

Knowledge, Attitudes, and Practices Regarding Postoperative Management Among Patients with Fractures: A Cross-Sectional Study

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Background: Patients with fractures often face complex postoperative management requirements, and their knowledge, attitude, and practice regarding these aspects remain insufficiently understood.

Purpose: This study aims to assess the knowledge, attitude, and practice (KAP) related to postoperative management among patients with fractures.

Patients and Methods: A cross-sectional study was conducted in the Trauma Orthopedics Department of the Second Affiliated Hospital of Wenzhou Medical University from July 2024 to August 2024. A self-designed questionnaire was administered to collect demographic information and to evaluate KAP scores.

Results: A total of 556 (n = 556) valid responses were analyzed. Of the respondents, 279 (50.18%) were female, and 380 (68.35%) reported fractures resulting from falls. The mean $\pm$ SD scores for knowledge, attitude, and practice were 15.24 ± 3.62 (possible range: 0–22), 31.43 ± 6.40 (possible range: 8–40), and 83.07 ± 17.24 (possible range: 21–105), respectively. Based on a 70% cutoff of the total score, 42.73% of participants had adequate knowledge, 82.59% had a positive attitude, and 72.53% reported proactive practice. Correlation analysis revealed significant positive correlations between knowledge scores and attitude scores ($r = 0.782$, $P < 0.001$), as well as between knowledge scores and practice scores ($r = 0.832$, $P < 0.001$). Additionally, attitude scores were positively correlated with practice scores ($r = 0.804$, $P < 0.001$). The structural equation model demonstrated that knowledge had a direct effect on attitude (standardized $\beta = 0.913$, $P < 0.001$) and practice (standardized $\beta = 0.710$, $P < 0.001$), while attitude also directly impacted practice (standardized $\beta = 0.258$, $P = 0.021$).

Conclusion: Patients with fractures exhibited suboptimal knowledge but generally positive attitudes and proactive practices toward postoperative management. Tailored educational interventions to improve patient knowledge could significantly enhance attitude and practice.

Keywords: health knowledge, attitudes, practice, fractures, bone, postoperative care, patient education as topic

Introduction

Fractures are a widespread clinical issue, particularly affecting older adults, and contribute significantly to both morbidity and healthcare costs worldwide.^{1,2} In China, approximately 5 million fracture cases occur annually.³ Effective postoperative management plays a critical role in ensuring successful recovery and improving patient prognosis. Proper management strategies can mitigate the risk of complications such as infection, nonunion, or refracture, and significantly enhance patients' quality of life by promoting faster rehabilitation and reducing long-term disability.^{4–6} Key aspects of postoperative care, including timely rehabilitation, fall prevention, and proper nutrition, are essential for achieving optimal outcomes and reducing the burden of fractures on both patients and healthcare systems.⁷

Despite the clear importance of effective postoperative management, there are considerable gaps in patients' understanding and application of recommended care practice. According to the Knowledge-Attitude-Practice (KAP) theory, knowledge forms the foundation for behavior change, while attitude and beliefs act as the driving force behind such changes.⁸ The process of behavior change, as outlined in KAP theory, involves three stages: first, acquiring knowledge,

then forming attitude or beliefs based on that knowledge, and finally, translating these attitudes into practice or behaviors.⁹ However, simply acquiring knowledge does not guarantee behavior change. A shift in perception or attitude must occur first, which then facilitates the transition to behavior change.¹⁰ Patients who possess limited knowledge or hold misconceptions about their postoperative care are more likely to experience delayed rehabilitation, an increased risk of secondary complications, and lower overall recovery outcomes. Non-compliance with postoperative recommendations, such as physical rehabilitation exercises or appropriate dietary modifications, can further exacerbate these challenges. Therefore, understanding patients' current levels of KAP regarding postoperative fracture management is essential for addressing these issues. In orthopaedic settings, several structured frameworks have been developed to assess and standardize postoperative care, including multidimensional evaluation tools that cover pain control, functional recovery, and patient education. For example, recent work has proposed an integrated postoperative care assessment model for orthopaedic patients, providing a practical reference for monitoring and improving rehabilitation quality in clinical practice.¹¹ In the Chinese context, postoperative fracture care is often embedded within family-centred caregiving, where spouses and adult children commonly act as primary caregivers and participate in health-related decision-making, which may shape patients' knowledge, attitudes, and everyday management practices.

Currently, there is a lack of KAP studies specifically focused on this topic in the context of fracture management. This study aims to explore the current knowledge, attitude, and practice of fracture patients regarding their postoperative care.

Materials and Methods

Study Design and Patients

This cross-sectional study was conducted on patients who had undergone fracture surgery at the Trauma Orthopaedics Department of the Second Affiliated Hospital of Wenzhou Medical University. The questionnaire distribution and data collection were carried out between July and August 2024. Ethical approval for the study was granted by the Medical Ethics Committee of the Second Affiliated Hospital of Wenzhou Medical University (Approval No: 2024-K-188-01), and informed consent was obtained from all participants. The inclusion criteria were as follows: (1) postoperative fracture patients; (2) age 18 years or older; (3) ability to understand the purpose of the study and willingness to sign the informed consent form; and (4) clear consciousness with basic cognitive functions to comprehend and respond to the questionnaire. The exclusion criteria were: (1) patients with other severe diseases, such as advanced cancer or serious cardiovascular or pulmonary diseases.

Questionnaire

The design of the questionnaire was based on previous literature¹² and relevant national and international guidelines.^{13–15} After the initial draft was completed, a preliminary survey (n=31) was conducted to test its reliability, yielding an overall Cronbach's α coefficient of 0.870, which indicates good internal consistency of the questionnaire. To further assess construct validity, we conducted confirmatory factor analysis (CFA) for the knowledge, attitude, and practice domains. A three-factor measurement model with correlated latent variables was specified and estimated using maximum likelihood.

The finalized questionnaire was in Chinese and consisted of four sections: demographic data (including age, sex, height, weight, education level, occupation, monthly income, type of fracture, cause of injury, surgical history, and primary caregiver), knowledge dimension (K), attitude dimension (A), and practice dimension (P). The full English versions of the original questionnaire are provided as [Supplement Figures 1–7](#). Body mass index (BMI) was calculated as $\text{BMI} = \text{weight (kg)} / \text{height (m)}^2$. The knowledge dimension included 11 items, with each item scored as 2 points for “very familiar”, 1 point for “somewhat familiar”, and 0 points for “unfamiliar”, resulting in a total possible score of 0–22 points. The attitude dimension consisted of 8 questions, rated on a 5-point Likert scale, with scores ranging from 5 (strongly agree) to 1 (strongly disagree), resulting in a total score range of 8–40 points. The practice dimension included 21 questions, with responses scored from 1 (never) to 5 (always), yielding a total possible score range of 21–105 points. In line with previous KAP studies, we used an empirical threshold of $\geq 70.0\%$ of the total score to classify “adequate” knowledge, “positive” attitude, and “proactive” practice for descriptive interpretation rather than as a clinically validated diagnostic standard.^{16–18}

Questionnaire Distribution and Quality Control

The questionnaire was distributed using both online and offline methods. Convenience sampling was conducted among surgical patients discharged from the trauma orthopedic ward at our hospital. An online questionnaire was created using the Questionnaire Star platform (<https://www.wjx.cn/>), generating an electronic survey link. This link was sent via SMS to the mobile phone numbers listed in the patients' hospitalization records. Additionally, telephone follow-up was conducted by directly calling the patients themselves to ensure that all respondents were indeed fracture patients. In total, 1000 text messages were sent to eligible patients, of whom 503 completed the online questionnaire (SMS response rate: 50.3%). In addition, 70 valid questionnaires were obtained via telephone follow-up among patients who did not complete the online survey, after excluding unanswered or unreachable calls. Throughout the questionnaire completion process, research assistants provided instructions to ensure participants fully understood the content and objectives of the study, without interfering with or influencing their individual responses. Following data collection, quality checks were conducted by members of the research team. Data accuracy of the telephone follow-up questionnaires was ensured through cross-verification by two researchers. Questionnaires were considered invalid and excluded if the completion time was less than 90 seconds, if responses were incomplete, or if logical inconsistencies or repetitive patterns were detected in the answers.

Sample Size

The sample size was calculated using the standard formula for cross-sectional studies:¹⁹ $n = (Z_{(1-\alpha/2)} / \delta)^2 \times p \times (1-p)$, where $Z_{(1-\alpha/2)} = 1.96$ for a significance level of $\alpha = 0.05$, $p = 0.5$ (which maximizes the required sample size by assuming maximum variability), and $\delta = 0.05$, representing the permissible margin of error. The calculated theoretical sample size was 480, which includes an additional 20% to account for potential subject loss.

Statistical Analysis

Statistical analyses were performed using SPSS 27.0 (IBM, Armonk, NY, USA) and AMOS 26.0 (IBM, Armonk, NY, USA). The normality of the score distribution for each dimension was evaluated. Normally distributed data are presented as means and standard deviations (SD), while non-normally distributed data are reported as medians with interquartile ranges (IQR; 25th and 75th percentiles). For comparisons between two groups, the *t*-test was applied for normally distributed continuous variables, whereas the Wilcoxon-Mann-Whitney test was used for non-normally distributed variables. For comparisons involving three or more groups, ANOVA was used for normally distributed variables with homogeneity of variance, and the Kruskal-Wallis test was applied to non-normally distributed variables. Spearman correlation coefficient was used to assess correlations between KAP scores. Structural equation modeling (SEM) was conducted to examine the relationships between knowledge, attitude, and practice within the KAP framework, specifically evaluating whether attitude mediates the effect of knowledge on practice behaviors. Both direct and indirect effects were calculated and compared. Model fit of both SEM and CFA was evaluated using the following criteria: Chi-square/degrees of freedom (CMIN/DF) < 3, Root Mean Square Error of Approximation (RMSEA) < 0.08, Standardized Root Mean Square Residual (SRMR) < 0.08, Tucker-Lewis Index (TLI) > 0.8, and Comparative Fit Index (CFI) > 0.8. In addition, univariable and multivariable linear regression models were fitted with knowledge, attitude, and practice scores as dependent variables to explore factors associated with each KAP domain. A two-sided P-value of < 0.05 was considered statistically significant.

Results

Demographic Information on Participants

Initially, 573 questionnaires were collected. Among these, 503 were obtained through SMS-based online responses, following the distribution of 1000 messages to the mobile phone numbers recorded in patients' hospitalization records. An additional 70 valid questionnaires were obtained through direct telephone follow-up with patients. However, 1 was excluded due to incorrect BMI value and 16 due to incomplete responses, leaving 556 valid cases. Among the respondents, 279 (50.18%) were female, with a mean age of 53.56 ± 15.49 years. A total of 286 participants (51.44%) had a primary school education or lower, 380 (68.35%) reported fractures due to falls, 146 (26.26%) had a history of

surgery, 432 (77.70%) were cared for by their spouse, and 216 (38.85%) had other listed conditions. The median [Q1, Q3] scores for knowledge, attitude, and practice were 16.00 [14.00, 18.00], 33.00 [31.00, 35.00], and 92.00 [73.75, 95.00], respectively (Table 1). Also, baseline demographic and clinical characteristics were broadly comparable between online and telephone respondents, although telephone respondents were more likely to live in rural areas, have lower monthly income, and require assistance with activities of daily living (Supplement Table 1).

The mean $\pm$ SD scores for knowledge, attitude, and practice were 15.24 ± 3.62 (possible range: 0–22), 31.43 ± 6.40 (possible range: 8–40), and 83.07 ± 17.24 (possible range: 21–105), respectively. These mean scores correspond to 69.3%, 78.6%, and 79.1% of the maximum possible scores, respectively. Thus, the average knowledge score fell just below the prespecified 70% adequacy threshold, whereas attitude and practice scores were above this cutoff, indicating suboptimal knowledge but generally positive attitudes and proactive practices toward postoperative management. Based on a 70% cutoff of the total score, 42.73% of participants had adequate knowledge, 82.59% had a positive attitude, and 72.53% reported proactive practice. Knowledge and practice scores differed significantly across age groups (both $P < 0.001$). In addition, marital status was associated with knowledge and practice scores ($P = 0.023$ and $P = 0.043$, respectively), and monthly per capita income was associated with practice scores ($P = 0.004$) (Table 1).

Multivariable regression analysis showed that age 41–50 years ($\beta = 1.748$, 95% CI: 0.501–2.995, $P = 0.006$), 51–60 years ($\beta = 1.368$, 95% CI: 0.192–2.544, $P = 0.023$), and 61–70 years ($\beta = 2.186$, 95% CI: 0.965–3.408, $P < 0.001$) were independently associated with higher knowledge scores, whereas a prior history of fracture was independently associated with lower knowledge scores ($\beta = -1.357$, 95% CI: -2.439 to -0.275 , $P = 0.014$) (Supplement Table 2). In the multivariable model, knowledge score ($\beta = 1.355$, 95% CI: 1.258–1.451, $P < 0.001$) and unmarried/divorced/widowed marital status ($\beta = 3.578$, 95% CI: 2.234–4.922, $P < 0.001$) were independently associated with higher attitude scores, while junior high school education ($\beta = -0.955$, 95% CI: -1.824 to -0.087 , $P = 0.031$) and junior college/bachelor's degree or above ($\beta = -1.222$, 95% CI: -2.384 to -0.059 , $P = 0.040$) were associated with lower attitude scores (Supplement Table 3). Also, higher knowledge score ($\beta = 2.056$, 95% CI: 1.747–2.365, $P < 0.001$), higher attitude score ($\beta = 1.332$, 95% CI: 1.161–1.503, $P < 0.001$), age 31–40 years ($\beta = 5.803$, 95% CI: 2.694–8.912, $P < 0.001$), 41–50 years ($\beta = 7.116$, 95% CI: 4.082–10.151, $P < 0.001$), 51–60 years ($\beta = 7.097$, 95% CI: 4.088–10.107, $P < 0.001$), 61–70 years ($\beta = 6.899$, 95% CI: 3.543–10.255, $P < 0.001$), >70 years ($\beta = 5.210$, 95% CI: 1.536–8.884, $P = 0.006$), and monthly per capita income of 5000–10,000 CNY ($\beta = 3.333$, 95% CI: 0.376–6.290, $P = 0.028$) and 10,000–20,000 CNY ($\beta = 6.531$, 95% CI: 2.922–10.141, $P < 0.001$) were independently associated with higher practice scores (Supplement Table 4).

Distribution of Responses to Knowledge, Attitude, and Practice

In the knowledge dimension, the three questions with the highest percentage of participants selecting “Unclear” were: “Bone mineral density testing is recommended after a fracture” (K2), with 27.34%; “Certain medications, such as loop diuretics, antipsychotics, antidepressants, and opioids, may increase the risk of falls” (K11), also with 27.34%; and “Early functional exercises should primarily involve active contraction and relaxation of the muscles in the affected limb” (K7), with 16.19% (Table 2).

Regarding attitude, 6.29% disagreed and 6.12% strongly disagreed with the statement that “Participating in social activities, as much as their physical condition allows, promotes recovery and physical and mental well-being” (A7). Furthermore, 4.32% disagreed and 5.76% strongly disagreed with the belief that “Calcium supplementation is essential for preventing bone loss and promoting fracture recovery” (A2), and 4.32% disagreed and 5.76% strongly disagreed that “Being attentive to one's health status is crucial for ensuring successful postoperative fracture recovery” (A4) (Table 3).

In the practice dimension, 16.37% reported never strictly following their doctor's prescriptions for long-term antihypertensive medication (P16), 12.59% never underwent regular bone-related examinations or paid attention to the results (P2), and 8.99% never limited their intake of foods that inhibit calcium absorption during calcium supplementation (P7) (Table 4).

Regarding health education received, among the 556 valid cases, the majority of patients reported receiving medical education on psychological care (496, 88.89%), fall prevention measures (462, 82.80%), and fracture-related knowledge (455, 81.54%). However, only 185 cases (33.15%) indicated they received education on medication precautions, and just 285 cases (51.08%) reported receiving information on the prevention and management of common complications (Supplement Figure 8 Health Education received).

Table I Sociodemographic and Clinical Characteristics of Fracture Patients and Corresponding KAP Scores (n = 556)

N=556	N (%)	Knowledge	p	Attitude	p	Practice	p
		Median [Q1, Q3]		Median [Q1, Q3]		Median [Q1, Q3]	
Total	556	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [73.75, 95.00]	
Age (years)	53.56±15.49		<0.001		0.797		<0.001
≤30	46 (8.27)	14.00 [12.00, 16.00]		33.00 [32.00, 35.00]		74.50 [63.25, 92.00]	
31–40	78 (14.03)	15.00 [14.00, 17.00]		34.00 [32.00, 35.00]		93.50 [71.25, 96.00]	
41–50	94 (16.91)	16.00 [15.00, 17.00]		33.00 [32.00, 35.00]		92.00 [88.25, 95.00]	
51–60	142 (25.54)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [76.00, 95.00]	
61–70	110 (19.78)	17.00 [15.00, 18.50]		34.00 [32.00, 35.00]		92.00 [87.00, 94.75]	
>70	86 (15.47)	16.00 [11.25, 18.00]		33.00 [29.25, 35.00]		89.00 [64.50, 92.00]	
Sex			0.120		0.721		0.998
Male	277 (49.82)	16.00 [13.00, 18.00]		33.00 [31.00, 35.00]		91.00 [71.00, 95.00]	
Female	279 (50.18)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [77.00, 94.00]	
BMI			0.804		0.804		0.514
<18.5	39 (7.01)	16.00 [13.75, 17.25]		34.00 [31.50, 35.00]		90.00 [60.50, 94.50]	
18.5–23.9	278 (50.00)	16.00 [14.00, 18.00]		34.00 [31.00, 35.00]		91.50 [75.00, 94.00]	
>24.0	239 (42.99)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [73.50, 95.00]	
Monthly per capita income (CNY)			0.077		0.196		0.004
<2000	73 (13.13)	17.00 [12.50, 18.00]		33.00 [31.00, 35.00]		89.00 [66.00, 93.00]	
2000–5000	183 (32.91)	17.00 [15.00, 18.00]		34.00 [32.00, 36.00]		91.00 [75.00, 94.00]	
5000–10,000	223 (40.11)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [75.00, 95.00]	
10,000–20,000	63 (11.33)	15.00 [13.00, 17.00]		34.00 [31.00, 35.00]		94.00 [88.50, 96.50]	
>20,000	14 (2.52)	15.00 [12.00, 16.00]		33.50 [22.25, 35.00]		93.00 [57.25, 96.25]	
Marital status			0.023		0.556		0.043
Unmarried/Divorced/Widowed	45 (8.09)	15.00 [13.00, 16.00]		33.00 [32.00, 35.00]		88.00 [68.00, 92.00]	
Married	511 (91.91)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [75.50, 95.00]	
Place of residence			0.209		0.112		0.509
Rural	182 (32.73)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		91.00 [75.00, 94.00]	
Urban	199 (35.79)	16.00 [12.00, 18.00]		33.00 [26.00, 35.00]		92.00 [60.00, 95.00]	
Suburban	175 (31.47)	16.00 [14.00, 18.00]		34.00 [32.00, 36.00]		92.00 [79.00, 95.00]	
Educational level			0.550		0.343		0.325
Primary school or below	286 (51.44)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		91.00 [77.00, 94.00]	
Junior high school	125 (22.48)	16.00 [12.50, 17.00]		33.00 [29.00, 35.00]		91.00 [65.00, 95.00]	
Senior high school/Vocational secondary school	70 (12.59)	16.00 [14.00, 18.00]		33.50 [32.00, 35.00]		93.00 [76.25, 95.00]	
Junior college/Bachelor's degree or above	75 (13.49)	16.00 [13.00, 18.00]		34.00 [32.00, 35.00]		92.00 [69.50, 95.00]	
Medical insurance type			0.348		0.475		0.429
Self-paid	156 (28.06)	16.00 [14.00, 18.00]		34.00 [31.00, 35.00]		92.00 [75.25, 95.00]	
Insurance reimbursement	400 (71.94)	16.00 [13.00, 18.00]		33.00 [31.00, 35.00]		91.00 [73.75, 95.00]	

(Continued)

Table I (Continued).

N=556	N (%)	Knowledge	p	Attitude	p	Practice	p
		Median [Q1, Q3]		Median [Q1, Q3]		Median [Q1, Q3]	
Fracture type			0.591		0.263		0.78
Hip	112 (20.14)	16.00 [13.00, 17.00]		34.00 [31.00, 36.00]		92.00 [75.75, 94.00]	
Proximal humerus	54 (9.71)	16.00 [15.00, 18.00]		33.00 [31.00, 34.00]		91.50 [76.25, 94.00]	
Distal radius	63 (11.33)	16.00 [13.50, 18.00]		34.00 [31.00, 36.00]		92.00 [69.00, 94.00]	
Other sites	327 (58.81)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [74.00, 95.00]	
Cause of fracture			0.034		0.094		0.814
Fall	380 (68.35)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [73.00, 95.00]	
Impact injury	121 (21.76)	17.00 [15.00, 18.00]		34.00 [31.00, 36.00]		91.00 [84.00, 95.00]	
Other	55 (9.89)	15.00 [13.00, 18.00]		33.00 [30.50, 35.00]		91.00 [62.50, 95.00]	
Have you ever sustained a fracture before this fracture?			0.057		0.233		0.391
Yes	46 (8.27)	15.00 [13.00, 17.00]		33.00 [30.25, 34.75]		91.00 [65.25, 94.75]	
No	510 (91.73)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [74.00, 95.00]	
History of surgery			0.399		0.386		0.367
Yes	146 (26.26)	16.00 [12.25, 18.00]		33.00 [30.00, 35.00]		91.00 [66.75, 95.00]	
No	410 (73.74)	16.00 [14.00, 18.00]		33.00 [31.00, 35.00]		92.00 [74.25, 95.00]	
Current ability to perform activities of daily living			0.657		0.237		0.695
Completely independent	280 (50.36)	16.00 [13.00, 18.00]		33.00 [31.00, 35.00]		92.00 [69.75, 95.00]	
Requires partial assistance	229 (41.19)	16.00 [14.00, 18.00]		34.00 [32.00, 35.00]		92.00 [75.00, 95.00]	
Requires extensive assistance/Completely dependent	47 (8.45)	16.50 [13.00, 18.25]		33.00 [31.00, 35.50]		91.00 [80.50, 93.00]	
Source of support and care							
Spouse	432 (77.70)	16.00 [14.00, 18.00]		34.00 [31.00, 35.00]		92.00 [77.00, 95.00]	
Children	180 (32.37)	16.00 [15.00, 18.00]		33.00 [31.00, 35.00]		92.00 [83.00, 94.00]	
Parents	53 (9.53)	16.00 [13.00, 17.00]		34.00 [31.00, 36.00]		91.00 [69.00, 94.00]	
Friends	12 (2.16)	14.50 [10.75, 17.25]		34.00 [23.25, 35.25]		81.50 [54.25, 90.25]	
Others	48 (8.63)	16.00 [15.00, 18.00]		33.00 [31.00, 35.00]		92.50 [87.75, 95.25]	
Do you have any of the following diseases? (Hyperlipidemia, cardiovascular disease, diabetes mellitus, hyperhomocysteinemia, hyperuricemia, cerebrovascular disease, malignancy, other metabolic syndromes, etc.)			0.026		0.327		0.258
Yes	216 (38.85)	17.00 [14.00, 18.00]		33.00 [31.00, 35.00]		91.00 [77.00, 94.00]	
No	340 (61.15)	16.00 [14.00, 17.00]		34.00 [31.00, 35.00]		92.00 [71.75, 95.00]	

Note: All KAP scores were non-normally distributed; medians (IQR) and non-parametric tests were used.

Table 2 Item-Level Distribution of Responses in the Knowledge Dimension (n = 556)

	Well Aware, n (%)	Have Heard of, n (%)	Unclear, n (%)
1. After a fracture, it is necessary to use crutches, a walker, or a wheelchair.	291 (52.34)	265 (47.66)	0
2. Bone mineral density testing is recommended after a fracture.	135 (24.28)	269 (48.38)	152 (27.34)
3. Calcium and/or vitamin D supplementation is necessary following a fracture.	491 (88.31)	63 (11.33)	2 (0.36)
4. Postoperative care should focus on fall prevention and avoiding secondary fractures.	254 (45.68)	256 (46.04)	46 (8.27)
5. Rehabilitation training, including muscle strength exercises, cognitive function training, balance training, and activities of daily living training, should be initiated as early as possible, provided that it does not interfere with fracture immobilization and healing. It is recommended to perform a variety of combined training exercises to enhance muscle strength and improve balance.	189 (33.99)	290 (52.16)	77 (13.85)
6. Early functional exercises for fractures aim to promote blood circulation in the affected limb, reduce swelling, and prevent muscle atrophy.	160 (28.78)	330 (59.35)	66 (11.87)
7. Early functional exercises should primarily involve active contraction and relaxation of the muscles in the affected limb.	120 (21.58)	346 (62.23)	90 (16.19)
8. Postoperative care should protect the affected area and avoid pressure on it.	258 (46.40)	258 (46.40)	40 (7.19)
9. Nutritional supplementation, including high-energy, high-protein, vitamins, and minerals, should commence early, preferably before surgery.	219 (39.39)	302 (54.32)	35 (6.29)
10. Smoking and alcohol cessation is recommended following fracture surgery, and daily caffeine intake should be limited to no more than 300 mg.	195 (35.07)	304 (54.68)	57 (10.25)
11. Certain medications, such as loop diuretics, antipsychotics, antidepressants, and opioids, may increase the risk of falls.	161 (28.96)	243 (43.71)	152 (27.34)

Table 3 Item-Level Distribution of Responses in the Attitude Dimension (n = 556)

	Strongly Agree, n (%)	Agree, n (%)	Neutral, n (%)	Disagree, n (%)	Strongly Disagree, n (%)
1. You believe that acquiring knowledge on postoperative fracture rehabilitation through various sources (eg, healthcare professionals, books, the internet) is very important.	195 (35.07)	222 (39.93)	87 (15.65)	31 (5.58)	21 (3.78)
2. You consider calcium supplementation to be essential for preventing bone loss and promoting fracture recovery.	196 (35.25)	211 (37.95)	93 (16.73)	24 (4.32)	32 (5.76)
3. You believe that regular exercise contributes to building strong bones.	197 (35.43)	214 (38.49)	94 (16.91)	31 (5.58)	20 (3.60)
4. You think that being attentive to one's health status is crucial for ensuring successful postoperative fracture recovery.	197 (35.43)	217 (39.03)	86 (15.47)	24 (4.32)	32 (5.76)
5. You consider it very important to supplement calcium and vitamins through diet and/or medication.	184 (33.09)	215 (38.67)	101 (18.17)	32 (5.76)	24 (4.32)
6. You believe that weight control can help prevent falls and fractures.	184 (33.09)	208 (37.41)	100 (17.99)	35 (6.29)	29 (5.22)
7. You think that participating in social activities, as much as your physical condition allows, can promote recovery and physical and mental well-being.	180 (32.37)	218 (39.21)	89 (16.01)	35 (6.29)	34 (6.12)
8. You believe that actively cooperating with the doctor's treatment plan and maintaining timely communication with healthcare professionals is crucial for fracture rehabilitation.	220 (39.57)	190 (34.17)	93 (16.73)	30 (5.40)	22 (3.96)

Correlations Between KAP

Further correlation analysis revealed positive correlations between knowledge scores and attitude scores ($r = 0.782$, $P < 0.001$), as well as between knowledge scores and practice scores ($r = 0.832$, $P < 0.001$). Additionally, attitude scores were positively correlated with practice scores ($r = 0.804$, $P < 0.001$) (Table 5).

Table 4 Item-Level Distribution of Responses in the Practice Dimension (n = 556)

	Always, n (%)	Often, n (%)	Sometimes, n (%)	Occasionally, n (%)	Never, n (%)
1. You proactively acquire knowledge related to osteoporosis through various sources, such as healthcare professionals, books, and the internet.	190 (34.17)	170 (30.58)	95 (17.09)	54 (9.71)	47 (8.45)
2. You undergo regular bone-related examinations (eg, bone density, bone metabolism markers) and pay attention to the results.	115 (20.68)	164 (29.50)	111 (19.96)	96 (17.27)	70 (12.59)
3. If you experience a decrease in height (a reduction of more than 3 cm after the age of 40) or a pronounced kyphosis, you seek medical consultation.	157 (28.24)	153 (27.52)	95 (17.09)	101 (18.17)	50 (8.99)
4. You take special care to protect areas such as the hips, wrists, and spine.	163 (29.32)	171 (30.76)	108 (19.42)	74 (13.31)	40 (7.19)
5. You consistently consume foods high in calcium (eg, milk, soy products, fish, shrimp, and seaweed).	178 (32.01)	207 (37.23)	102 (18.35)	44 (7.91)	25 (4.50)
6. You supplement calcium and vitamins through diet and/or medication.	186 (33.45)	192 (34.53)	110 (19.78)	38 (6.83)	30 (5.40)
7. During calcium supplementation, you limit the intake of foods that inhibit calcium absorption (eg, foods high in oxalic acid such as spinach and celery, or those high in phytic acid such as cereals).	105 (18.88)	128 (23.02)	114 (20.50)	159 (28.60)	50 (8.99)
8. You perform household chores to the best of your ability, based on your physical condition.	190 (34.17)	169 (30.40)	102 (18.35)	59 (10.61)	36 (6.47)
9. You participate in social activities as much as your physical condition allows.	188 (33.81)	206 (37.05)	101 (18.17)	37 (6.65)	24 (4.32)
10. You establish a good relationship with healthcare professionals (eg, effective communication, active cooperation with treatment or care) and undergo regular health check-ups.	182 (32.73)	213 (38.31)	96 (17.27)	39 (7.01)	26 (4.68)
11. You wear well-fitting clothes and appropriate, non-slip shoes to prevent falls.	316 (56.83)	164 (29.50)	42 (7.55)	17 (3.06)	17 (3.06)
12. You engage in activities only when your vision is clear (eg, wearing suitable glasses if you are myopic) to prevent falls.	296 (53.24)	184 (33.09)	46 (8.27)	13 (2.34)	17 (3.06)
13. You avoid falls by preventing sudden postural changes (eg, standing up or sitting up abruptly).	199 (35.79)	200 (35.97)	92 (16.55)	34 (6.12)	31 (5.58)
14. You modify your environment (eg, keeping the floor dry, removing obstacles) to prevent falls.	207 (37.23)	199 (35.79)	85 (15.29)	32 (5.76)	33 (5.94)
15. What is the frequency of your physical exercise (more than 30 minutes at moderate intensity)?	171 (30.76)	193 (34.71)	96 (17.27)	63 (11.33)	33 (5.94)
16. You strictly follow the doctor's prescriptions and take antihypertensive medications for the long term.	180 (32.37)	162 (29.14)	97 (17.45)	26 (4.68)	91 (16.37)

(Continued)

Table 4 (Continued).

	Completely conform, n (%)	Conform, n (%)	Not necessarily, n (%)	Do not conform, n (%)	Strongly do not conform, n (%)
17. You choose an exercise regimen suitable for your physical condition.	162 (29.14)	245 (44.06)	77 (13.85)	44 (7.91)	28 (5.04)
18. You adhere to a gradual approach when exercising.	182 (32.73)	211 (37.95)	98 (17.63)	33 (5.94)	32 (5.76)
19. You perform warm-up and cool-down exercises for approximately 10 minutes before and after each exercise session.	168 (30.22)	183 (32.91)	111 (19.96)	51 (9.17)	43 (7.73)
20. You engage in regular exercise (at least 30 minutes per session, 3 times per week).	168 (30.22)	197 (35.43)	119 (21.40)	46 (8.27)	26 (4.68)
21. You ensure that each exercise session does not cause fatigue or only results in mild fatigue.	189 (33.99)	212 (38.13)	81 (14.57)	44 (7.91)	30 (5.40)
22. You actively participate in outdoor activities, exposing your skin to sunlight for 15–30 minutes per session, at least twice per week.	185 (33.27)	196 (35.25)	95 (17.09)	38 (6.83)	42 (7.55)

Table 5 Spearman Correlation Coefficients Among Knowledge, Attitude, and Practice Scores (n = 556)

	Knowledge	Attitude	Practice
Knowledge	1		
Attitude	0.782 (P<0.001)	1	
Practice	0.832 (P<0.001)	0.804 (P<0.001)	1

SEM Analysis

Before estimating the structural paths, we first tested a three-factor CFA measurement model for the knowledge, attitude, and practice domains. The CFA demonstrated an acceptable model fit, with RMSEA = 0.056 and SRMR = 0.058, both below the recommended threshold of 0.08, and satisfactory incremental fit indices (TLI = 0.867 and CFI = 0.874), indicating an overall adequate fit of the measurement model ([Supplement Table 5](#)). The standardized path coefficients of SEM showed that knowledge had a direct effect on attitude ($\beta = 0.913$, 95% CI: 0.877–0.949; $P < 0.001$) and practice ($\beta = 0.710$, 95% CI: 0.495–0.925; $P < 0.001$), while attitude also directly influenced practice ($\beta = 0.258$, 95% CI: 0.040–0.475; $P = 0.021$). Knowledge also had an indirect effect on practice through attitude ($\beta = 0.235$, 95% CI: 0.041–0.430; $P = 0.018$), indicating that attitude partially mediates the relationship between knowledge and practice ([Supplement Table 6](#) and [Figure 1](#)). The SEM demonstrated an acceptable overall fit ([Supplement Table 7](#)).

Discussion

Patients with fractures demonstrated suboptimal knowledge but exhibited generally positive attitudes and proactive practices toward postoperative management. These findings highlight the need for targeted educational interventions to enhance patient knowledge, which may help promote better attitudes and postoperative management practices.

The findings of this study indicate that while patients with fractures generally display positive attitude and proactive practice towards postoperative management, their knowledge levels remain suboptimal. This gap in knowledge is particularly concerning, as adequate understanding of postoperative care is crucial for preventing complications such as secondary fractures and for ensuring proper rehabilitation. Similar results have been observed in other studies, where

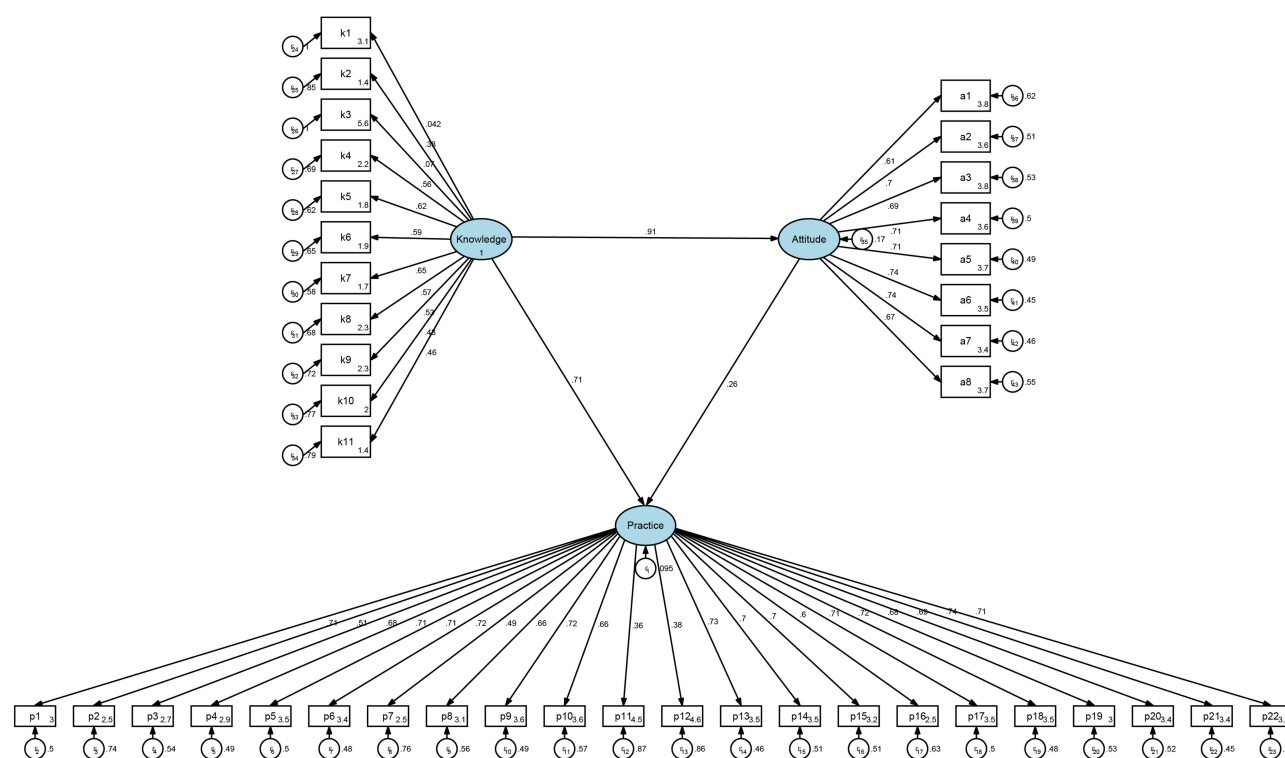


Figure 1 Structural equation model of the relationships between knowledge, attitude, and practice. Ellipses represent latent variables (unobserved constructs), including overall knowledge, attitude, and practice. Rectangles represent observed variables (measured questionnaire items) that serve as indicators of the latent variables. Circles represent error terms or residuals associated with the observed variables. Single-headed arrows indicate hypothesized directional relationships (pathways) between latent variables and from latent variables to observed variables, with standardized path coefficients labeled on the arrows.

patients with orthopedic conditions demonstrated insufficient knowledge about their conditions, leading to poor compliance with rehabilitation protocols and longer recovery periods.^{20,21} Patient knowledge plays a critical role in shaping adherence to treatment and effective self-management, thereby potentially affecting overall clinical outcomes.²² However, our cross-sectional design did not include objective clinical endpoints, so any link between knowledge deficits and prognosis in this population remains hypothetical. In this context, we cautiously suggest that improving patient knowledge through targeted education may support better self-management and rehabilitation adherence, but the impact on clinical outcomes should be examined in future longitudinal studies.

Regarding the relationships between KAP, the correlation analysis and SEM reveal that knowledge is significantly associated with both attitude and practice. These results are consistent with other studies, which have shown that improving patient knowledge can positively influence health-related behaviors, such as medication adherence and participation in rehabilitation.^{23,24} The direct effect of knowledge on both attitude and practice emphasizes the importance of patient education in postoperative care. Although the standardized path coefficients indicated moderately strong associations among the three domains, they should be interpreted with caution because the knowledge, attitude, and practice dimensions cover related aspects of postoperative care and may share overlapping content. In particular, items K1 (use of assistive devices) and K3 (calcium and/or vitamin D supplementation) showed relatively lower factor loadings in the measurement model, suggesting that they may capture more general fracture-related awareness rather than postoperative management specifically; these items could be refined in future iterations of the scale. Furthermore, in the CFA, most items showed moderate-to-high standardized factor loadings, whereas a small number of knowledge items (such as K1 and K3) had relatively low or non-significant loadings, indicating potential item ambiguity and measurement error. These items will need to be refined and revalidated in future iterations of the scale, and the KAP relationships observed here should therefore be interpreted with appropriate caution. However, despite this positive relationship, the lower knowledge scores observed in this study suggest that the current educational approaches may not be sufficiently

effective. It is possible that the information provided to patients is either too complex, not relevant to their specific needs, or not communicated in a way that promotes long-term retention and understanding.

When exploring the significant differences across demographic variables, several interesting patterns emerge. Age was significantly associated with both knowledge and practice scores, with older participants generally demonstrating better practice. This may be because older adults are more likely to have experienced fractures or other serious health issues in the past,^{25,26} which may lead to a greater appreciation for postoperative care and the importance of adhering to medical advice. However, despite their better practice, older participants did not necessarily exhibit higher knowledge levels, which may be due to a reliance on healthcare providers rather than self-directed learning.^{27,28} This trend is consistent with findings from other studies that suggest older adults often trust healthcare providers' recommendations but may not actively seek additional knowledge.^{29,30} In contrast, younger patients may not yet fully recognize the long-term consequences of inadequate postoperative care, leading to less proactive behavior despite having better access to information. These age-related patterns in knowledge and practice remained evident after adjustment for other demographic and clinical covariates in multivariable regression models.

Significant differences were also observed between married and unmarried participants, as well as between urban and rural residents, in terms of attitude towards postoperative care. Married participants and those from urban areas generally exhibited lower attitude scores, which might be explained by their access to more comprehensive healthcare systems or greater reliance on external support, such as family or caregivers.^{31,32} This suggests a passive stance towards self-managed care, as they might perceive less individual responsibility for their recovery outcomes. Previous studies also identified similar patterns, indicating that patients with easier access to healthcare often demonstrate reduced self-efficacy in managing personal health matters.^{33,34} In contrast, rural and suburban residents may encounter more access barriers and fewer formal support options, which can foster a stronger sense of personal responsibility for self-care and lead to more proactive attitudes despite these structural disadvantages. Consistent with these univariable findings, multivariable models also suggested that unmarried or widowed status was associated with more positive attitudes after accounting for other covariates. This emphasizes the necessity for tailored interventions that promote patient empowerment, regardless of marital status or location.

When analyzing the distribution of responses in the KAP dimensions, several areas of concern become apparent. In the knowledge domain, many participants lacked awareness about key aspects of postoperative care, particularly bone mineral density testing following fractures. Additionally, there was limited understanding of medication risks, such as diuretics and antipsychotics, play in increasing the risk of falls. These knowledge gaps have been similarly documented in previous research, where inadequate patient education has been linked to higher rates of complications, such as refractures or prolonged immobilization.^{35,36} Furthermore, in the attitude dimension, a considerable proportion of participants underestimated the importance of dietary calcium supplementation and consistent health monitoring after surgery. These misconceptions are likely to lower adherence to rehabilitation protocols and elevate the risk of post-operative complications.

In the practice domain, several concerning trends were observed. Participants often reported irregular bone density tests and inadequate adherence to dietary guidelines, particularly regarding foods that inhibit calcium absorption. Such findings are consistent with other research, where non-compliance with dietary and medical recommendations has been associated with poor long-term recovery outcomes in fracture patients.^{37,38} This gap between patients' positive intentions and their actual behaviors may critically impact recovery, indicating that improving practice remains a significant challenge.

To address these gaps, a comprehensive, evidence-based approach to patient education is necessary. Healthcare providers should offer tailored interventions that cater to each patient's specific condition and circumstances. For instance, visually engaging educational materials could be developed that directly address the weakest items identified in this survey, such as the need for bone mineral density testing after a fracture (K2), the fall risk associated with commonly used medications such as diuretics and psychotropic drugs (K11), and practical examples of calcium-rich diets and foods that inhibit calcium absorption (P7). Personalized materials could be tailored for patients with lower educational attainment and for those who reported irregular bone-related examinations or dietary non-adherence, using plain language, pictorial examples, and step-by-step guidance that match their fracture type and rehabilitation stage. Additionally, structured follow-up consultations should be implemented, focusing on reinforcing key messages and

correcting any misconceptions. For example, patients could maintain a health diary to record adherence to rehabilitation exercises, medication schedules, and dietary intake. Regular follow-ups would allow healthcare providers to track progress, provide feedback, and promote positive behavioral changes. Continuous, interactive education—particularly when supported by self-monitoring tools—has been shown to enhance patient engagement and clinical outcomes.^{39,40}

To improve poor practice scores in areas like dietary adherence and regular bone health assessments, follow-up care should be more structured. In line with the low proportions of regular bone-related examinations (P2) and long-term antihypertensive adherence (P16), healthcare providers could use simple SMS- or app-based reminders to prompt patients to schedule bone mineral density tests, attend follow-up appointments, and review short checklists on medication adherence, fall prevention, and exercise intensity.^{41,42} Integrating these approaches into postoperative fracture care could enhance adherence, contributing to better recovery outcomes.

Potential Selection Biases and Generalizability

Several features of our study design may have introduced selection bias and affected the generalizability of the findings. First, all participants were recruited from a single tertiary trauma orthopaedics department, where clinical pathways, discharge planning, and patient education practices may differ from those in other hospitals and regions of China. Second, we used convenience sampling and a mixed recruitment strategy, inviting patients via SMS and supplementing with telephone follow-up. Only 50.3% of patients invited by SMS completed the online questionnaire, and telephone follow-up mainly included patients who could be reached at the recorded phone numbers. As a result, our sample may over-represent patients who are more reachable, more motivated, or have better access to mobile devices, and under-represent those with lower health literacy or poorer access to digital tools. These potential selection biases should be taken into account when extrapolating our KAP estimates to the broader population of fracture patients.

This study has several limitations. First, as an inherent limitation of cross-sectional studies, the design precludes the ability to establish causal relationships between knowledge, attitude, and practice variables. Second, the study was conducted in a single tertiary hospital, where clinical pathways, discharge planning, and patient education practices may differ from those in other regions of China, which may limit the generalizability of the findings. Third, the use of convenience sampling from a single trauma orthopaedics department and the mixed recruitment strategy (SMS invitations and telephone follow-up) may limit the representativeness of the sample and introduce selection bias. Fourth, self-reported data from questionnaires are subject to recall bias and social desirability bias, particularly for practice items; because the survey was conducted under the auspices of the treating hospital and the telephone follow-up was performed by study personnel, some participants may have over-reported desirable self-management behaviors, which could lead to an overestimation of practice levels. Finally, among the 1000 individuals invited to participate via SMS, 503 provided online responses, yielding an initial response rate of 50.3%. This relatively low response rate raises the possibility of non-response bias in addition to selection bias, as those who chose to participate might have had a greater interest in postoperative management than non-respondents, potentially skewing the findings. Moreover, the 70% cutoff used to define adequate knowledge, positive attitude, and proactive practice was an empirical threshold adopted from previous KAP studies and has not been specifically validated in fracture populations; alternative classification approaches such as quartiles or standardized scores may yield complementary insights. Some questionnaire items (eg, antihypertensive adherence, vision correction, dietary choices) may not apply to all patients. Future studies with longitudinal designs, multi-center settings, and improved response rates are warranted to validate and expand upon these findings.

Conclusion

In conclusion, using a $\geq 70\%$ adequacy threshold adopted in previous KAP studies,^{16,17} patients with fractures showed suboptimal knowledge yet generally positive attitudes and proactive practices toward postoperative management. Implementing targeted educational strategies that enhance patient knowledge may also positively influence attitudes and practices.

Data Sharing Statement

All data generated or analyzed during this study are included in this published article.

Ethics Approval and Informed Consent

The study was approved by Medical Ethics Committee of the Second Affiliated Hospital of Wenzhou Medical University (2024-K-188-01). All participants were informed about the study protocol and provided written informed consent to participate in the study. I confirm that all methods were performed in accordance with the relevant guidelines. All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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