

Original Research Article

Sex distribution and bone mineral density by current low-trauma fracture status in a hospital DXA cohort: a retrospective single-centre study

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ABSTRACT

Background: Osteoporosis in men is frequently underrecognized. We compared sex distribution and T-scores from dual-energy X-ray absorptiometry (DXA) in patients with and without a current low-trauma fracture.

Methods: Authors retrospectively analysed 307 hospital DXA reports obtained between September 2025 and September 2026. Patients were classified by recorded diagnosis into a current-fracture group (n=109) or a no-current-fracture group (n=198). Logistic regression evaluated the association of male sex with current-fracture group membership, adjusting for age and lowest available T-score.

Results: Men comprised 22 of 109 patients (20.2%) in the current-fracture group and 13 of 198 (6.6%) in the no-current-fracture group (crude odds ratio (OR) 3.60, 95% confidence interval CI) 1.73–7.48; age- and T-score-adjusted OR 3.70, 95% CI 1.72–7.95). Median lowest T-scores were –1.90 and –1.50, respectively (p = 0.011). Among patients with available T-scores, 33 of 105 (31.4%) in the current-fracture group and 29 of 196 (14.8%) in the no-current-fracture group had values in the osteoporosis range.

Conclusions: Within this selected DXA cohort, men were more frequent in the current-fracture group even after adjustment for age and T-score. Most patients with a current fracture had T-scores above –2.5, emphasizing the need to consider fracture status alongside densitometry.

Keywords: Osteoporosis, Sex, Dual-energy X-ray absorptiometry, Fracture, T-score, Slovakia

INTRODUCTION

Fragility fractures are a substantial clinical burden. SCOPE 2021 estimated 4.3 million new fragility fractures across the European Union, United Kingdom and Switzerland in 2019, including approximately 1.4 million in men.¹ Osteoporosis in men remains underdiagnosed and undertreated.^{2,3} A recent systematic review found lower rates of dual-energy X-ray absorptiometry (DXA) testing and osteoporosis treatment in men than in women after fragility fracture; reports from Spain and Brazil describe similar disparities in assessment or treatment.^{4–6} Bone mineral density (BMD) predicts fracture risk, although

many fragility fractures occur in patients whose T-scores are above –2.5. In the Rotterdam study, 44% of nonvertebral fractures in women and 21% in men occurred at T-scores below –2.5.⁷ In the Dubbo cohort, approximately half occurred above that threshold.⁸ A recent meta-analysis also examined the contribution of BMD to prediction of hip and other fractures.⁹

Slovakia has national osteoporosis guidelines,¹⁰ and published Slovak DXA studies have focused on postmenopausal women, women with low bone mass or osteoporosis, and patients with chronic kidney disease.^{11–13} Less is known about differences in sex distribution and

DXA findings according to current low-trauma fracture status in routine hospital practice. We therefore compared these characteristics in patients undergoing DXA at a Slovak university hospital and examined the association of male sex with current-fracture group membership after adjustment for age and lowest available T-score.

METHODS

Study design

We conducted a retrospective single-centre cross-sectional study at the Department of Orthopedics and Traumatology of Locomotor Apparatus, P. J. Šafárik University and L. Pasteur University Hospital, Košice, Slovakia. Data were taken from DXA reports held in the hospital's outpatient system. Scans were performed on a Lunar Prodigy densitometer (GE Healthcare). The study is reported according to the STROBE recommendations for observational studies.¹⁴

Participants

Authors included patients with DXA reports recorded in the hospital outpatient information system between September 2025 and September 2026. One report per patient was analysed, with no age-based exclusion. Patients referred from outside solely for DXA were not available in the system and were not included. Groups were defined by the diagnosis documented in the report. Patients with an M80 diagnosis (osteoporosis with current pathological fracture) were assigned to the current-fracture group only when imaging confirmed a current fracture and the clinical report documented a low-energy trauma mechanism. Patients without a current fracture, predominantly coded M81, formed the comparison group. A previous fracture without a current fracture did not qualify a patient for the current-fracture group.

DXA variables

Age at DXA, sex, and the T-scores for total lumbar spine (L1–L4), femoral neck and total hip were extracted from each report. When only individual vertebral T-scores were provided, the total lumbar spine T-score was considered unavailable rather than calculated from individual values. The lowest available T-score was used as the principal densitometric measure. For descriptive analysis, values were grouped as osteoporosis range (≤ -2.5), low bone mass range (> -2.5 to ≤ -1.0) or normal range (> -1.0).¹⁵ Six patients had no available T-score and were excluded from T-score-based analyses.

T-scores were those calculated by the scanner software. The positions of the international society for clinical densitometry (ISCD) recommend a uniform female reference database for T-scores in men, and with a Lunar densitometer the effect of using a female instead of a male reference depends on the skeletal site.^{15–18}

Statistical analysis

The primary analysis compared the proportion of men between the groups. Age is given as mean (standard deviation, SD) and was compared with Welch's *t* test. The lowest T-score is given as median (interquartile range, IQR), with mean (SD) added for description, and was compared with the Mann–Whitney *U* test. Categorical variables are given as number (percentage) and were compared with Pearson's chi-square test. For male sex we report the crude odds ratio (OR) and 95% confidence interval (CI) of belonging to the current-fracture group, with women as the reference.

Authors then fitted logistic regression models with current-fracture group membership as the outcome (current-fracture group = 1, no-current-fracture group = 0). The first model included male sex and age (per year); the second added the lowest T-score (per 1.0 unit). The odds ratios describe cross-sectional associations within this hospital sample, and we did not estimate predicted probabilities, population prevalence or predictive values. Missing values were not imputed, and each analysis used the patients with complete data for its variables. All tests were two-sided with a significance level of 0.05, and secondary analyses were exploratory. No formal sample-size calculation was performed; the analysis used all patients retrieved from the hospital system. Analyses were performed with IBM SPSS Statistics, version 32 (IBM Corp., Armonk, NY, USA).

Ethics

The study protocol was approved by the ethics committee of the University Hospital of Louis Pasteur in Košice (registration number: 2025/EK/08065) and conducted in accordance with the principles of the Declaration of Helsinki. The dataset contained study numbers only and no patient names or other direct identifiers.

RESULTS

Study population

We included 307 patients: 109 (35.5%) in the current-fracture group and 198 (64.5%) in the no-current-fracture group; 35 patients (11.4%) were men. Age ranged from 45 to 89 years, with a mean of 68.1 years (SD 9.5). A lowest T-score was available for 301 patients (105 of 109 in the current-fracture group and 196 of 198 in the no-current-fracture group).

Sex distribution and logistic regression

Men comprised 22 of 109 patients (20.2%) in the current-fracture group and 13 of 198 (6.6%) in the no-current-fracture group (Pearson $\chi^2=12.91$, $p<0.001$; Table 1). The crude OR for current-fracture group membership in men versus women was 3.60 (95% CI 1.73–7.48).

After adjustment for age (n=307), the OR for male sex was 3.54 (95% CI 1.70–7.36). After further adjustment for lowest available T-score (n=301), it was 3.70 (95% CI 1.72–7.95; $p=0.001$). In the extended model, a 1-unit higher T-score was associated with lower odds of current-fracture group membership (OR 0.72, 95% CI 0.56–0.92; $p=0.009$), while age was not (OR 0.99 per year, 95% CI 0.96–1.01; $p=0.355$; Table 3).

Bone mineral density and age

Median lowest T-scores were -1.90 (IQR -2.50 to -1.00) in the current-fracture group and -1.50 (IQR -2.10 to -0.90) in the no-current-fracture group ($p = 0.011$; Table 2). The distribution of T-score categories differed between

groups ($p = 0.003$). Among patients with available T-scores, 33 of 105 (31.4%) in the current-fracture group and 29 of 196 (14.8%) in the no-current-fracture group had a value ≤ -2.5 . In the current-fracture group, 72 of 105 (68.6%) had a value above -2.5 . Mean ages were 67.3 (SD 10.0) and 68.5 (SD 9.2) years, respectively (mean difference -1.22 years, 95% CI -3.50 to 1.06 ; $p=0.292$).

In a post hoc analysis restricted to women with an available lowest T-score (85 in the current-fracture group and 183 in the no-current-fracture group), the mean lowest T-score was again lower in the current-fracture group (-1.82 vs -1.49 ; mean difference -0.33 , 95% CI -0.61 to -0.05).

Table 1: Age and sex according to current-fracture status.

Characteristics	Current-fracture group (n=109)	No-current-fracture group (n=198)	Effect and P value
Age, years, mean (SD)	67.3 (10.0)	68.5 (9.2)	Difference -1.22 years (95% CI -3.50 to 1.06); $p=0.292$
Women, N (%)	87 (79.8)	185 (93.4)	
Men, N (%)	22 (20.2)	13 (6.6)	OR 3.60 (95% CI 1.73 to 7.48); $p < 0.001$

Table 2: Lowest T-score and T-score category according to current-fracture status.

Characteristics	Current-fracture group (n=105)	No-current-fracture group (n=196)	P value
Lowest T-score, mean (SD)	-1.75 (1.11)	-1.46 (1.03)	
Lowest T-score, median (IQR)	-1.90 (-2.50 to -1.00)	-1.50 (-2.10 to -0.90)	0.011
T-score category, N (%)			0.003
Normal range	26 (24.8)	55 (28.1)	
Low bone mass or osteopenia range	46 (43.8)	112 (57.1)	
Osteoporosis range	33 (31.4)	29 (14.8)	

Table 3: Association between male sex and current-fracture group membership.

Variables	Crude OR (95% CI)	Age-adjusted OR (95% CI)	Age+T-score OR (95% CI)
Male sex (reference: women)	3.60 (1.73 to 7.48)	3.54 (1.70 to 7.36)	3.70 (1.72 to 7.95)
Age, per year		0.99 (0.96 to 1.01)	0.99 (0.96 to 1.01)
Lowest T-score, per 1.0 unit higher			0.72 (0.56 to 0.92)
Patients analysed, N	307	307	301

DISCUSSION

In this hospital DXA cohort, men represented a greater proportion of patients with a current low-trauma fracture than of those without one. The association remained after adjustment for age and lowest available T-score (adjusted OR 3.70). Patients with a current fracture also had lower T-scores, but most did not meet the densitometric threshold of -2.5 . These findings describe associations within a selected group of patients undergoing DXA; they do not establish a higher population fracture risk in men.

This difference in sex distribution is clinically relevant given the documented underassessment and undertreatment of osteoporosis in men.^{2–6} Nevertheless, the present data do not include referral histories or the population eligible for DXA. We therefore cannot determine whether the observed distribution reflects differences in referral, fracture ascertainment or other characteristics of patients attending this centre. The T-score findings are consistent with reports that fragility fractures frequently occur outside the densitometric osteoporosis range.^{7,8} In the current-fracture group, 68.6% of patients with available T-scores had a lowest value

above -2.5 , including 24.8% in the normal range. The classification of bone density and the presence of a documented low-trauma fracture thus provide different clinical information. Guidelines recommend osteoporosis assessment after fragility fracture and support treatment decisions that incorporate fracture type and clinical risk rather than T-score alone.^{3,10}

This study has several limitations. It included only patients with retrievable DXA reports in one hospital information system and excluded patients referred solely for DXA from outside the hospital. As all participants underwent DXA and were largely coded M80 or M81, the comparison does not represent patients with and without osteoporosis in the general population, and we could not estimate referral rates or population fracture risk. Only 35 men were included, which limits precision, and fracture sites were insufficiently documented for site-specific analysis. Information on smoking, alcohol consumption, glucocorticoid use, hypogonadism, secondary causes of bone loss and falls was unavailable, and previous osteoporosis treatment was incompletely documented and was therefore not analysed.

The availability of DXA measurements at individual skeletal sites differed between groups, which may affect comparisons based on the lowest available T-score and the T-score-adjusted model. T-scores were taken from scanner-generated reports, and the choice of reference database for men influences male T-scores, with effects that vary by site and densitometer;^{15–18} a post hoc analysis restricted to women showed a similar direction of T-score difference (mean difference -0.33). Adults aged 45–49 years were included, and ISCD guidance favours Z-scores in men younger than 50 years and in premenopausal women, so T-score categories in younger participants are descriptive.^{15,19} Finally, the study had no longitudinal follow-up, and patients without a current fracture may have had previous fractures.

CONCLUSION

In this hospital DXA cohort, men had more than three times the odds of belonging to the current-fracture group (20.2% of the group versus 6.6%; crude odds ratio 3.60), and neither age nor bone mineral density explained this: the odds ratio was 3.70 after adjustment for both. Bone density also failed to identify most of the patients who had fractured. Only 31.4% had a T-score in the osteoporosis range, 68.6% had a lowest T-score above -2.5 , and a quarter had a T-score within the normal range. A diagnosis based on the T-score alone would therefore have excluded about two thirds of these patients. The study adds data from routine hospital practice at a Slovak centre showing that a low-trauma fracture should itself be the indication for osteoporosis assessment and treatment, in men as well as women, whatever the T-score. These are associations within the patients of one centre registered in its hospital system, not estimates of population fracture risk, and they need confirmation in larger, multicentre samples.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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