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ORIGINAL RESEARCH

Knowledge, Attitudes, and Practices of Orthopedic Surgical Healthcare Professionals Regarding Perioperative Anesthetic Management Under the Enhanced Recovery After Surgery (ERAS) Concept

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Objective: Enhanced recovery after surgery (ERAS) has been popularized in clinical settings, and perioperative anesthetic management under the ERAS concept in orthopedic surgery is increasingly emphasized. This study aimed to assess the knowledge, attitudes, and practices (KAP) of orthopedic surgical healthcare professionals regarding perioperative anesthetic management.

Methods: This cross-sectional study included orthopedic surgical healthcare professionals at four hospitals between January and December 2023. A self-administered questionnaire was developed to collect participants' socio-demographic information and KAP scores. Structural equation modeling (SEM) was applied to assess direct and indirect associations among KAP dimensions.

Results: Totally, 386 participants were included, with a mean age of 36.17±8.34 years. The KAP scores were 23.23±5.88 (possible range: 0–30), 46.99±4.38 (possible range: 11–55), and 33.13±7.46 (possible range: 9–45), respectively. Multivariate logistic analysis revealed that age, employment in the anesthesiology department, ERAS training experience within the past year, and number of orthopedic surgeries in the past year were independently associated with good knowledge. Knowledge score, master's degree or above, and work experience were independently associated with a positive attitude. Knowledge score, attitude score, and employment in the anesthesiology department were independently associated with proactive practice. SEM further indicated positive associations between knowledge and attitude (β=0.29, P<0.001), between knowledge and practice (β=0.54, P<0.001), and between attitude and practice (β=0.30, P<0.001).

Conclusion: Orthopedic surgical healthcare professionals showed a positive attitude, while their knowledge and practice of perioperative anesthetic management remained at a moderate level. Educational and behavioral interventions are recommended for those with young age, shorter work experience, less surgical caseload, and lower educational levels.

Keywords: knowledge, attitude, practice, perioperative anesthetic management, healthcare professional, enhanced recovery after surgery, anaesthetist

Introduction

Enhanced recovery after surgery (ERAS) refers to a multifaceted approach to perioperative care aimed at optimizing patient outcomes and expediting recovery following surgical procedures.[1] The adoption of ERAS has revolutionized perioperative management, shifting from traditional practices such as prolonged fasting, liberal fluid administration, and

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opioid-centric analgesia to an individualized multimodal approach including early oral nutrition, goal-directed fluid therapy, and enhanced mobility regimens, which improve recovery and patient outcomes.[2–4]

Within ERAS, perioperative anesthetic management is particularly crucial, as it directly determines intraoperative hemodynamic stability, the adequacy of analgesia, and the trajectory of postoperative recovery. In orthopedic surgery, where perioperative challenges such as blood loss, pain control, and functional rehabilitation are especially prominent, anesthetic management plays a central role in achieving favorable outcomes.[5] Preoperatively, orthopedic surgical healthcare professionals assess patients' medical comorbidities and tailor anesthesia regimens. Preoperative carbohydrate loading, goal-directed fluid therapy, and regional anesthesia techniques are employed to attenuate the physiological stress response to surgery.[6] Intraoperatively, anesthetic management focuses on maintaining hemodynamic stability, ensures adequate analgesia, and minimizes intraoperative fluid shifts to optimize tissue perfusion.[7] Techniques such as intrathecal anesthesia, peripheral nerve blocks, and balanced anesthesia regimens are frequently utilized.[8] Postoperatively, the healthcare professionals collaborate to promote early mobilization and facilitate timely discharge through coordinated rehabilitation efforts.[9] Therefore, assessing the knowledge, attitudes, and practices (KAP) of orthopedic surgical healthcare professionals regarding perioperative anesthetic management, rather than ERAS in general, is essential to optimize perioperative outcomes.

The KAP study employs quantitative surveys and qualitative interviews to capture healthcare professionals' perspectives and behaviors toward perioperative anesthetic management.[10] To our knowledge, comprehensive KAP studies among orthopedic surgical healthcare professionals regarding perioperative anesthetic management are lacking in existing literature. The study aimed to address the research gap by assessing the KAP of orthopedic surgical healthcare professionals toward perioperative anesthetic management. Previous studies have largely emphasized the general benefits of ERAS protocols, such as reduced hospital stay and improved nutrition, but they rarely evaluated the readiness of healthcare professionals to implement anesthetic management strategies in practice. This gap underscores the need for a focused KAP assessment, particularly in the orthopedic surgical context.

Materials and Methods

Study Design and Participants

This cross-sectional study included healthcare professionals at four hospitals between January 2023 and December 2023, including Shanxi Bethune Hospital, Taiyuan Microsurgery Hospital, Second Hospital of Shanxi Medical University, and the Seventh Medical Center of the Chinese People's Liberation Army General Hospital. The inclusion criteria were:1) having a valid medical license; 2) healthcare professionals from surgery, orthopedics, and anesthesiology; 3) Consented to participate in this study. No specific exclusion criteria were applied in this research. This study was approved by the Ethic Committee of the Shanxi Bethune Hospital (YXLL-2023-241), and all participants provided written informed consent. This cross-sectional design was chosen to allow for a comprehensive assessment of KAP within a defined timeframe, providing a pragmatic snapshot of current practices across multiple institutions.

Questionnaire Design

The design of the questionnaire was informed by *Expert Consensus on Perioperative Anesthesia Management of Orthopedic Enhanced Recovery*,[11] *Expert Consensus on Perioperative Pain Management of Orthopedic Enhanced Recovery*,[11] and relevant literature.[12,13] Subsequently, suggestions from three experts (2 orthopedic specialists and 1 anesthesiologist, each with over 30 years of professional experience in their respective fields) were incorporated. Based on their feedback, items were revised to better reflect key aspects of perioperative anesthetic management, thereby enhancing the questionnaire's content validity. A pre-experiment of 27 valid questionnaires yielded an overall Cronbach's α coefficient of 0.895, indicating good internal consistency. Face validity was assessed during a pilot survey, in which participants were asked to provide feedback on the clarity and understandability of each item. No respondents reported ambiguous or redundant wording, indicating that the questionnaire was clear and comprehensible to the target population.

The final questionnaire, in Chinese, comprised four sections: demographic information (age, gender, education, working duration, professional title, type of occupation, hospital levels, department, ERAS training experience in the

past year, and the number of orthopedic surgeries in the past year), knowledge dimension, attitude dimension, and practice dimension (Supplementary Materials 1). The knowledge dimension consisted of 15 questions, where respondents rated their understanding on a scale of 0–2 (0 for "Not familiar", 1 for "Partly familiar", and 2 for "Very familiar"). The total score of the knowledge dimension ranged from 0 to 30 points. The attitude dimension comprised 11 questions, using a five-point Likert scale ranging from "Strongly agree (5 points)" to "Strongly disagree (1 point)". The total score of the attitude dimension ranged from 11 to 55 points. The practice dimension included 9 questions, where scores were rated from "Always (5 points)" to "Never (1 point)". The total score of the practice dimension ranged from 9 to 45 points. To assess the KAP levels, participants' total scores were categorized using predefined cutoffs, where scores <60% were classified as poor knowledge / negative attitude / suboptimal practice, 60–80% as moderate scores, and > 80% as good knowledge / positive attitude / proactive practice.[14,15] The cut-off threshold has been widely adopted in KAP research as an indicator of adequate competency or readiness for practice, reflecting a pragmatic benchmark that distinguishes high performance from merely moderate understanding.

Questionnaire Distribution and Quality Control

The online questionnaire was distributed via Questionnaire Star (https://www.wjx.cn). Participants could scan the QR code using WeChat or follow the provided link to access and complete the questionnaire. To maintain data quality and ensure comprehensive responses, a one-submission-per-IP address restriction was enforced, and all questionnaire items were mandatory. Participants were assured of anonymity during the survey process. The research team, comprising three doctors trained as research assistants responsible for questionnaire promotion and distribution, meticulously reviewed all submissions for completeness, internal consistency, and logical coherence. Questionnaires containing logical errors, incomplete answers, or uniform responses across all items were categorized as invalid.

Sample Size

The sample size should ideally be at least 10 times the number of KAP items based on the sample size estimation methods for surveys.[16] With 33 KAP items in this questionnaire, the minimum sample size required would be 330. Accounting for a 25% non-response rate, the final necessary sample size would be 413.

Statistical Methods

All statistical analyses were performed using STATA 14.0 software. We selected both parametric and non-parametric tests according to data distribution to ensure robust statistical inference. The modeling strategy was guided by both theoretical considerations and prior literature, aiming to enhance interpretability and minimize potential bias. Descriptive analysis was conducted for demographic data and KAP scores. The normal distribution of continuous data was checked using the Kolmogorov–Smirnov test. The continuous variables conforming to the normal distribution were described as means ± standard deviations (SD) and analyzed using Student's *t*-test (two groups) or ANOVA (more than two groups). Those with a skewed distribution were presented as medians (ranges) and analyzed using the Wilcoxon-Mann–Whitney *U*-test (two groups) or the Kruskal–Wallis analysis of variance (more than two groups). The categorical variables were described as n (%). Spearman correlation analysis was employed to assess the correlations between KAP scores. Furthermore, the participants in each group were divided based on KAP scores with a cutoff of 80%. Univariate and multivariate logistic regression analysis was conducted to explore the relationships between demographic data and KAP scores. Variables with P<0.05 in univariate logistic regression analysis were further incorporated in multivariate logistic regression analysis. In structural equation modeling (SEM), the following hypotheses were made: (H1) knowledge directly influences attitude, (H2) attitude influences practice, and (H3) knowledge directly influences practice. SEM was employed to simultaneously test the hypothesized direct and indirect pathways among knowledge, attitudes, and practices, which cannot be fully captured by simple regression models. This approach allowed us to quantify both mediation effects and overall model fit, thereby strengthening the validity of the proposed conceptual framework. Model fit was evaluated using the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), the Tucker–Lewis index (TLI), and the comparative fit index (CFI). Two-sided P<0.05 was considered statistically significant.

Results

A total of 423 questionnaires were collected. Exclusions comprised 5 cases exhibiting response times of less than 90 seconds, 3 cases displaying abnormal age, and 29 cases providing incorrect answers to trap questions. After the exclusions, 386 valid questionnaires were included for analysis. The mean age was 36.17±8.34 years. The majority of participants were female (50.52%), with bachelor's degrees and below (51.55%), doctors (72.02%), and worked in public tertiary hospitals (70.47%). Additionally, 45.85% reported a tenure exceeding 10 years, and 61.4% specialized in anesthesiology. Moreover, 51.04% received ERAS training within the previous year. A total of 27.72% reported conducting 0–50 orthopedic surgeries in the past year, followed by 51–100 (26.68%) and 101–300 (22.28%) (Table 1).

Table 1 Basic Information and KAP Scores of Orthopedic Surgical Healthcare Professionals

N=386	N (%)	Knowledge Score		Attitude Score		Practice Score	
		Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
Total score		23.23±5.88		46.99±4.38		33.13±7.46	
Age (years)	36.17±8.34						
Gender			**0.008**		0.080		**<0.001**
Male	191(49.48)	24.06±5.44		47.43±4.24		34.55±6.96	
Female	195(50.52)	22.42±6.18		46.55±4.48		31.73±7.67	
Education			0.256		**0.002**		0.246
Bachelor's degree and below	199(51.55)	22.64±6.43		46.31±4.63		33.43±7.92	
Master's degree and above	187(48.45)	23.85±5.16		47.71±3.97		32.80±6.92	
Working duration			0.154		0.052		0.534
1–3 years	114(29.53)	22.35±5.73		46.14±4.54		32.57±7.70	
4–6 years	43(11.14)	23.60±5.46		47.81±4.58		32.95±7.20	
7–10 years	52(13.47)	23.53±5.82		47±4.63		34.25±6.72	
>10 years	177(45.85)	23.61±6.07		47.33±4.08		33.20±7.58	
Professional title			**0.009**		**0.007**		0.317
None	53(13.73)	22.11±6.12		45.43±4.29		33.26±8.76	
Junior	89(23.06)	22.88±5.82		46.39±4.49		32.08±6.99	
Intermediate	157(40.67)	22.77±6.16		47.47±4.44		33.39±7.33	
Associate senior/senior	87(22.54)	25.10±4.86		47.68±3.94		33.64±7.30	
Type of occupation			**<0.001**		**0.006**		0.209
Physician	278(72.02)	23.82±5.36		47.32±4.14		33.45±6.97	
Department (vice) director	39(10.1)	24.94±4.98		47.56±3.87		34±6.60	
Nurse/nurse manager	69(17.88)	19.86±7.07		45.33±5.17		31.33±9.39	
Hospital levels			0.593		**0.035**		0.793
Public tertiary hospital	272(70.47)	23.4±5.71		47.31±4.25		33.08±7.23	
Other	114(29.53)	22.8±6.27		46.21±4.58		33.23±7.98	
Department			**<0.001**		**0.003**		**0.004**
Orthopedics	84(21.76)	23.13±5.68		47.13±4.75		35.84±6.50	
Surgery	26(6.74)	20.38±6.41		43.73±4.01		32.34±7.93	
Anesthesiology	237(61.4)	24.45±4.97		47.26±4.08		32.57±6.87	
Other	39(10.1)	17.92±7.42		47.20±4.76		31.20±10.6	
ERAS training experience in the past year			**<0.001**		**<0.001**		**<0.001**
Yes	197(51.04)	25.47±4.78		47.91±4.20		35.37±6.68	
No	189(48.96)	20.89±6.01		46.03±4.36		30.79±7.52	
Number of orthopedic surgeries in the past year			**<0.001**		**<0.001**		**0.097**
0–50	107(27.72)	20.03±6.31		45.37±4.64		31.84±8.42	
51–100	103(26.68)	24.00±5.99		47.41±4.17		32.53±7.54	
101–300	86(22.28)	24.67±4.47		48.16±4.04		34.5±5.72	
301–500	50(12.95)	24.26±5.10		47.18±4.23		33.86±7.41	
> 500	40(10.36)	25.4±4.71		47.47±4.00		34.27±7.41	

Note: Bold values indicate statistical significance at $P < 0.05$.

The mean scores for knowledge, attitude, and practice were 23.23±5.88 (possible range: 0–30), 46.99±4.38 (possible range: 11–55), and 33.13±7.46 (possible range: 9–45), respectively. Significant differences were observed in knowledge scores across different gender (P=0.008), professional title (P=0.009), occupation type (P<0.001), department (P<0.001), ERAS training experience within the past year (P<0.001), and the number of orthopedic surgeries performed in the preceding year (P<0.001). Attitude scores displayed significant variations across different educational levels (P=0.002), professional title (P=0.007), occupation type (P=0.006), hospital levels (P=0.035), department (P=0.003), ERAS training experience within the past year (P<0.001), and the number of orthopedic surgeries performed in the preceding year (P<0.001). Practice scores demonstrated significant disparities concerning different gender (P<0.001), department (P=0.004), and ERAS training within the past year (P<0.001) (Table 1).

The distribution of the responses to the knowledge, attitude, and practice items was presented in Supplementary Tables 1–3, respectively. Rates of "Very familiar" in the knowledge dimension ranged from 33.42% to 73.58%. The least proportion (33.42%) accurately identified preoperative education and assessment in outpatient clinics and preoperative treatment of comorbidities (K1). In the attitudes section, the vast majority (98.71%) acknowledged the importance of preoperative assessment for intraoperative anesthesia management (A4). In the practice dimension, only 40.94% indicated frequently studying the relevant content of perioperative anesthesia management under the ERAS concept (P1). The differences in knowledge levels among healthcare professionals from different departments regarding perioperative management were presented in Figure S1.

Spearman correlation analysis unveiled positive correlations between knowledge and attitude (r=0.3931, P<0.001), knowledge and practice (r=0.5078, P=0.0045), and attitude and practice (r=0.3430, P<0.001) (Table 2). SEM results indicated positive associations between knowledge and attitude (β=0.29, P<0.001), between knowledge and practice (β=0.54, P<0.001), and between attitude and practice (β=0.30, P<0.001) (Figure 1, Supplementary Table 4). Additionally, knowledge exerted a direct effect on attitude (β=0.29, 95% CI: 0.22–0.36; P<0.001), and attitude had a direct effect on practice (β=0.30, 95% CI: 0.14–0.45; P<0.001). Moreover, knowledge had both a direct effect (β=0.53, 95% CI: 0.41–0.65; P<0.001) and an indirect effect (β=0.08, 95% CI: 0.03–0.13; P<0.001) on practice (Supplementary Table 5). SEM demonstrated a good model fit (RMSEA<0.001, SRMR<0.001, TLI=1.000, CFI=1.000) (Supplementary Table 6).

Using the 80% cut-off value, KAP scores were categorized into high and low levels (Supplementary Table 7). The results of multivariate logistic analysis revealed that age (OR=1.09, 95% CI: 1.03–1.16; P=0.003), employment in the anesthesiology department (OR=2.01, 95% CI: 1.10–3.69; P=0.023), ERAS training experience within the past year (OR=0.19, 95% CI: 0.11–0.31; P=0.023) and conducting 51–100 (OR=2.97, 95% CI: 1.51–5.85; P=0.002), 101–300 (OR=2.61, 95% CI: 1.23–5.52; P=0.012), and > 500 (OR=2.95, 95% CI: 1.16–7.47; P=0.022) orthopedic surgeries in the past year were independently associated with knowledge (Table 3). Additionally, a knowledge score (OR=1.16, 95% CI: 1.10–1.22; P<0.001), a master's degree or above (OR=2.09, 95% CI: 1.16–3.79; P=0.014), and 4–6 years of work experience (OR=3.01, 95% CI: 1.02–8.86; P=0.045) were positively associated with positive attitude (Table 4). And knowledge score (OR=1.18, 95% CI: 1.10–1.25; P<0.001), attitude score (OR=1.10, 95% CI: 1.03–1.17; P=0.003), and employment in the anesthesiology department (OR=0.33, 95% CI: 0.17–0.61; P<0.001) were independently associated with proactive practice (Table 5).

Table 2 Correlation Analysis of KAP Scores

	Knowledge	Attitude	Practice
Knowledge	1		
Attitude	0.3931 (P<0.001)	1	
Practice	0.5078 (P<0.001)	0.3430 (P<0.001)	1

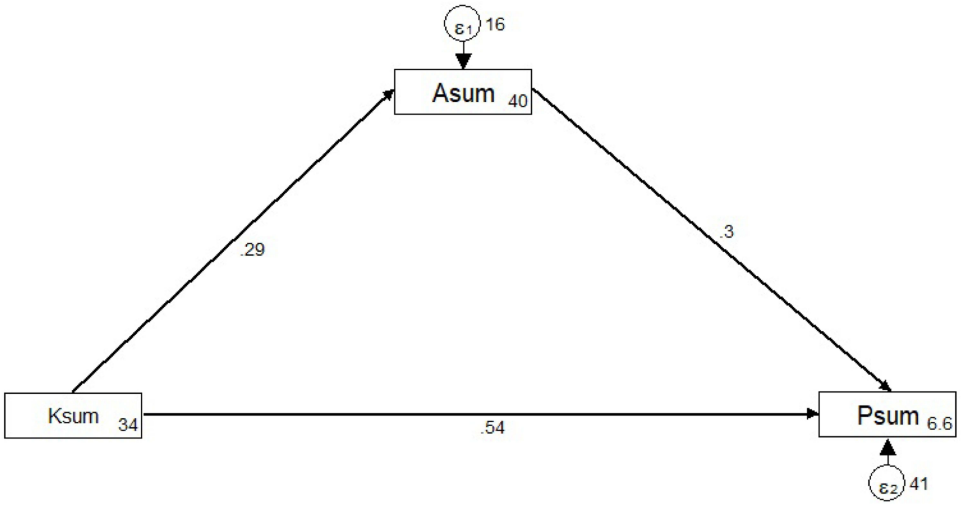

Figure 1 Structural equation model showing the associations between KAP scores.

Discussion

While prior literature has consistently demonstrated the benefits of ERAS (eg, shorter length of stay, improved recovery), many of these findings remain descriptive and do not critically examine provider-level factors that influence successful implementation. Our study adds to the literature by identifying how demographic and professional characteristics shape knowledge, attitudes, and practices, thereby addressing a dimension often overlooked in existing ERAS research.

Table 3 The Univariate and Multivariate Analysis of Knowledge Score

Knowledge	**Univariate Analysis**		**Multivariate Analysis**	
	OR (95% CI)	**P**	**OR (95% CI)**	**P**
Age (years)	1.05(1.03,1.08)	**<0.001**	1.09(1.03,1.16)	**0.003**
Gender				
Male				
Female	0.67(0.44,1.00)	0.052		
Education				
Bachelor's degree and below				
Master's degree and above	1.37(0.92,2.05)	0.120		
Working duration				
1–3 years				
4–6 years	1.7(0.83,3.44)	0.141	1.81(0.69,4.73)	0.223
7–10 years	2.01(1.03,3.92)	**0.039**	1.31(0.46,3.66)	0.606
>10 years	2.01(1.24,3.24)	**0.004**	0.46(0.14,1.47)	0.193
Professional title				
None				
Junior	1.24(0.62,2.48)	0.536	0.71(0.30,1.68)	0.442
Intermediate	1.54(0.81,2.90)	0.179	0.57(0.19,1.71)	0.317
Associate senior/senior	3.57(1.74,7.32)	**<0.001**	0.97(0.25,3.79)	0.970
Type of occupation				
Physician				
Department (vice) director	1.58(0.78,3.21)	0.200		
Nurse/nurse manager	0.32(0.18,0.57)	**<0.001**		

(*Continued*)

Table 3 (Continued).

Knowledge	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	**P**	**OR (95% CI)**	**P**
Hospital levels				
Public tertiary hospital				
Other	0.65(0.42,1.02)	0.063		
Department				
Orthopedics				
Surgery	0.58(0.23,1.45)	0.246	1.03(0.33,3.21)	0.951
Anesthesiology	1.70(1.03,2.81)	**0.037**	2.01(1.10,3.69)	**0.023**
Other	0.28(0.11,0.68)	**0.005**	0.42(0.14,1.22)	0.113
ERAS training experience in the past year				
Yes				
No	0.20(0.13,0.31)	**<0.001**	0.19(0.11,0.31)	**<0.001**
Number of orthopedic surgeries in the past year				
0–50				
51–100	3.86(2.17,6.86)	**<0.001**	2.97(1.51,5.85)	**0.002**
101–300	3.93(2.15,7.19)	**<0.001**	2.61(1.23,5.52)	**0.012**
301–500	3.12(1.55,6.26)	**0.001**	1.98(0.85,4.61)	0.113
> 500	4.55(2.10,9.85)	**<0.001**	2.95(1.16,7.47)	**0.022**

Note: Bold values indicate statistical significance at $P < 0.05$.

Table 4 The Univariate and Multivariate Analysis of Attitude Score

Attitude	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	**P**	**OR (95% CI)**	**P**
Knowledge	1.15(1.10,1.20)	**<0.001**	1.16(1.10,1.22)	**<0.001**
Age (years)	1.03(1.00,1.06)	**0.016**	0.95(0.90,1.01)	0.15
Gender				
Male				
Female	0.79(0.52,1.21)	0.297		
Education				
Bachelor's degree and below				
Master's degree and above	1.98(1.28,3.06)	**0.002**	2.09(1.16,3.79)	**0.014**
Working duration				
1–3 years				
4–6 years	3.28(1.44,7.46)	**0.005**	3.01(1.02,8.86)	**0.045**
7–10 years	1.95(0.97,3.91)	0.058	2.29(0.76,6.91)	0.14
>10 years	2.14(1.31,3.50)	**0.002**	3.18(0.86,11.6)	0.08
Professional title				
None				
Junior	1.29(0.65,2.55)	0.462	1.17(0.51,2.65)	0.701
Intermediate	2.39(1.26,4.54)	**0.007**	1.99(0.65,6.00)	0.222
Associate senior/senior	3.22(1.54,6.72)	**0.002**	2.30(0.54,9.67)	0.254
Type of occupation				
Physician				
Department (vice) director	1.10(0.52,2.31)	0.797	0.79(0.29,2.14)	0.653
Nurse/nurse manager	0.44(0.26,0.76)	**0.003**	0.87(0.34,2.24)	0.786

(*Continued*)

Table 4 (Continued).

Attitude	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	**P**	**OR (95% CI)**	**P**
Hospital levels				
Public tertiary hospital				
Other	0.68(0.43,1.08)	0.103		
Department				
Orthopedics				
Surgery	0.28(0.11,0.69)	**0.006**	0.37(0.11,1.25)	0.113
Anesthesiology	1.04(0.61,1.79)	0.865	0.83(0.42,1.61)	0.59
Other	0.64(0.29,1.41)	0.274	1.12(0.37,3.36)	0.828
ERAS training experience in the past year				
Yes				
No	0.52(0.33,0.80)	**0.003**	1.02(0.60,1.73)	0.925
Number of orthopedic surgeries in the past year				
0–50				
51–100	1.65(0.94,2.89)	0.079	0.84(0.42,1.68)	0.64
101–300	2.68(1.43,5.03)	**0.002**	0.88(0.40,1.96)	0.773
301–500	2.09(1.01,4.32)	**0.046**	0.68(0.27,1.69)	0.412
> 500	1.68(0.78,3.62)	0.178	0.49(0.19,1.27)	0.144

Note: Bold values indicate statistical significance at P < 0.05.

Table 5 The Univariate and Multivariate Analysis of Practice Score

Practice	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	**P**	**OR (95% CI)**	**P**
Knowledge score	1.18(1.12,1.24)	**<0.001**	1.18(1.10,1.25)	**<0.001**
Attitude score	1.17(1.10,1.23)	**<0.001**	1.10(1.03,1.17)	**0.003**
Age (years)	1.00(0.97,1.02)	0.879		
Gender				
Male				
Female	0.57(0.37,0.88)	**0.012**	0.78(0.47,1.29)	0.34
Education level				
Bachelor's degree and below				
Master's degree and above	0.82(0.53,1.26)	0.38		
Working duration				
1-3 years				
4–6 years	1.04(0.49,2.21)	0.907		
7–10 years	1.24(0.62,2.48)	0.529		
>10 years	1.02(0.62,1.70)	0.911		
Professional title				
None				
Junior	0.77(0.37,1.60)	0.498		
Intermediate	0.78(0.40,1.51)	0.477		
Associate senior/senior	1.04(0.51,2.11)	0.911		
Type of occupation				
Physician				
Department (vice) director	1.28(0.64,2.56)	0.478		
Nurse/nurse manager	0.83(0.47,1.49)	0.55		

(*Continued*)

Table 5 (Continued).

Practice	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	**P**	**OR (95% CI)**	**P**
Hospital levels				
Public tertiary hospital				
Other	1.04(0.65,1.66)	0.851		
Department				
Orthopedics				
Surgery	0.34(0.12,0.94)	**0.039**	0.60(0.18,2.02)	0.416
Anesthesiology	0.45(0.27,0.76)	**0.003**	0.33(0.17,0.61)	**<0.001**
Other	0.64(0.29,1.41)	0.274	1.44(0.54,3.84)	0.464
ERAS training experience in the past year				
Yes				
No	0.38(0.24,0.59)	**<0.001**	0.77(0.46,1.30)	0.339
Number of orthopedic surgeries in the past year				
0–50				
51–100	1.15(0.63,2.10)	0.631		
101–300	1.67(0.91,3.07)	0.097		
301–500	1.94(0.96,3.94)	0.064		
> 500	1.15(0.51,2.56)	0.728		

Note: Bold values indicate statistical significance at P < 0.05.

Healthcare professionals held moderate knowledge, positive attitude, and moderate practice towards perioperative anesthetic management. Positive associations, as well as direct and indirect associations, were identified among KAP scores. Educational and behavioral interventions are recommended for those with young age, shorter work experience, less surgical caseload, and lower educational levels.

In the knowledge dimension, only 33.42% accurately identified preoperative education and assessment in outpatient clinics and preoperative treatment of comorbidities. Preoperative education helps prepare patients for surgery by providing information about the procedure, potential risks, and postoperative care instructions. Besides, preoperative assessment allows for the identification and management of comorbidities.[17] Besides, 39.90% were highly familiar with postoperative dietary management. Postoperative dietary management incorporates multiple recovery processes following orthopedic surgery, such as wound healing, immune function, and overall nutritional status.[18] Reportedly, healthcare professionals including orthopedic surgeons, may lack adequate training in nutrition-related topics, which can impact patient care and outcomes.[19] To address the knowledge gaps, it may include implementing standardized perioperative management and fostering interdisciplinary collaborations between orthopedic surgeons and anesthesiologists. To further bridge these knowledge gaps, the integration of artificial intelligence (AI) into perioperative care has been proposed as a promising strategy. AI-driven clinical decision support systems can help standardize perioperative management, optimize patient-specific nutritional and rehabilitation plans, and enhance interdisciplinary collaboration by providing real-time, evidence-based recommendations.[20]

The results of the distribution of knowledge responses from different departments revealed that anesthesiologists exhibit the highest level of knowledge regarding perioperative management, as evidenced by the substantial proportion of "Very Familiar" responses. This result is not surprising. In 2021, Chen et al found that anesthesiologists possess extensive knowledge in perioperative pain management, including strategies like multimodal analgesia (MMA) and ERAS pathways, which significantly improve postoperative outcomes such as pain, function, and patient satisfaction.[21] In questions K13 (knowledge of postoperative dietary management) and K14 (knowledge of early postoperative mobilization), anesthesiologists' responses showed significant differences compared to other questions, with relatively lower scores. This indicates a need to enhance training and education in these specific areas. Improving interdisciplinary knowledge and practices can lead to better collaborative care and improved patient outcomes.[22]

Only 25.65% indicated that perioperative anesthesia management under the ERAS does not increase workload. The implementation of ERAS often involves modifications to anesthesia management, preoperative preparation, intraoperative techniques, and postoperative care.[23] Addressing the concerns requires a multifaceted approach. Firstly, training programs are needed to ensure that healthcare professionals are adequately prepared for ERAS protocols. Secondly, fostering interdisciplinary collaboration is essential for optimizing workload distribution.

In the practice dimension, the least proportion (40.94%) had frequent studies of perioperative anesthesia management under the ERAS concept. To date, no standardized training course or mechanism for the ERAS can be reached in China.[24] Such absence may hinder implementation and adherence to ERAS protocols, resulting in variability in practice patterns and outcomes across institutions. In addition, 52.85% were involved in assessing and guiding patients' dietary recovery postoperatively. Postoperative dietary management encompasses assessing patients' nutritional status, providing dietary recommendations, and addressing nutritional deficiencies during the recovery period. Given the risk of postoperative complications associated with malnutrition and underfeeding, timely enteral feeding holds significance for surgical patients.[25]

Positive relationships of KAP scores were observed from Spearman correlation analysis and SEM. Consistent with the theory of planned behavior, participants with knowledge of perioperative anesthetic management may recognize its clinical potential, resulting in positive attitudes and increased acceptance of patient care.[26] Aside from its direct effect, knowledge also exerted an indirect effect on practice. One plausible explanation is that higher levels of knowledge may lead to more positive attitudes toward perioperative anesthetic management, which, in turn, influences clinical practice. The influential factors of KAP were additionally determined. First, healthcare professionals with advanced age may have accumulated more experience in perioperative anesthetic management. Second, employment in the anesthesiology department was positively associated with knowledge, indicating greater access to clinical experience related to perioperative anesthetic management. Third, the positive association between surgical caseload and knowledge suggests the role of orthopedic surgeries in fostering clinical experience. Fourth, the negative association between the absence of ERAS training and knowledge underscored the importance of continuing education and training initiatives in perioperative care. Fifth, a positive association between higher education level and attitude was observed. Higher education often fosters critical thinking skills and research abilities, which contribute to positive attitudes toward evidence-based practices in healthcare.[27] Sixth, individuals with moderate levels of work experience may have a greater appreciation for perioperative anesthetic management. Seventh, healthcare professionals in the anesthesiology department exhibited a lower likelihood of engaging in proactive practices. Anesthesiologists may primarily focus on administering anesthesia during surgical procedures, which could limit their involvement in perioperative care activities.[28] This pattern may also reflect institutional and cultural factors, including traditional role definitions, hierarchical structures within surgical teams, and the perception that perioperative recovery is primarily the responsibility of surgeons and nurses. Such interdisciplinary barriers and role boundaries can constrain anesthesiologists' contributions and hinder the comprehensive implementation of ERAS protocols. Addressing these barriers through interdisciplinary training and institutional policy adjustments could better translate anesthesiologists' expertise into proactive practice. From a policy and educational perspective, younger professionals and those with fewer surgical cases may particularly benefit from structured ERAS-focused training, while incorporating perioperative anesthetic management into graduate curricula and continuing education could help mitigate gaps associated with lower educational levels. The use of SEM further enabled us to disentangle direct and indirect effects, confirming that knowledge not only directly influenced practice but also exerted an indirect effect via attitudes. This analytic approach provided a more nuanced understanding of the interplay among KAP components than would have been possible with simple regression analyses alone.

To the best of our knowledge, this is the first study in China to comprehensively evaluate orthopedic surgical healthcare professionals' KAP towards perioperative anesthetic management under the ERAS framework, thereby addressing a significant gap in the literature. However, the study had several limitations. The study adopted a cross-sectional design, thereby limiting the determination of causality. The questionnaire was designed by the researchers, taking into account regional practices, cultural nuances, and institutional policies, thereby constraining its applicability to other settings or regions and the broader extrapolation of findings. Additionally, unmeasured confounders such as institutional policies, resource availability, and departmental culture may have influenced KAP levels but were not

captured in the present study. Given that data collection relied on self-report, participants may have overestimated their knowledge or reported socially desirable practices rather than their actual behaviors, which could affect the accuracy of the findings.[29] Lastly, test-retest reliability was not evaluated; therefore, the stability of responses over time cannot be confirmed. Despite these limitations, the study provides valuable real-world insights into current gaps in KAP among orthopedic surgical healthcare professionals. The findings highlight priority areas for targeted training and policy interventions, which could directly inform the design of ERAS-based educational programs and support evidence-based improvements in perioperative care delivery.

Conclusions

The study revealed the orthopedic surgical healthcare professionals showed a positive attitude, while their knowledge and practice of perioperative anesthetic management remained at a moderate level. To enhance their KAP scores, continuing training in perioperative anesthetic management is recommended, particularly for those with young age, shorter work duration, less surgical caseload, and lower educational levels. In practical terms, incorporating ERAS-focused modules into ongoing medical education and institutional training programs may help bridge these gaps, while fostering interdisciplinary collaboration could further strengthen perioperative care delivery.

Abbreviations

ERAS, Enhanced recovery after surgery; KAP, knowledge, attitudes, and practices; SD, standard deviations; SEM, structural equation modeling; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker–Lewis index; CFI, comparative fit index; MMA, multimodal analgesia.

Data Sharing Statement

Raw data supporting the findings of this study is available from the corresponding author on reasonable request.

Ethics Approval and Informed Consent

This work has been carried out in accordance with the Declaration of Helsinki (2000) of the World Medical Association. This study was approved by the Ethic Committee of the Shanxi Bethune Hospital (YXLL-2023-241), and all participants provided written informed consent.

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 report no conflict of interest in this work.

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