Article

Dan Wang[1,*]
Fang Liu[1]
Hongmei Li [1]
Ziyan Wan [1]

Preoperative Anxiety and Depression in Elderly Patients With Osteoporotic Fractures and Their Association With Postoperative Recovery

[1]Department of Orthopedics, Yueyang People's Hospital, 414000 Yueyang, Hunan, China

Abstract

Background: This study aimed to determine the prevalence of preoperative comorbid anxiety and depression in elderly patients undergoing surgery for osteoporotic fractures and to investigate its independent association with key postoperative recovery indicators.

Methods: A retrospective analysis was conducted on 132 patients aged $\geq$ 60 years who underwent surgical treatment between July 2021 and July 2025. Preoperative psychological status was assessed using the Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) at admission. Patients meeting the cut-off for both scales (SAS $\geq$ 50, SDS $\geq$ 53) were defined as having comorbid anxiety/depression. Recovery outcomes included length of hospital stay (LOS), time to first ambulation, Visual Analog Scale (VAS) and Barthel Index (BI) scores at admission, 1 week, and 3 months postoperatively, complications, and readmissions. Group comparisons and repeated-measures analysis of variance (ANOVA) were performed. Multiple linear regression was employed to examine the independent association between comorbid anxiety/depression and 3-month BI scores.

Results: The prevalence of comorbid anxiety/depression was 31.06% (41/132). This group had a higher proportion of females, diabetes, and American Society of Anesthesiologists (ASA) class III/IV ($p < 0.05$). Compared to the non-anxiety/depression group (n = 91), they experienced a significantly longer LOS (12.71 $\pm$ 2.82 vs. 11.18 $\pm$ 2.51 days, $p = 0.002$), higher complication rates (21.95% vs. 8.79%, $p = 0.037$), and persistently worse VAS and BI scores at 3 months ($p < 0.001$). After adjusting for confounders, comorbid anxiety/depression was independently associated with a 5.22-point reduction in 3-month BI scores ($\beta = -5.22$, 95% confidence interval (CI): –8.17 to –2.27, $p < 0.001$).

Conclusions: Comorbid anxiety and depression are highly prevalent and serve as a significant, independent risk factor for adverse recovery in elderly patients with osteoporotic fractures. Routine preoperative psychological screening and integrated interventions are warranted to improve outcomes in this vulnerable population.

Keywords

osteoporotic fractures; anxiety; depression; elderly patients; postoperative recovery

Introduction

With the acceleration of global population ageing, the proportion of elderly individuals in China continues to rise, making osteoporosis and its complications a significant public health issue that poses a serious threat to the health of older adults [1,2]. Osteoporotic fractures, as the most serious outcome of osteoporosis, are most commonly seen in hip, vertebral and distal radius fractures, and their incidence rate increases exponentially with age [3,4]. Data show that the prevalence of osteoporotic fractures among the elderly in China is 18.9%, and the majority of these patients require surgical intervention to restore limb function [5]. However, elderly patients, with their declining physiological functions and multiple comorbidities, are prone to experiencing a range of psychological and physiological stress responses triggered by surgical trauma and the postoperative recovery process [6]. Among these, negative emotions such as

Submitted: 6 May 2026 Revised: 3 June 2026 Accepted: 24 June 2026 Online First: 25 November 2026
*Corresponding author details: Dan Wang, Department of Orthopedics, Yueyang People's Hospital, 414000 Yueyang, Hunan, China. Email: 13657306567@163.com

© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

anxiety and depression are particularly prominent.

Preoperative anxiety and depression, as common psychological disorders among surgical patients, are associated with multiple factors including perceived surgical risk, anticipated pain, and insufficient confidence in recovery [7]. For elderly patients with osteoporotic fractures, such negative emotions not only exacerbate postoperative pain perception and impair sleep quality, but may also suppress immune function through neuroendocrine disturbances [8,9]. This, in turn, increases the risk of postoperative complications such as infection and deep vein thrombosis, thereby delaying the fracture healing process. Research has indicated that the incidence of preoperative anxiety and depression among orthopaedic surgery patients can exceed 30% [10]. However, research into emotional issues among the specific cohort of elderly patients with osteoporotic fractures remains insufficient, and the quantitative association between their emotional disorders and postoperative recovery indicators has yet to be clearly established.

In current clinical practice, the treatment of osteoporotic fractures in the elderly predominantly focuses on optimising surgical techniques and the application of anti-osteoporosis medications, with insufficient emphasis placed on the assessment and intervention of preoperative psychological states [11]. Clarifying the characteristics of preoperative anxiety and depression in elderly patients with osteoporotic fractures, and quantitatively analysing their association with postoperative pain scores, fracture healing duration, complication incidence, and functional recovery scores, may provide theoretical support for developing integrated physiological-psychological treatment protocols in clinical practice. Based on this, this study retrospectively analysed the clinical data of elderly patients with osteoporotic fractures undergoing surgical treatment. The aim was to determine the incidence of preoperative anxiety and depression, explore its correlation with postoperative recovery indicators, and provide a reference basis for optimising clinical intervention strategies and improving patient outcomes.

Materials and Methods

Patient Population

This retrospective study examined elderly patients with osteoporotic fractures who underwent surgical treatment in Yueyang People's Hospital between July 2021 and July 2025. A total of 189 patients aged $\geq$ 60 years were initially screened via the hospital's electronic medical record system using the keywords "osteoporosis", "fracture", and "surgery". Among them, 12 patients were excluded due to pre-existing psychiatric disorders or prior anxiolytic/antidepressant use, 19 were excluded due to severe comorbidities or terminal illnesses, and 26 were excluded due to incomplete perioperative psychological assessment or follow-up data. Following inclusion and exclusion criteria, 132 patients were enrolled in the final analysis. This retrospective study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Yueyang People's Hospital (Approval No.: 2026008). All the research subjects have given their informed consent.

Inclusion and Exclusion Criteria

Inclusion criteria: (1) Age $\geq$ 60 years old, gender not limited; (2) Patients who meet the diagnostic criteria in the Chinese Guidelines for the Diagnosis and Treatment of Primary Osteoporosis (2022) [12]; (3) Fractures of the hip, vertebrae or distal radius caused by osteoporosis, and having undergone surgical treatments such as open reduction and internal fixation, or artificial joint replacement; (4) The case data are complete, including preoperative baseline information, preoperative psychological assessment records and postoperative follow-up data.

Exclusion criteria: (1) Combined with severe mental system disorders (such as schizophrenia, bipolar disorder); (2) Anxiety disorder and depression were diagnosed before the fracture and drug treatment was received; (3) Combined with terminal diseases such as malignant tumors, severe heart, liver and kidney failure, and acute infections; (4) If severe complications occur within 24 hours after the operation, the patient should be transferred to the intensive care unit.

Data Collection

Data were systematically extracted from the hospital's electronic medical record system, nursing documentation, and post-discharge follow-up database by two trained researchers independently, with discrepancies resolved through consultation with a senior orthopedic physician to ensure data accuracy. The collected data included three main categories: (1) Baseline characteristics: demographic information (age, gender, body mass index [BMI], educational attainment, marital status), comorbidities (hypertension, diabetes mellitus), American Society of Anesthesiologists (ASA) classification, fracture site (intertrochanteric fracture, femoral neck fracture, lumbar vertebral compression fracture), and fracture history; the ASA

Actas Esp Psiquiatr 2026;1–11. https://doi.org/10.62641/aep.2315 | ISSN:1578-2735
© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

physical status classification is a widely used preoperative risk-stratification tool that categorizes patients from grade I (normal healthy) to grade V (moribund) based on systemic disease severity [13]. In the present study, no patient was classified as grade V or higher. Therefore, all included patients were categorized as ASA I–IV. For statistical analysis, ASA grades were dichotomized into low-risk (I and II) and high-risk (III and IV) groups according to clinical convention. (2) Preoperative emotional assessment results: scores of anxiety and depression assessment scales at the time of admission; (3) Postoperative outcome indicators: Visual Analog Scale (VAS) scores for pain at admission, 1 week postoperatively, and 3 months postoperatively; modified Barthel Index (BI) scores for activities of daily living at the same three time points; time to first ambulation; length of hospital stay (LOS); postoperative complications (poor incision healing, pulmonary infection, deep vein thrombosis, urinary tract infection) adjudicated according to predefined clinical criteria and extracted from medical records within 3 months; and 3-month readmission status. All complications were uniformly defined and confirmed by two independent orthopedic physicians based on electronic medical records, laboratory tests, and imaging findings to ensure consistency and standardization.

Assessment Scales

Two validated self-rating scales were used to assess the emotional status of patients at admission, which served as the basis for grouping (anxiety/depression group vs. non-anxiety/depression group). The Zung Self-Rating Anxiety Scale (SAS) [14] was employed to evaluate anxiety symptoms. This scale consists of 20 items, each scored on a 4-point Likert scale (1 = rarely, 2 = sometimes, 3 = often, 4 = almost always). The raw score is converted to a standard score by multiplying by 1.25, and a standard score $\geq$ 50 indicates the presence of anxiety (50–59 = mild anxiety, 60–69 = moderate anxiety, $\geq$ 70 = severe anxiety) [15]. The Zung Self-Rating Depression Scale (SDS) [16], parallel in structure to SAS, was used for depression assessment. It also contains 20 items with the same 4-point scoring system, and the standard score is calculated identically. A standard score $\geq$ 53 indicates depression (53–62 = mild depression, 63–72 = moderate depression, $\geq$ 73 = severe depression) [15]. Patients meeting both criteria (SAS $\geq$ 50 and SDS $\geq$ 53) were classified into the anxiety/depression group [17]; those with SAS $<$ 50 or SDS $<$ 53 were assigned to the non-anxiety/depression group.

Pain intensity was assessed using the VAS [18], where patients mark a point on a 10-cm horizontal line (0 = no pain, 10 = the most severe pain imaginable) to represent their subjective pain level. The modified BI was used to evaluate functional recovery, which includes 10 items covering feeding, bathing, grooming, dressing, bowel control, bladder control, toilet use, transfers, mobility, and climbing stairs [19]. Each item is scored from 0 to 5, 0 to 10 or 0 to 15, with a total score ranging from 0 to 100; higher scores indicate better ability to perform activities of daily living.

Statistical Analysis

All statistical analyses were performed using SPSS 26.0 software (IBM Corp., Armonk, NY, USA), with a two-tailed $p < 0.05$ considered statistically significant. Continuous variables were tested for normality using the Shapiro–Wilk test. Normally distributed data are presented as mean $\pm$ standard deviation ($\bar{x} \pm$ s), while non-normal data are expressed as median (interquartile range) [M (Q1, Q3)]. Categorical variables are presented as counts and percentages [n (%)]. Between-group comparisons of baseline characteristics were conducted using the independent samples *t*-test (normally distributed continuous variables), Mann–Whitney U test (non-normal continuous variables), or chi-square test (categorical variables). Repeated-measures analysis of variance (ANOVA) was employed to analyze the longitudinal changes in VAS and BI scores across the three time points between the two groups. Mauchly's test of sphericity was performed, and the Greenhouse–Geisser correction was applied if the assumption was violated. The independent association between comorbid anxiety/depression and functional recovery was assessed via multivariable linear regression, with the continuous 3-month BI score as the dependent variable. To exclude potential confounding from temporal changes in preoperative management, surgical techniques, and clinical protocols over the study period, the year of surgery was additionally included as a covariate. Regression results are reported as regression coefficients (β) and 95% confidence intervals (CI).

Results

Incidence of Anxiety and Depression

Among the 132 elderly patients with osteoporotic fractures included in the final analysis, 49 (37.12%) exhibited anxiety symptoms (SAS $\geq$ 50), and 55 (41.67%) exhibited depressive symptoms (SDS $\geq$ 53). Specifically, mild anxiety and depression were present in 29.55% (39/132) and 35.61% (47/132) of patients, respectively. A total of 41 patients (31.06%) were comorbid for anxiety and depression, meeting both the SAS $\geq$ 50 and SDS $\geq$ 53 criteria

© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

Table 1. Incidence of anxiety and depression in elderly patients with osteoporotic fractures.

Indicator	n	Score	Mild	Moderate	Severe	Total
Anxiety (SAS)	132	47.52 ± 8.24	39 (29.55)	10 (7.58)	0 (0.00)	49 (37.12)
Depression (SDS)	132	50.23 ± 9.08	47 (35.61)	8 (6.06)	0 (0.00)	55 (41.67)
Anxiety*Depression	132	-	-	-	-	41 (31.06)

Abbreviations: SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale.

(Table 1). This comorbid group constituted the primary exposure group for subsequent comparative analyses.

Baseline Characteristics Comparison

When stratified by the presence of comorbid anxiety and depression (n = 41), significant differences were observed in several baseline characteristics compared to the non-anxiety/depression group (n = 91). The two groups differed significantly in gender distribution ($\chi^2 = 5.63$, $p = 0.018$), with the anxiety/depression group featuring a higher percentage of female patients (80.49% vs. 59.34). In addition, intergroup differences were detected in diabetes prevalence and ASA grading distribution (diabetes: $\chi^2 = 4.66$, $p = 0.031$; ASA: $\chi^2 = 7.02$, $p = 0.008$). Specifically, the anxiety/depression group presented higher diabetes rate (41.46% vs. 23.08) and a larger proportion of ASA III/IV classification (51.22% vs. 27.47). No significant differences were found regarding age, BMI, educational attainment, marital status, hypertension, fracture history, or fracture site distribution between the two groups ($p > 0.05$) (Table 2).

Postoperative Functional Recovery: Mobility and Length of Stay

The time to first ambulation was not significantly different between the two groups (7.12 ± 1.21 days vs. 6.82 ± 1.43 days; $p = 0.250$) (Fig. 1A). Analysis of key functional recovery indicators revealed a significant disparity in the LOS. Patients with comorbid anxiety/depression had a significantly prolonged LOS (12.71 ± 2.82 days) compared to those without (11.18 ± 2.51 days; $p = 0.002$) (Fig. 1B).

Post-Operative Pain Trajectory

Repeated-measures ANOVA revealed a significant main effect of time ($F = 3998.50$, $p < 0.001$) and group ($F = 17.03$, $p < 0.001$), but no significant time × group interaction ($F = 1.77$, $p = 0.172$). VAS decreased progressively in both groups (Table 3). While both groups showed a marked decline in pain scores over time, the anxiety/depression group reported significantly higher VAS scores at both postoperative week 1 (3.54 ± 0.60 vs. 3.27 ± 0.54, $p < 0.05$) and month 3 (2.15 ± 0.36 vs. 1.84 ± 0.37, $p < 0.001$) (Fig. 2).

Functional Recovery Trajectory

BI improved significantly over time ($F = 382.71$, $p < 0.001$), with a main effect of group ($F = 14.74$, $p < 0.001$) and a significant time × group interaction ($F = 4.67$, $p = 0.011$). At admission, mean BI was comparable between groups ($p > 0.05$). By week 1, the anxiety/depression group showed slower recovery (58.2 ± 6.1 vs. 60.1 ± 6.6, $p = 0.09$). At month 3, the gap widened significantly (73.6 ± 7.2 vs. 79.4 ± 6.8, $p < 0.001$) (Table 4; Fig. 3).

Postoperative Complications and Readmission at 3 Months

At the 3-month, the incidence of total postoperative complications was significantly higher in the anxiety/depression group compared to the non-anxiety/depression group (21.95% vs. 8.79%, $p = 0.037$) (Table 5). Common complications in the comorbid group included poor incision healing (7.32%), pulmonary infection (7.32%), and deep vein thrombosis (4.88%). The rate of readmissions within 3 months was numerically higher in the anxiety/depression group (29.27% vs. 19.78%), but this difference did not reach statistical significance ($p = 0.229$).

Independent Impact of Comorbid Anxiety-Depression on 3-Month BI Scores

Multivariable linear regression was used to assess the independent effect of comorbid anxiety/depression on 3-month functional recovery, with BI analyzed as a continuous variable (Table 6). In the crude model (Model 1), comorbid anxiety/depression was associated with a 5.82-point reduction in 3-month BI scores ($\beta = -5.82$, 95% CI: –8.38 to –3.26, $p < 0.001$). Adjustment for baseline confounders (gender, diabetes, ASA classification) in Model 2 yielded a similar robust association ($\beta = -5.88$, 95% CI: –8.63 to –3.12, $p < 0.001$). Further adjustment for postoperative

Actas Esp Psiquiatr 2026;1–11. https://doi.org/10.62641/aep.2315 | ISSN:1578-2735
© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

Table 2. Comparison of baseline characteristics between patients with and without comorbid anxiety and depression.

Indicator	Total (n = 132)	Non-Anxiety/Depression group (91 cases)	Anxiety/Depression group (41 cases)	Statistic	*p*
Age, year	67.53 ± 5.23	67.42 ± 5.51	67.78 ± 4.60	$t = -0.37$	0.713
Gender, n (%)				$\chi^2 = 5.63$	0.018
Female	87 (65.91)	54 (59.34)	33 (80.49)		
Male	45 (34.09)	37 (40.66)	8 (19.51)		
BMI, kg/m^2	22.87 ± 2.58	22.94 ± 2.46	22.71 ± 2.83	$t = 0.45$	0.651
Educational attainment, n (%)				$\chi^2 = 0.44$	0.801
Primary school and below	15 (11.36)	10 (10.99)	5 (12.20)		
Junior to senior high school	73 (55.30)	49 (53.85)	24 (58.54)		
College degree or above	44 (33.33)	32 (35.16)	12 (29.27)		
Marital status, n (%)				$\chi^2 = 1.35$	0.246
Married	112 (84.85)	75 (82.42)	37 (90.24)		
Unmarried/Divorced/widowed	20 (15.15)	16 (17.58)	4 (9.76)		
Hypertension, n (%)				$\chi^2 = 0.13$	0.721
No	61 (46.21)	43 (47.25)	18 (43.90)		
Yes	71 (53.79)	48 (52.75)	23 (56.10)		
Diabetes, n (%)				$\chi^2 = 4.66$	0.031
No	94 (71.21)	70 (76.92)	24 (58.54)		
Yes	38 (28.79)	21 (23.08)	17 (41.46)		
History of fractures, n (%)				$\chi^2 = 1.62$	0.203
No	111 (84.09)	79 (86.81)	32 (78.05)		
Yes	21 (15.91)	12 (13.19)	9 (21.95)		
Fracture site, n (%)				$\chi^2 = 0.14$	0.987
Intertrochanteric fracture	53 (40.15)	36 (39.56)	17 (41.46)		
Femoral neck fracture	39 (29.55)	27 (29.67)	12 (29.27)		
Lumbar vertebral compression fracture	28 (21.21)	20 (21.98)	8 (19.51)		
Other fractures	12 (9.09)	8 (8.79)	4 (9.76)		
ASA classification, n (%)				$\chi^2 = 7.02$	0.008
I and II	86 (65.15)	66 (72.53)	20 (48.78)		
III and IV	46 (34.85)	25 (27.47)	21 (51.22)		

Abbreviations: BMI, body mass index; ASA, American Society of Anesthesiologists.

Table 3. Repeated-measures analysis of variance for VAS scores over time.

Group	n	VAS score		
		Admission	Postoperative week 1	Postoperative month 3
Anxiety/Depression group	41	7.51 ± 0.51	3.54 ± 0.60*	2.15 ± 0.36***
Non-Anxiety/Depression group	91	7.43 ± 0.50	3.27 ± 0.54	1.84 ± 0.37
F value		F-group = 17.03, F-time = 3998.50, F-interaction = 1.77		
p value		*p*-group < 0.001, *p*-time < 0.001, *p*-interaction = 0.172		

*$p < 0.05$; ***$p < 0.001$. Abbreviations: VAS, Visual Analog Scale.

Table 4. Repeated-measures analysis of variance for BI scores over time.

Group	n	BI score		
		Admission	Postoperative week 1	Postoperative month 3
Anxiety/Depression group	41	51.83 ± 5.61	58.24 ± 6.14	73.56 ± 7.18***
Non-Anxiety/Depression group	91	52.27 ± 5.81	60.13 ± 6.56	79.38 ± 6.84
F value		F-group = 14.74, F-time = 382.69, F-interaction = 4.67		
p value		*p*-group < 0.001, *p*-time < 0.001, *p*-interaction = 0.011		

***$p < 0.001$. Abbreviations: BI, Barthel Index.

© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

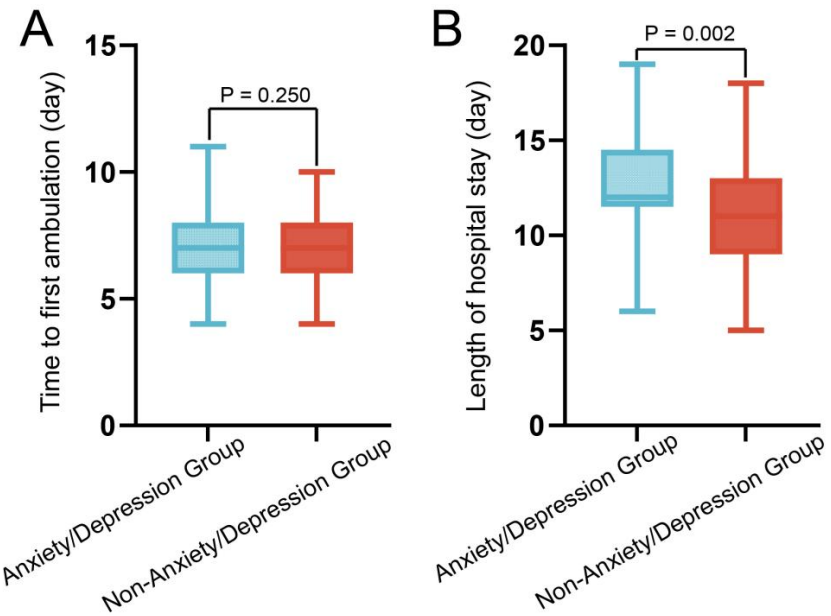


Fig. 1. Comparison of functional recovery milestones between groups. (A) Time to first ambulation. (B) Length of hospital stay.

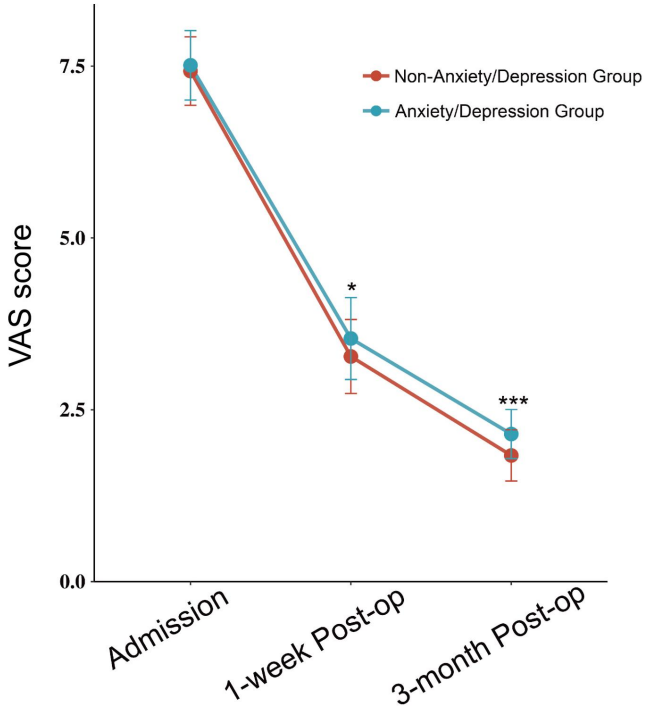


Fig. 2. Trajectory of postoperative pain scores over time. *$p < 0.05$; ***$p < 0.001$. VAS, Visual Analog Scale.

complications, LOS, baseline VAS, baseline BI and year of surgery (Model 3) slightly attenuated but did not eliminate the effect; comorbid anxiety/depression remained independently linked to a 5.22-point lower 3-month BI score (β = –5.22, 95% CI: –8.17 to –2.27, $p < 0.001$). These findings confirm that comorbid anxiety/depression is an independent predictor of worse medium-term functional recovery.

Actas Esp Psiquiatr 2026;1–11. https://doi.org/10.62641/aep.2315 | ISSN:1578-2735
© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

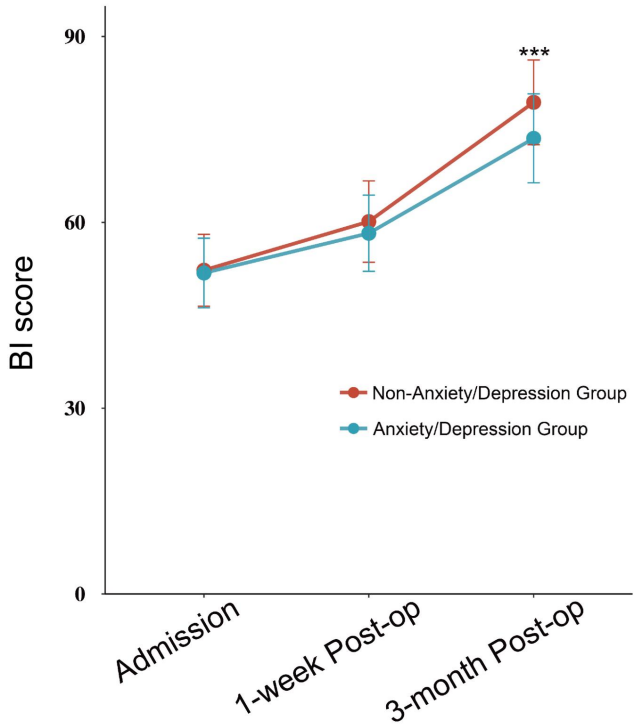


Fig. 3. Trajectory of functional recovery over time. ***$p < 0.001$. BI, Barthel Index.

Table 5. Postoperative complications and readmission status at the 3-month.

Indicator	Anxiety/Depression group (41 cases)	Non-Anxiety/Depression group (91 cases)	Statistic	*p* value
Total complications	9 (21.95)	8 (8.79)	4.36	0.037
Poor incision healing	3 (7.32)	3 (3.30)		
Pulmonary infection	3 (7.32)	2 (2.20)		
Deep vein thrombosis	2 (4.88)	1 (1.10)		
Urinary tract infection	1 (2.44)	2 (2.20)		
Number of readmissions	12 (29.27)	18 (19.78)	1.45	0.229

Table 6. Independent impact of comorbid anxiety-depression on functional outcome.

Variables	Model 1		Model 2		Model 3	
	β (95% CI)	*p*	*β* (95% CI)	*p*	*β* (95% CI)	*p*
Anxiety/Depression						
Without	0.00 (Reference)		0.00 (Reference)		0.00 (Reference)	
With	–5.82 (–8.38 – –3.26)	< 0.001	–5.88 (–8.63 – –3.12)	< 0.001	–5.22 (–8.17 – –2.27)	< 0.001

Model 1: Crude. Model 2: Adjust: Gender, diabetes, ASA classification. Model 3: Adjust: Gender, diabetes, ASA classification, complications, LOS, baseline VAS, baseline BI and year of surgery. Abbreviations: ASA, American Society of Anesthesiologists; VAS, Visual Analog Scale; BI, Barthel Index; LOS, length of hospital stay; CI, confidence interval.

Discussion

This retrospective analysis of 132 elderly patients undergoing surgery for osteoporotic fractures identified the characteristics of preoperative anxiety and depression and their association with postoperative recovery. Key findings are as follows: Firstly, preoperative anxiety and depression occurred in 37.12% and 41.67% of patients respectively, with 31.06% experiencing both emotional disorders concurrently. These descriptive data show a considerable proportion of elderly osteoporotic fracture patients suffered from preoperative anxiety, depression, or concurrent anxiety-depression comorbidity in the current cohort. Secondly, patients with comorbid anxiety and depression

© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

exhibited baseline characteristics including a higher proportion of females, elevated diabetes prevalence, and higher ASA physical status classification. Thirdly, comparisons of postoperative recovery indicators showed that although the time to first ambulation did not differ significantly between the anxiety/depression group and the control group, the former experienced significantly prolonged hospital stays and a higher incidence of complications within three months postoperatively. Fourthly, analysis of pain and functional recovery trajectories revealed that the anxiety-depression group exhibited higher VAS scores at all time points and slower BI recovery, with intergroup differences becoming increasingly pronounced over time. Fifthly, multivariable linear regression, using 3-month BI as a continuous outcome, confirmed that even after adjusting for confounding factors such as gender, diabetes, ASA classification, complications, LOS, baseline BI and baseline VAS, coexisting anxiety and depression remained an independent risk factor for worse functional recovery at three months postsurgery, associated with a clinically meaningful reduction in BI scores.

The high prevalence of anxiety and depression observed in this study is strongly associated with the specific physiological and psychological conditions experienced by elderly patients with osteoporotic fractures. A previous study has shown that anxiety and depression are highly prevalent among patients with osteoporosis [20]. It has been reported that the detection rate of depression reached 31.9%, which is similar to the results of this study [21]. Elderly patients experience physiological decline, with limited limb mobility following fractures and a loss of independence in daily activities, making them prone to feelings of helplessness and loss of control [22,23]. The anticipated pain from surgical trauma, uncertainty regarding prognosis, and concerns over medical expenses further exacerbate psychological stress responses, ultimately inducing or intensifying feelings of anxiety and depression. It is worth noting female patients occupied a significantly larger proportion in the comorbid anxiety-depression group, which aligns with the findings reported by Ortiz *et al*. [24] that emotional disorders occur disproportionately more frequently among aged female trauma patients. Additionally, patients with coexisting diabetes face an elevated risk of emotional disorders. This is thought to arise from the cumulative effects of chronic disease management stress compounded by fracture trauma, creating a bidirectional physiological-psychological negative feedback loop [25,26]. A high ASA classification indicates poorer systemic health, which may also indirectly trigger emotional issues by heightening patients' concerns about surgical risks [27].

The negative impact of combined anxiety and depression on postoperative recovery may be analysed from two perspectives: neuroendocrine-immune regulation and behavioural intervention. From a physiological perspective, it is speculated that anxiety and depression may activate the hypothalamic-pituitary-adrenal axis, potentially resulting in sustained elevation of stress hormones such as cortisol [28]. It is further hypothesized that this pathway may inhibit osteoblast activity, delay callus formation, and impair immune function, thereby increasing the risk of postoperative complications such as infection and deep vein thrombosis [29]. These mechanistic interpretations remain speculative and require further experimental validation. This finding is consistent with the findings of Modairesi *et al*. [30], who reported that depression prolongs the recovery trajectory in patients with distal radius fractures. From the perspective of pain perception, it is hypothesized that negative emotions may amplify central nervous system processing of pain signals, potentially lowering postoperative pain tolerance [31]. This plausible mechanism requires further experimental verification. Even when the objective intensity of pain is comparable, individuals experiencing anxiety or depression report a more pronounced subjective sensation. Persistent pain may further exacerbate emotional distress, potentially forming a bidirectional pain-mood cycle [32]. This phenomenon explains the sustained difference in VAS scores between the two groups observed over time in this study. In terms of functional recovery, anxiety and depression may diminish patients' motivation to rehabilitate, leading to reduced cooperation during rehabilitation training and consequently delaying improvements in BI scores. This "psychological-behavioural-functional" pathway ensures that emotional issues exert a persistent influence on recovery [33]. In the present study, we focused on the baseline confounders (gender, diabetes, ASA classification, baseline BI and VAS, year of surgery) in the regression models. Postoperative complications and LOS were not adjusted as covariates because they occur after the exposure (preoperative anxiety/depression) and may act as mediators in the causal pathway. Adjusting for such post-exposure intermediate variables could lead to over-adjustment bias and underestimate the true total effect of anxiety/depression on functional recovery. For transparency, both unadjusted and confounder-adjusted models are presented to show the stability of the main association.

The findings of this study provide crucial practical guidance for the clinical management of osteoporotic fractures in the elderly, with its core value lying in advancing the establishment of an integrated "physiological-psychological" intervention model. Firstly, within the preoperative assessment phase, anxiety and depression screening should be incorporated into routine procedures, par-

Actas Esp Psiquiatr 2026;1–11. https://doi.org/10.62641/aep.2315 | ISSN:1578-2735
© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

ticularly for high-risk populations including women, those with concomitant diabetes, and patients with higher ASA classifications. Utilising the SAS and SDS scales enables rapid identification of individuals with emotional disorders, laying the groundwork for targeted interventions. Secondly, for patients with confirmed anxiety or depression, a multidisciplinary collaboration mechanism should be established: psychiatrists may employ cognitive behavioural therapy and relaxation training to alleviate negative emotions, supplemented by pharmacological intervention where necessary; orthopaedic healthcare professionals should enhance health education by thoroughly explaining surgical procedures, prognosis data, and rehabilitation plans to reduce uncertainty-related anxiety, while optimising pain management protocols to break the vicious cycle of pain-emotion interplay. Furthermore, the postoperative rehabilitation phase should feature personalised recovery plans. Setting phased objectives and providing progress feedback enhances patient engagement, shortens hospital stays, and reduces complication risks. These interventions not only improve psychological well-being but also optimise recovery processes, thereby alleviating healthcare burdens and demonstrating significant health economic value.

This study has the following limitations: Firstly, the design was a single-centre retrospective analysis with a relatively limited sample size. Data were derived from electronic medical records, and certain subjective indicators (such as pain scores) may have been subject to recording bias. Caution is required when extrapolating results to other centres. In addition, the study's retrospective design spans a four-year period. While this extended timeframe facilitated adequate sample collection, it may also introduce time-related confounding factors. Clinical practices, surgical techniques, preoperative care protocols, and even the criteria for psychological assessment or pain management may have evolved over this period. Such temporal variations could potentially influence both the prevalence of anxiety/depression and the measured recovery outcomes, introducing bias that is not fully accounted for in our analysis. Future prospective studies with standardized, time-limited data collection windows are needed to minimize this potential source of heterogeneity. Secondly, anxiety and depression were assessed solely using the SAS and SDS scales at admission, without dynamic monitoring of preoperative emotional trajectories. Consequently, the duration of emotional disturbances and their impact on long-term outcomes remain unclear. Thirdly, potential confounding factors such as social support levels and quality of family care were excluded, despite their potential indirect influence on postoperative recovery through emotional state regulation. Fourthly, the study lacked exploration of intervention measures, leaving unclear whether targeted psychological interventions could improve recovery outcomes. Finally, given the retrospective nature, we cannot definitively disentangle confounding from mediation; future prospective studies with formal mediation analysis are warranted to clarify the causal pathways linking anxiety/depression to postoperative recovery. Consequently, future research should conduct multicentre prospective cohort studies with expanded sample sizes and dynamic monitoring of anxiety/depression and recovery indicators. Additionally, randomised controlled trials should be designed to validate the efficacy of cognitive behavioural interventions and multidisciplinary collaboration models for patients with comorbid emotional disorders.

Conclusions

This study demonstrates a high prevalence of comorbid preoperative anxiety and depression among elderly patients with osteoporotic fractures. This specific psychological state is an independent and significant risk factor for adverse recovery outcomes, including prolonged hospitalization, increased complications, poorer pain control, and delayed functional recovery. Our findings strongly advocate for the routine integration of psychological screening into the standard care pathway for this vulnerable population. Early identification of at-risk patients is a crucial first step toward implementing timely, multidisciplinary interventions aimed at mitigating psychological distress, thereby potentially improving both short-term clinical outcomes and long-term functional independence.

Availability of Data and Materials

The datasets used and/or analysed during the current study were available from the corresponding author on reasonable request.

Author Contributions

DW conceived and designed the study, was responsible for the overall coordination of the research project. Independently completed the main data collection, statistical analysis, and drafted the initial manuscript. Took the lead in revising the paper based on peer-review comments. FL provided crucial guidance on the research conception and study design. Supervised the overall progress of the study and offered valuable suggestions on manuscript revision and academic writing. HML assisted in the collection of clinical case data. Took primary responsibility for the ethical re-

© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

view process, including the application and approval procedures, and ensured strict compliance with ethical guidelines. ZYW assisted in data collection and source verification. Specifically, validated the accuracy and integrity of the database, and supported the systematic organization of clinical materials. All authors have read and agreed to the final version of the manuscript. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of Yueyang People's Hospital (institution review board number, 2026008) and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

Acknowledgment

Not applicable.

Funding

No funding.

Conflict of Interest

The authors declare no conflict of interest.

References

[1] Pan XB, Ma QY, Gao T, Zhang T, Xun J, Ma XT, *et al*. Osteoporosis risk and its association with all-cause and cause-specific mortality among the elderly: a 16-year nationwide cohort study. BMC geriatrics. 2025; 25: 199. https://doi.org/10.1186/s12877-025-05843-7.

[2] Liu Y, Huang X, Tang K, Wu J, Zhou J, Bai H, *et al*. Prevalence of osteoporosis and associated factors among Chinese adults: a systematic review and modelling study. Journal of global health. 2025; 15: 04009. https://doi.org/10.7189/jogh.15.04009.

[3] Khan AA, Slart RHJA, Ali DS, Bock O, Carey JJ, Camacho P, *et al*. Osteoporotic Fractures: Diagnosis, Evaluation, and Significance From the International Working Group on DXA Best Practices. Mayo Clinic proceedings. 2024; 99: 1127–1141. https://doi.org/10.1016/j.mayocp.2024.01.011.

[4] Tang N, Gao L, Song J, Li Y, Song M, Qiu C, *et al*. Risk analysis for subsequent fracture of osteoporotic fractures in Chinese women over age 60: a nationwide cross-sectional study. Scientific reports. 2024; 14: 13319. https://doi.org/10.1038/s41598-024-64170-w.

[5] Meng S, Tong M, Yu Y, Cao Y, Tang B, Shi X, *et al*. The prevalence of osteoporotic fractures in the elderly in China: a systematic review and meta-analysis. Journal of orthopaedic surgery and research. 2023; 18: 536. https://doi.org/10.1186/s13018-023-04030-x.

[6] Kang W, Shi J, Long Y, Li L, Xu W. Exploring the experience and needs of postoperative rehabilitation management for elderly patients with osteoporotic vertebral compression fractures after percutaneous vertebroplasty: a qualitative study. BMC geriatrics. 2025; 25: 1065. https://doi.org/10.1186/s12877-025-06667-1.

[7] Srifuengfung M, Abraham J, Avidan MS, Lenze EJ. Perioperative Anxiety and Depression in Older Adults: Epidemiology and Treatment. The American journal of geriatric psychiatry: official journal of the American Association for Geriatric Psychiatry. 2023; 31: 996–1008. https://doi.org/10.1016/j.jagp.2023.07.002.

[8] Liu C, Shi L, He J, Wang L, Min N, Wang F, *et al*. Effects of depressive symptoms on osteoporotic bone metabolism and prognosis of joint replacement surgery in elderly male patients with femoral neck fracture. Asian journal of surgery. 2023; 46: 3687–3692. https://doi.org/10.1016/j.asjsur.2023.06.020.

[9] Schwarz F, Klee E, Schenk P, Katscher S, Schnake KJ, Bäumlein M, *et al*. Impact of Anxiety During Hospitalization on the Clinical Outcome of Patients With Osteoporotic Thoracolumbar Vertebral Fracture. Global spine journal. 2025; 15: 417–424. https://doi.org/10.1177/21925682231192847.

[10] Jacobs CA, Hawk GS, Jochimsen KN, Conley CE, Vranceanu AM, Thompson KL, *et al*. Depression and Anxiety Are Associated With Increased Health Care Costs and Opioid Use for Patients With Femoroacetabular Impingement Undergoing Hip Arthroscopy: Analysis of a Claims Database. Arthroscopy: the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association. 2020; 36: 745–750. https://doi.org/10.1016/j.arthro.2019.09.048.

[11] Hakami IA. An Outline on the Advancements in Surgical Management of Osteoporosis-Associated Fractures. Curēus. 2024; 16: e63226. https://doi.org/10.7759/cureus.63226.

[12] Chinese Society of Osteoporosis and Bone Mineral Research. Guidelines for the Diagnosis and Treatment of Primary Osteoporosis (2022). Chinese General Practice. 2023; 26: 1671–1691. https://doi.org/10.12114/j.issn.1007-9572.2023.0121. (In Chinese)

[13] Owens WD, Felts JA, Spitznagel EL Jr. ASA physical status classifications: a study of consistency of ratings. Anesthesiology. 1978; 49: 239–243. https://doi.org/10.1097/00000542-197810000-00003.

[14] Zung WW. A rating instrument for anxiety disorders. Psychosomatics. 1971; 12: 371–379. https://doi.org/10.1016/S0033-3182(71)71479-0.

[15] He J, Song X, Wang C, Zhang R. Intercultural sensitivity as a mediator in the relationship between implicit intercultural identification and emotional disturbance-An exploratory study of international high school students. Frontiers in psychiatry. 2023; 14: 1098671. https://doi.org/10.3389/fpsyt.2023.1098671.

[16] Zung WW. A SELF-RATING DEPRESSION SCALE. Archives of general psychiatry. 1965; 12: 63–70. https://doi.org/10.1001/archpsyc.1965.01720310065008.

[17] Song S, Yang X, Yang H, Zhou P, Ma H, Teng C, *et al*. Psychological Resilience as a Protective Factor for Depression and Anxiety Among the Public During the Outbreak of COVID-19. Frontiers in psychol-

© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.

ogy. 2021; 11: 618509. https://doi.org/10.3389/fpsyg.2020.618509.

[18] Sala-Pujals A, Portes Chiva A, Chillon Soria J, Valverde Vilamala D, Dominguez Font E, Pardo Pol A. Immobilization Time for Conservative Treatment of Distal Radial Fractures in Elderly Patients: A Randomized Controlled Trial. The Journal of bone and joint surgery. American volume. 2025; 107: 1628–1635. https://doi.org/10.2106/JBJS.24.01480.

[19] Che YJ, Qian Z, Chen Q, Chang R, Xie X, Hao YF. Effects of rehabilitation therapy based on exercise prescription on motor function and complications after hip fracture surgery in elderly patients. BMC musculoskeletal disorders. 2023; 24: 817. https://doi.org/10.1186/s12891-023-06806-y.

[20] Chen JL, Luo R, Liu M. Prevalence of depression and anxiety and associated factors among geriatric orthopedic trauma inpatients: A cross-sectional study. World journal of clinical cases. 2022; 10: 919–928. https://doi.org/10.12998/wjcc.v10.i3.919.

[21] Chen K, Wang T, Tong X, Song Y, Hong J, Sun Y, *et al*. Osteoporosis is associated with depression among older adults: a nationwide population-based study in the USA from 2005 to 2020. Public health. 2024; 226: 27–31. https://doi.org/10.1016/j.puhe.2023.10.022.

[22] Taylor NF, Rimayanti MU, Peiris CL, Snowdon DA, Harding KE, Semciw AI, *et al*. Hip fracture has profound psychosocial impacts: a systematic review of qualitative studies. Age and ageing. 2024; 53: afae194. https://doi.org/10.1093/ageing/afae194.

[23] Li J, Hu J, Zhang Q. Progress of systematic psychological interventions in elderly patients with femoral fractures: A comprehensive review. World journal of psychiatry. 2024; 14: 1623–1630. https://doi.org/10.5498/wjp.v14.i11.1623.

[24] Ortiz D, Perkins AJ, Fuchita M, Gao S, Holler E, Meagher AD, *et al*. Pre-Existing Anxiety and Depression in Injured Older Adults: An Under-Recognized Comorbidity With Major Health Implications. Annals of surgery open: perspectives of surgical history, education, and clinical approaches. 2022; 3: e217. https://doi.org/10.1097/AS9.0000000000000217.

[25] Zhang E, Miramini S, Zhang L. The impact of osteoporosis and diabetes on fracture healing under different loading conditions. Computer methods and programs in biomedicine. 2024; 244: 107952. https://doi.org/10.1016/j.cmpb.2023.107952.

[26] Tully PJ, Schutte N, Guppy MP, Garatva P, Wittert G, Baumeister H. Psychological interventions for depression in people with diabetes mellitus. The Cochrane database of systematic reviews. 2025; 1: CD016005. https://doi.org/10.1002/14651858.CD016005.

[27] Al-Husinat L, Azzam S, Sharie SA, Al Hseinat L, Araydah M, Al Modanat Z, *et al*. Impact of the American Society of Anesthesiologists (ASA) classification on hip fracture surgery outcomes: insights from a retrospective analysis. BMC anesthesiology. 2024; 24: 271. https://doi.org/10.1186/s12871-024-02660-0.

[28] Ariño-Braña P, Zareba MR, Ibáñez Montolio M, Visser M, Picó-Pérez M. Influence of the HPA Axis on Anxiety-Related Processes: An RDoC Overview Considering Their Neural Correlates. Current psychiatry reports. 2025; 27: 593–611. https://doi.org/10.1007/s11920-025-01633-5.

[29] Hachemi Y, Rapp AE, Picke AK, Weidinger G, Ignatius A, Tuckermann J. Molecular mechanisms of glucocorticoids on skeleton and bone regeneration after fracture. Journal of molecular endocrinology. 2018; 61: R75–R90. https://doi.org/10.1530/JME-18-0024.

[30] Modarresi S, Suh N, Walton DM, MacDermid JC. Depression affects the recovery trajectories of patients with distal radius fractures: A latent growth curve analysis. Musculoskeletal science & practice. 2019; 43: 96–102. https://doi.org/10.1016/j.msksp.2019.07.012.

[31] Scaini S, Davies S, De Francesco S, Pelucchi A, Rubino S, Battaglia M. Altered pain perception and nociceptive thresholds in major depression and anxiety disorders: A meta-analysis. Neuroscience and biobehavioral reviews. 2025; 169: 106014. https://doi.org/10.1016/j.neubiorev.2025.106014.

[32] Zhuo M. Neural Mechanisms Underlying Anxiety-Chronic Pain Interactions. Trends in neurosciences. 2016; 39: 136–145. https://doi.org/10.1016/j.tins.2016.01.006.

[33] Głowacka M, Polak-Szabela A, Sienkiewicz Z, Kornatowski M. Trait-anxiety, depressive symptoms, family support and life satisfaction as determinants conditioning the degree of adherence of people in pre-older adults and older adults. Frontiers in public health. 2024; 12: 1336020. https://doi.org/10.3389/fpubh.2024.1336020.

© 2026 The Author(s). This is an open access article under the CC BY 4.0 license.