# PREVALENCE AND ASSOCIATED FACTORS OF VERTEBRAL COMPRESSION FRACTURE AMONG OLDER WOMEN WITH OSTEOPOROSIS

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## Abstract

**Objectives:** To investigate the prevalence and associated factors of vertebral compression fracture (VCF) in older women with osteoporosis. **Methods:** A cross-sectional study was conducted on 279 older women with osteoporosis at the Rheumatology and Neurosurgery Department and Rheumatology Clinic, University Medical Center, from August 2022 to May 2023. **Results:** 102/279 older women (36.6%) had at least one vertebral fracture, and more than 50% of participants were symptomatic. In the adjusted logistic regression, physical activity (OR: 0.44; 95%CI: 0.20 - 0.94; p = 0.038), osteoarthritis (OR: 0.24; 95%CI: 0.12 - 0.48; p < 0.001), frailty (OR: 7.41; 95%CI: 3.45 - 16.73; p < 0.001), falls (OR: 3.86; 95%CI: 1.68 - 9.32; p = 0.002), T-score at femoral neck (OR: 0.63; 95%CI: 0.41 - 0.92; p = 0.002) were associated with vertebral fracture. **Conclusion:** The prevalence of VCF was quite high among older women with osteoporosis, highlighting a disease burden in this population. Physical activity, osteoarthritis, and higher T-score at the femoral neck decreased the odds of VCF, while frailty and falls increased the odds of VCF.

Keywords: Vertebral fracture; Osteoporosis; Aged; Women.

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## INTRODUCTION

A VCF is a break in the vertebral body, mostly due to osteoporosis in older women. VCF affects around 20 - 25% of older people across the globe and increases with age up to 40%at the age of 80 [1]. VCF predicts morbidity comprising back pain, kyphotic deformity, and loss of height, resulting in subsequent vertebral fracture and mortality eventually [2, 3]. Unfortunately, VCF is under-recognized in clinical settings [4]. In Vietnam, the increasing number of older women has put a heavy burden of osteoporosis and VCF on this population. Although there was some research about osteoporotic VCF, the participants were less responded to conservative management and had indications of surgical intervention. These articles also did not examine the prevalence of VCF in older women with osteoporosis and did not focus on the geriatric female population, which can have different clinical and radiologic characteristics because of the aging process, frailty, and multimorbidity. The study aims to: Investigate the prevalence and several factors associated with VCF among older females at University Medical Center, Ho Chi Minh City.

#### **MATERIALS AND METHODS**

#### 1. Subjects

Including 279 older women with osteoporosis at the Rheumatology and Neurosurgery Department and Rheumatology Clinic, University Medical Center, from August 2022 to May 2023.

\* Inclusion criteria: Females aged  $\geq 60$  whose bone density scan had a T-score  $\leq -2.5$ , which is the World Health Organization's definition of osteoporosis.

\* *Exclusion criteria:* We excluded any cases suspected of having nonfragility fracture or secondary osteoporosis to focus on post-menopausal osteoporosis.

#### 2. Methods

\* *Study design*: A cross-sectional study.

# \* Study procedure:

A geriatrician asked the participants about background information and previous height - the highest one they remembered at the age of 30. The participants' height and weight were measured. Their bone mineral density was measured using dual-energy X-ray absorptiometry (DEXA) at the lumbar

#### JOURNAL OF MILITARY PHARMACO-MEDICINE Nº4 - 2025

spine and femoral neck, and thoracolumbar X-ray results were recorded. The participants' inquiry information, along with X-ray and DEXA results, which were retrieved from electronic health records, was then recorded on data collection sheets.

# \* Definition of variables:

VCF is diagnosed using the morphology of vertebrae based on Genant's method. We also examined back pain and kyphosis using clinical judgment. Height loss was defined if the previous height minus the current height was at least 4cm.

Comorbidities were collected using electronic medical records, and multimorbidity was determined if there were at least two diseases. Activities of daily living (ADL) were assessed using the Katz index, and instrumental activities of daily living (IADL) were assessed using the Lawton index. Frailty was diagnosed using the Clinical Frailty Scale (CFS) and categorized as non-frailty (CFS  $\leq$  3), pre-frailty (CFS = 4), and frailty (CFS  $\geq$  5).

## \* Statistical analysis:

Data were analyzed using R (R Foundation for Statistical Computing, Vienna, Austria). Categorical variables were expressed as frequencies and percentages, and quantitative variables were expressed as means and medians for normally distributed variables or medians and interquartile ranges for non-normally distributed variables. Variables between groups were compared using the Chi-square test or Fisher's exact test for categorical variables and the T-test for normally distributed quantitative variables. Logistic regression assessed associations of related factors and VCF. Statistical significance was defined as a p-value < 0.05.

## 3. Ethics

This study was approved by the Ethics Committee of the University of Medicine and Pharmacy in Ho Chi Minh City (approval number 639/HDDD dated 1<sup>st</sup> August 2022). The University Medical Center granted permission for the use and publication of the research data. All participants were informed of the objectives and obtained informed consent. The authors declare to have no conflicts of interest in this research.

## RESULTS

279 patients were included in the study.

**Table 1.** Baseline characteristics of older women with T-score  $\leq$  -2.5.

Characteristics	<b>Overall (n = 279)</b>
Age (year) <sup>b</sup>	$72.0\pm7.3$
Age groups, n (%)	
60 - 69	114 (40.9)
70 - 79	115(41.2)
$\geq 80$	50 (17.9)
Previous VCF, n (%)	15 (5.4)
Bisphosphonate usage, n (%)	77 (27.6)
Physical activity, n (%)	95 (34.1)
Current height (cm) <sup>b</sup>	$152\pm4.9$
Weight (kg) <sup>b</sup>	$52.4\pm8.8$
BMI (kg/m <sup>2</sup> ) <sup>b</sup>	$22.6\pm3.5$
Comorbidities, n (%)	
Hypertension	114 (40.9)
Diabetes mellitus	52 (18.6)
Osteoarthritis	142 (50.9)
Stroke	11 (3.9)
Chronic kidney disease	20 (7.2)
Multimorbidity, n (%)	119 (42.7)

(BMI: Body mass index; <sup>*a*</sup>VCF group vs. non-VCF group; <sup>*b*</sup>Mean  $\pm$  Standard deviation)

The majority of our participants were between 60 - 79. The VCF group also had less physical activity, less osteoarthritis occurrence, and lower T-scores at all three sites (femoral neck, total hip, and lumbar spine) than the non-VCF group.

#### JOURNAL OF MILITARY PHARMACO-MEDICINE Nº4 - 2025

	VC			
Characteristics	Yes (n = 102)	Yes (n = 102) No (n = 177)		
VCF, n (%)	102 (36.6)			
Back pain, n (%)	74 (72.5)	20 (11.3)	< 0.001	
Kyphosis, n (%)	69 (67.6)	5 (2.8)	< 0.001	
Height loss, n (%)	64 (62.7)	4 (2.3)	< 0.001	
T-score <sup>a</sup>				
Femoral neck	$-2.8 \pm 1.0$	$\textbf{-2.4}\pm0.8$	< 0.001	
Total hip	$\textbf{-2.4}\pm0.9$	$\textbf{-}1.9\pm0.9$	0.001	
Lumbar spine	$-3.1 \pm 1.0$	$-2.8\pm0.8$	0.009	
Number of fractures <sup>b</sup>	1.5 (1.0 - 2.0)			
One fracture	51 (50.0)			
Two fractures	27 (26.5)			
Three or more fractures	24 (23.5)			
Severity, n (%)				
Mild	4 (3.9)			
Moderate	14 (13.7)			
Severe	84 (82.4)			

Table 2. Clinical characteristics and X-ray images of VCF.

(<sup>a</sup>Mean ± Standard deviation; <sup>b</sup>Median (Interquartile range); <sup>\*</sup>VCF group vs. non-VCF group)

The prevalence of VCF among the participants was 36.6% (102/279). Overall T-scores at the femoral neck, total hip, and lumbar spine were  $-2.5 \pm 0.9$ ,  $-2.2 \pm 0.9$ , and  $-2.9 \pm 0.9$ , respectively. More participants with VCF had back pain, kyphosis, and height loss than those without VCF. Most participants with VCF had one fracture and severe deformity.

Chave stavistics	Overall	VC	8	
Characteristics	(n = 279)	Yes (n = 102)	No (n = 177)	р.
ADL dependence, n (%)	49 (17.6)	33 (32.4)	16 (9.0)	< 0.001
IADL dependence, n (%)	101 (36.2)	66 (64.7)	35 (19.8)	< 0.001
Frailty, n (%)				
Non-frailty	132 (47.3)	22 (21.6)	110 (62.1)	< 0.001
Pre-frailty	43 (15.4)	12 (11.8)	31 (17.5)	< 0.001
Frailty	104 (37.3)	68 (66.7)	36 (20.3)	
Falls, n (%)	51 (18.3)	36 (35.3)	15 (8.5)	< 0.001

**Table 3.** Geriatric characteristics of older women with T-score  $\leq$  -2.5.

(<sup>a</sup>VCF group vs. non-VCF group)

The VCF group had more frailty, falls, and ADL and IADL dependence than the non-VCF group.

Table 4. Logistic	regression n	nodel of factors	associated with	VCF (	(n = 279).
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	Univariate regr	ession	Multivariate regression		
Factors	OR (95%CI)	р	Adjusted OR (95%CI)	р	
Age	1.10 (1.06 - 1.14)	< 0.001	1.02 (0.96 - 1.08)	0.521	
Physical activity	0.25 (0.14 - 0.45)	< 0.001	0.44 (0.20 - 0.94)	0.038	
BMI	0.99 (0.93 - 1.07)	0.939			
Diabetes mellitus	1.98 (1.08 - 3.67)	0.027	1.45 (0.65 - 3.25)	0.359	
Osteoarthritis	0.42 (0.25 - 0.68)	< 0.001	0.24 (0.12 - 0.48)	< 0.001	
Frailty					
Non-frailty	Reference		Reference		
Pre-frailty	1.94 (0.84 - 4.30)	0.109	1.55 (0.59 - 3.96)	0.363	
Frailty	9.44 (5.21 - 17.71)	< 0.001	7.41 (3.45 - 16.73)	< 0.001	
Falls	5.89 (3.08 - 11.77)	< 0.001	3.86 (1.68 - 9.32)	0.002	
T-score					
Femoral neck	0.53 (0.37 - 0.73)	< 0.001	0.63 (0.41- 0.92)	0.002	
Lumbar spine	0.65 (0.47 - 0.88)	0.007	0.70 (0.48 - 1.00)	0.055	

(OR: Odds ratio; CI: Confidence interval)

Variables with p-value < 0.2 in the univariate regression model were included in the multivariate regression model. The T-score at the total hip was omitted because the T-score at the femoral neck could affect the T-score at the total hip, leading to multicollinearity. Age was included in the two models as a quantitative variable.

In multivariate logistic regression (*Table 5*), physical activity, osteoarthritis, and high T-score at the femoral neck decreased the odds of VCF, while frailty and falls increased the odds of VCF.

# DISCUSSION

Our study found that the proportion of VCF among older females with osteoporosis was 36,6% (*Table 2*). For baseline characteristics, the participants in this study were older, had lower T-scores, and were more frail compared to previous studies [5].

The most striking finding was the substantial prevalence of VCF in older women with osteoporosis. Xia et al. used Genant's semiquantitative method and found that the prevalence of VCF was 21.6% among women aged > 65 years. Waterloo et al. reported that the prevalence of VCF was 12.6% in Sweden. Our results were higher than those of published studies worldwide for several reasons as follows: (1) Our

participants were older than those in previous studies; (2) over 80% of our participants experienced severe deformity of the VCF; (3) a third of participants were ADL- and IADL-dependent, and 40% were frail. Frailty is an issue that requires further research in older women because of the increased risk of VCF, multimorbidity, and mortality burden.

Physical activity has been proven to benefit skeletal health, but whether physical activity helps to prevent vertebral fractures is still debatable. A previous study showed no significant association between total physical activity and clinical vertebral fracture [6]. On the other hand, Ling et al. demonstrated that women doing heavy physical work were less likely to have VCF (hazard ratio: 0.87; 95%CI: 0.78 -0.96; p < 0.006). The protective effect of physical activity on bone health can be explained by attenuating age-related bone mineral loss, improving balance and muscle strength, and thus reducing fall risk and fall-related fractures [7].

Our data showed an inverse association between osteoarthritis and vertebral fracture (*Table 4*). Osteoarthritis becomes more prevalent with age; therefore, it could have affected the age variable in the multivariate logistic regression model. Nevertheless, longitudinal research is needed to discover the association between osteoarthritis at various sites and vertebral fractures among older females with osteoporosis.

Frailty is a common syndrome in older adults with osteoporosis, increasing morbidity and worsening quality of life. Our study was consistent with previous research. Interestingly, fracture also increased the risk of subsequent frailty [8], and the more severe frailty was, the more the hazard ratio increased after adjusting for age, sex, and socioeconomic status [9]. This bidirectional interaction between frailty and VCF demonstrated how the aging musculoskeletal system plays a vital role in the development of frailty [8]. Therefore, it is critical that clinicians should pay more attention to frailty, prescribe walking aids, and fall education, and encourage older women to exercise to minimize the risk of vertebral fracture.

Falls interact with VCF due to agerelated alteration in spinal structure. Hyperkyphotic posture at thoracic spine level could jeopardize patients by increasing fall risk (OR = 2.13, 95%CI: 1.10 - 4.51) [10]. The VCF group in our study had more kyphosis than the non-VCF group (*Table 2*). Our study implies that physicians should employ strategies to prevent falls in older women with osteoporosis.

The limitations of our study include several factors that were self-reported, data on vitamin D status. and comprehensive medication history, and chronic inflammatory disease were absent, which may lead to overestimation or underestimation of VCF prevalence. Second, osteoarthritis becomes more prevalent with age; therefore, it could have affected the age variable in the multivariate logistic regression model. Finally, our study conducted quite distant from 2025 (from August 2022 to May 2023) could affect the evolution of factors associated with osteoporosis and vertebral fracture.

# CONCLUSION

The prevalence of VCF among older women is high. Physical activity and osteoarthritis decreased the odds of VCF, whereas frailty, lower T-score, and falls increased the odds of VCF.

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