was done by SPSS software version 22. Descriptive statistics were adopted to examine characteristics data: frequency, percent, mean. Inferential statistics were done to perform comparison between groups using Chi-square, t-test. Statistical significance was defined as any p-value less than 0.05.

3. Research ethics

All data collected was used for research. The results of the study were proposed for improving

health of community, not for other purposes and ensure all ethical issues in biological research.

III. RESULTS

1. Characteristics among all participants

Table 1. Social demographic characteristics (n = 141)

	Characteristics	Frequency (n)	Percentage (%)
Age group	60 - 69	50	35.5
	70 - 79	55	39.0
	≥ 80	36	25.5
Gender	Male	8	5.7
	Female	133	94.3
Occupation	Working	20	14.2
	Retired	121	85.8
Educational level	Below high school	100	71
	High school	16	11.3
	Above high school	25	17.7
BMI (kg/m ²)	Underweight	19	13.5
	Normal	69	48.9
	Overweight and obesity	53	37.6
Marital status	Married	118	83.7
	Divorced/ widow	23	16.3
Living with	Family	132	93.6
	Living Alone	9	6.4
Living area	City	71	50.4
	Rural area	70	49.6
		$\bar{x} \pm SD$	
Mean BMI		21.92 ± 2.96	
Mean age		73.12 ± 8.62	

A total of 141 older patients with osteoporosis aged 60 years and older who came to The Central Geriatric Hospital for examination and treatment from August 1st, 2022 to October

15th, 2022 were selected for this study. The mean age of the study participants was 73.12 ± 8.62 years old with the maximum age of 97 and the minimum age of 60 years old. In which,

patients from 70 - 79 years old accounted for the largest percentage 39%. Among the study participants, female patients accounted for majority with 94.3% while male patients accounted for a smaller proportion of 5.7%. The female/male ratio was 16.63. Most of patients had less than upper secondary education (71%). The number of patients graduating from high school was 11.3%. There were 25 patients (17.7%) who had graduated from college and

higher educational levels. The number of patients graduating from high school was 44 (23.9%). There were 39 patients (21.2%) who have graduated from university and higher educational levels. 19 patients (13.5%) enrolled in the study were underweight and 53 patients (37.6) were overweight and obese. 69 patients (48.9%) were in normal condition. The mean BMI was 21.92 ± 2.96 .

Table 2. Characteristics of comorbidities (n = 141)

Comorbidities	Frequency	Percentage		
Hypertension	59	41.8		
Diabetes	25	17.8		
Depression	11	7.8		
Heart failure	7	5.0		
Lipid disorders	18	12.8		
Parkinson	12	8.5		
Knee osteoarthritis	35	24.8		
	Min	Median	Max	$\bar{x} \pm SD$
Charlson index	0	1	6	0.89 ± 1.087
Number of diseases	1	2	9	2.87 ± 1.529

Most of the study participants had hypertension, accounting for 41.8%. 17.8% had diabetes Depression, Knee osteoarthritis, Parkinson and Lipid disorders had a ratio of 7.8%, 24.8%, 8.5% and 12.8% respectively.

Heart failure accounted for the lowest percentage of 5%. The Charlson Index had a mean score of 0.89 ± 1.09 and the mean number of patients' diseases was 2.87 ± 1.53 .

Table 3. Clinical characteristics of osteoporosis (n = 141)

Osteoporosis characteristics	Frequency	Percentage	
Osteoporosis location	Spine	115	81.6
	Femoral neck	8	5.7
	Spine + Femoral neck	18	12.8
Symptoms	Yes	135	95.7
	No	6	4.3

Osteoporosis characteristics		Frequency	Percentage
History of musculoskeletal surgery	Yes	6	4.3
	No	135	95.7
History of bone fracture from middle-age	Yes	9	6.4
	No	132	93.6
Treatment of osteoporosis	Yes	72	51.1
	No	69	48.9
Treatment of pain	Yes	82	58.2
	No	59	41.8
		$\bar{x} \pm SD$	
Mean duration		1.70 ± 2.67	
Mean t-score	Spine	-3.3 ± 0.71	
	Femoral neck	-1.5 ± 1.17	

A total of 141 study subjects, 135 people (95.7%) reported that they were experiencing symptoms of osteoporosis. The average duration (in years) of osteoporosis in the study group was 1.70 ± 2.67 , with a minimum of 0 (newly diagnosed) and a maximum of 10. In which, the number of patients with osteoporosis in the spine accounted for the highest rate (81.6%); in the femoral neck was 5.7%, both

spine and femoral neck were 12.8%. The mean t-score in the spine was -3.3 ± 0.71 , in the femoral neck was -1.5 ± 1.17 .

There were 6.4% of patients who had a history of bone fracture from middle age. More than half of patients (51.1%) had treatment for osteoporosis and 58.2% had treatment for pain due to osteoporosis.

Table 4. Association between risk of falls and demographic characteristics

Related factors	High risk of falls		Low risk of falls		p (Chi-Square Tests)	
	n	%	n	%		
Age group	60 - 69	18	25.4	32	45.7	0.004
	70 - 79	27	38	28	40	
	≥ 80	26	36.6	10	14.3	
Gender	Male	2	25	6	8.6	0.140
	Female	69	51.9	64	91.4	
Occupation	Working	13	18.3	7	10	0.321
	Retired	58	81.7	63	90	

	Related factors	High risk of falls		Low risk of falls		p (Chi-Square Tests)
		n	%	n	%	
Educational level	Below high school	34	67,6	28	74.3	0.124
	High school	8	11.3	8	11.4	
	Above high school	15	21.1	10	14.3	
BMI (kg/m ²)	Underweight	13	18.3	6	8.6	0.217
	Normal	34	47.9	35	50	
	Overweight and obesity	24	33.8	29	41.4	
Living with	Family	65	91.5	67	95.7	0.312
	Professional caretaker 24/24	0	0	0	0	
	Living Alone	6	8.5	3	4.3	
Living area	City	35	49.3	36	51.4	0.800
	Rural area	36	50.7	34	48.6	
$\bar{x} \pm SD$						
Mean BMI		21.45±3.16		22.39 ± 2.68		0.057
Mean age		75.59 ±9.01		70.61 ± 7.47		< 0.01

Based on 21-item Fall Risk Index questionnaire, more than half of patients (50,4%) had high risk of falls, and 49.6% of the patients had low risk of falls. Age group was associated with the risk of falls in older patients with osteoporosis ($p < 0.05$). The mean age in the group of patients at high risk of falls was

higher than in the group of patients with low risk of falling (with $p < 0.05$). The differences were not statistical significance between gender, occupation, education level, body mass index, living with, living area and the risk of falls in the older osteoporosis patients ($p > 0.05$).

Table 5. Association between risk of falls and comorbidities

Comorbidities		High risk of falls		Low risk of falls		p (Chi-Square Tests)
		n	%	n	%	
Heart failure	Yes	7	9.9	0	0	0.007
	No	64	90.1	70	100	
Diabetes	Yes	18	25.4	7	10	0.017
	No	53	74.6	63	90	
Depression	Yes	7	9.9	4	5.7	0.359
	No	64	90.1	66	94.3	

Comorbidities		High risk of falls		Low risk of falls		p (Chi-Square Tests)
		n	%	n	%	
Hypertension	Yes	32	45.1	27	38.6	0.434
	No	39	54.9	43	61.4	
Lipid disorders	Yes	12	16.9	6	8.6	0.138
	No	59	83.1	64	91.4	
Parkinson	Yes	5	7.0	7	10	0.529
	No	66	93	63	90	
Knee osteoarthritis	Yes	20	28.2	15	21.4	0.354
	No	51	71.8	55	78.6	

	Mean (Min - Max)	Median (Min - Max)	Mean	Median (Min - Max)	p (Independent sample T tests)
Charlson index	1.17	1 (0 - 6)	0.61	1 (0 - 3)	0.002
Number of disease	3.25	2 (1 - 9)	2.49	2 (1 - 5)	0.003

Heart failure and diabetes mellitus were associated with the risk of falls in older patients with osteoporosis ($p < 0.05$). The mean Charlson Index and mean number of diseases in the group of patients at high risk of falls were higher than in the group of patients with low risk of falls (with $p < 0.05$). The differences were not statistical significance between hypertension, depression, lipid disorders, Parkinson, knee osteoarthritis and the risk of falls in the older osteoporosis patients ($p > 0.05$).

IV. DISCUSSION

The study was conducted at the National Geriatric Hospital in 141 patients aged from 60 years and older. Patients aged from 70 to 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 this 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 because postmenopausal women had higher risk of osteoporosis than men. As shown above, more than half of patients (50.4%) had high risk of falls, and 49.6% of the patients had low risk of falls. This results were similar to the percentage of high risk of falls with the study of Nitchanant kitcharanant et al in 68 men or postmenopausal women aged >65years who were diagnosed with osteoporosis: the ratio of high risk of falls was 55.9%.¹² The majority of patients in the study were retiree with the rate of 85.8%. Only 14.2% of patients are still employed. This large disparity in percentage was explained by the elderly population of our study. Patients who did not graduate from high school accounted for the highest percentage 71%, while 11.3% graduated from high school. Especially, 17.7% of participants had post high school education. This is quite similar

to the study of J. W. Wastesson et al on the educational level in osteoporosis patients with low 57.1%, medium 34.2% and high 8.7%. The majority of patients in the study lived with family (93.6%). Only 9 patients lived alone, accounted for 6.4%. The percentage of patients living in city and rural areas were similar with 50.4% and 49.6% respectively. This can explain by in Viet Nam elderly usually live with family to take care of each other's, only a small proportion of elderly with no family or house live alone.

The distribution of diseases in our study was asymmetrical. The majority of the study participants had hypertension, accounting for 41.8%. Diabetes occurred in 17.8% of participants. Other diseases such as depression, Knee osteoarthritis, Parkinson and Lipid disorders were 7.8%, 24.8%, 8.5% and 12.8% respectively. Heart failure accounted for the lowest percentage of 5%. The mean number of patient's diseases was 2.87 ± 1.53 . This result is similar to study of Hong-Ying Pi et al, the mean number of diseases was 2.07.¹³ The majority of patients in our study had comorbidities, since our study subjects were 60 years old and over, there is an increase in the number of diseases.

In our study, there were 135 people (95.7%) reported that they were experiencing symptoms of osteoporosis (pain, reduced height, kyphosis, bone fracture...) and only 4.3% of patients were asymptomatic. There were 93.6% of patients reported pain in which back pain accounted for the highest rate (85.8%) with 40.5% of mild pain, 57% of moderate pain and 2.6% of severe pain. Pelvis, femur, shin had a ratio of 7.8%, 13.5%, 8.5% respectively with more than half of patients reporting mild pain. The average duration of osteoporosis in the study group was 1.70 ± 2.67 , with a minimum of 0 (newly diagnosed) and a maximum of 10. The

osteoporosis duration in our study was lower than in others studies this may be because nearly half of patients in our study (49.6%) lived in rural areas with low technology and economic conditions and most of study subjects had low educational levels (71% patients did not graduate from high school) so they were not aware of the importance of osteoporosis examination. The number of patients with osteoporosis in spine accounted for the highest rate (81.6%); in Femoral neck was 5.7%, both spine and femoral neck were 12.8%. This is similar in terms of spine osteoporosis ratio with the study of Tran Bui Hoai Vong and colleagues in Hue Central Hospital (52.8%).¹⁴ The mean t-score in spine was -3.3 ± 0.71 , in Femoral neck was -1.5 ± 1.17 . These results are similar to the study of Le Thi Hue in 2013: the mean t-score in spine was $3,14 \pm 1,19$ (72). There were 6.4% of patients who had history of bone fracture from middle age. More than half of patients (51.1%) had treatment for osteoporosis and 58.2% had treatment for pain due to osteoporosis. The rate of patients who had treatment for osteoporosis is still low.

The mean age of the high-fall risk group was higher than the low-risk group's mean age, with $p < 0.05$. Age is a factor directly related to the risk of falls. In this study, we note that the percentage of high fall risk increases by age group. Participants over 70 years old were 2.5 times higher risk of falls than participants under 70 years old. Other studies have also shown that increasing age leads to a higher risk of falls and fall rate such as the study of Barrett-Connor E 2009...¹⁵ Factors such as gender, BMI, occupation (retired or working), marital status, living status (alone, family) had no associated with the risk of falls in older patients with osteoporosis.

Heart failure and diabetes mellitus were

associated with the risk of falls in older patients with osteoporosis ($p < 0.05$). The mean Charlson Index and mean number of diseases in the group of patients at high risk of falls were higher than in the group of patients with low risk of falls (with $p < 0.05$). This is similar to the results of Antonia Oliveira Silva et al 2017 in 240 elderly patients: patients with heart failure and diabetes had higher risk of falls than patients without.¹⁶ There was no significant difference between hypertension, depression, lipid disorders, Parkinson, knee osteoarthritis and the risk of falls in the older osteoporosis patients ($p > 0.05$).

V. CONCLUSION

The study showed that advanced age, heart failure, diabetes and depression were significantly associated with a higher risk of falls in older patients with osteoporosis. A fall risk assessment in older patients with osteoporosis is necessary to prevent falls and reducing consequences after a fall as well as to improve patients' quality of life.

REFERENCE

1. Cosman F, de Beur SJ, LeBoff MS, et al. Clinician's Guide to Prevention and Treatment of Osteoporosis. *Osteoporos Int*. 2014;25(10):2359-2381. doi:10.1007/s00198-014-2794-2
2. National Institutes of Health. *Osteoporosis overview*. U.S. Department of Health and Human Services. Available at: <https://www.bones.nih.gov/health-info/bone/osteoporosis/overview>. Accessed March 12, 2023.
3. Liu-Ambrose T, Eng JJ, Khan KM, et al. Older women with osteoporosis have increased postural sway and weaker quadriceps strength than counterparts with normal bone mass: Overlooked determinants of fracture risk? *J Gerontol A Biol Sci Med Sci*. 2003;58(9):M862-866. doi:10.1093/gerona/58.9.m862
4. de Groot MH, van der Jagt-Willems HC, van Campen JPCM, et al. A flexed posture in elderly patients is associated with impairments in postural control during walking. *Gait Posture*. 2014;39(2):767-772. doi:10.1016/j.gaitpost.2013.10.015
5. Colón-Emeric C, Whitson HE, Berry SD, et al. AGS and NIA Bench-to Bedside Conference Summary: Osteoporosis and Soft Tissue (Muscle and Fat) Disorders. *J Am Geriatr Soc*. 2020;68(1):31-38. doi:10.1111/jgs.16248
6. Santy-Tomlinson J, Speerin R, Hertz K, Tochon-Laruaz AC, van Oostwaard M. Falls and Secondary Fracture Prevention. In: Hertz K, Santy-Tomlinson J, eds. *Fragility Fracture Nursing: Holistic Care and Management of the Orthogeriatric Patient*. Perspectives in Nursing Management and Care for Older Adults. Springer International Publishing; 2018:27-40. doi:10.1007/978-3-319-76681-2_3
7. Centers for Disease Control and Prevention. *Facts about falls (2021) Centers for Disease Control and Prevention*. Available at: <https://www.cdc.gov/falls/facts.html>. Accessed March 12, 2023.
8. Bone Mass Measurement: What the Numbers Mean | NIH Osteoporosis and Related Bone Diseases National Resource Center. <https://www.bones.nih.gov/health-info/bone/bone-health/bone-mass-measure?fbclid=IwAR1QtP4mIAkmAVwCWAZ1yyAi0U3t9ZN5n6yQ6mgdWHtly2R3kZD0IR6kFWA>. Accessed March 12, 2023.
9. da Silva RB, Costa-Paiva L, Morais SS, et al. Predictors of falls in women with and without osteoporosis. *The Journal of orthopaedic and sports physical therapy*. 2010;40(9):582-8. doi:10.2519/jospt.2010.3239.
10. Ishimoto Y, Wada T, Kasahara Y, et al. Fall Risk Index predicts functional decline regardless of fall experiences among

community-dwelling elderly. *Geriatr Gerontol Int*. 2012;12(4):659-666. doi:10.1111/j.1447-0594.2012.00837.x

11. Yoon S, Lee Y, Han C, et al. Usefulness of the Patient Health Questionnaire-9 for Korean medical students. *Acad Psychiatry J Am Assoc Dir Psychiatr Resid Train Assoc Acad Psychiatry*. 2014;38(6):661-667. doi:10.1007/s40596-014-0140-9.

12. Kitcharanant N, Vanitcharoenkul E, Unnanuntana A. Validity and reliability of the self-rated fall risk questionnaire in older adults with osteoporosis. *BMC Musculoskelet Disord*. 2020;21(1):757. doi:10.1186/s12891-020-03788-z

13. Pi HY, Hu MM, Zhang J, et al. Circumstances of falls and fall-related injuries among frail elderly under home care in China. *Int J Nurs Sci*. 2015;2(3):237-242. doi:10.1016/j.

ijnss.2015.07.002

14. Vong TBH, Nguyen TT, Nhat TQ, et al. Khao sat ty le loang xuong cua phu nu tai Benh vien Trung uong Hue. *Vietnam J Diabetes Endocrinol*. 2022;(51):81-85. doi:10.47122/vjde.2022.51.11

15. Barrett-Connor E, Weiss TW, McHorney CA, et al. Predictors of falls among postmenopausal women: results from the National Osteoporosis Risk Assessment (NORA). *Osteoporos Int J Establ Result Coop Eur Found Osteoporos Natl Osteoporos Found USA*. 2009;20(5):715-722. doi:10.1007/s00198-008-0748-2

16. Smith A de A, Silva AO, Rodrigues RAP, et al. Assessment of risk of falls in elderly living at home. *Rev Lat Am Enfermagem*. 2017;25:e2754. doi:10.1590/1518-8345.0671.2754