

Knowledge, Attitudes, and Practices of Healthcare Workers Regarding Postoperative Behavioral Changes in Pediatric Anaesthesia

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Purpose: Postoperative behavioral changes (POBC) pose significant challenges in pediatric anesthesia. Understanding healthcare workers' knowledge, attitudes, and practices (KAP) towards POBC is essential for improving patient care.

Patients and Methods: A cross-sectional study was conducted between April and May 2024 across China, involving 618 healthcare workers (75.57% physicians; mean experience: 9.44 [SD = 6.36] years). The respondents' feedback was collected using a self-developed questionnaire assessing KAP of POBC in children.

Results: Moderate knowledge (score: 20.49, SD = 6.35), positive attitudes (score: 34.21, SD = 5.25), but suboptimal practices (score: 19.89, SD = 7.42). Structural equation modeling indicated that knowledge was associated with attitude ($\beta=0.15$, $P=0.010$) and practice ($\beta=0.35$, $P=0.018$). Attitude was also associated with practice ($\beta=0.10$, $P=0.017$), and knowledge showed an indirect association with practice mediated through attitude ($\beta=0.02$, $P=0.008$). Similar trends were observed in physicians. Among nurses, knowledge was directly associated with practice ($\beta=0.27$, $P=0.012$), highlighting differences based on professional roles.

Conclusion: While healthcare workers demonstrated a foundational understanding and positive attitudes towards POBC, their clinical practices require improvement. Targeted training interventions are recommended to enhance practice skills and optimize pediatric anesthesia outcomes.

Keywords: knowledge, attitudes, practices, healthcare professional, postoperative behavioral changes, emergence agitation, pediatric anesthesia

Introduction

Postoperative behavioral changes (POBC) encompass a spectrum of adverse psychological and behavioral outcomes frequently observed in pediatric patients following general anaesthesia. These manifestations may include separation anxiety, temper tantrums, nightmares, enuresis, eating disturbances, and sleep disorders. POBC can emerge immediately post-discharge or persist for several weeks, potentially compromising children's emotional and cognitive development while disrupting family dynamics.¹ Emerging evidence suggests that anaesthetic agents may adversely affect pediatric neurodevelopment, with potential consequences including learning impairment, memory deficits, and possibly permanent neurological sequelae.^{2,3} While particular concerns have been raised regarding prolonged anaesthesia exposure in young children, POBC frequently occur even after brief, single anaesthetic episodes.^{4,5} Among the earliest observable

phenomena is emergence delirium – characterised by acute agitation and disorientation during recovery. Although pathologically distinct from POBC, emergence agitation may share similar common risk factors and could potentially predispose certain children to developing POBC.¹ In this study, we use the term POBC to describe a broader range of maladaptive psychological and behavioral outcomes, while “emergence agitation” is treated as an acute and distinct phenomenon during recovery.

POBC can significantly impact both pediatric patients and their families. Commonly observed adverse effects include temper tantrums, nightmares, anxiety, enuresis, and disruptions in both sleep patterns and eating habits. Current evidence suggests that more than 50% of children receiving general anaesthesia experience such behavioral alterations, which share several risk factors with emergence agitation – particularly pre-school age and pre-existing anxiety.⁶ These changes frequently result in increased general practitioner consultations, additional parental work absenteeism, and diminished compliance with subsequent medical care.^{7,8}

Despite the high prevalence of POBC, healthcare professionals often inadequately address these outcomes. Insufficient recognition and management may result in missed opportunities for early intervention, potentially exacerbating long-term developmental or psychological consequences for affected children. Importantly, while knowledge acquisition is necessary, it does not automatically translate to behavioral change; meaningful practice modification requires first altering perceptions, which subsequently enable changed behaviours.^{9,10}

Additionally, surgery and anaesthesia are recognised as highly stressful events for both pediatric patients and their parents.^{11,12} By focusing on this specific group, the study aims to enhance healthcare providers’ understanding of potential risks and improve postoperative management strategies following anaesthesia. This increased awareness and shift in attitudes may influence clinical practices, ultimately promoting safer and more effective recovery care for pediatric patients.

Therefore, this study aimed to investigate healthcare workers’ KAP of healthcare regarding POBC, including emergence agitation, in pediatric anaesthesia. Although these risks are increasingly recognised, few studies have specifically evaluated healthcare workers’ KAP concerning POBC, particularly in China, where pediatric anaesthesia services face unique challenges such as uneven distribution of resources and limited training opportunities compared with international settings.¹³ Existing KAP studies in the perioperative field have primarily focused on other outcomes, such as postoperative cognitive dysfunction (POCD),¹⁴ but no prior research has systematically explored healthcare workers’ KAP regarding POBC. In particular, studies focusing on nurses’ knowledge, attitudes, and practices regarding POBC are scarce, despite their essential role in perioperative care. By applying the KAP framework, this study aims to address those gaps by assessing clinicians’ perceptions and management strategies related to POBC in pediatric patients.

Materials and Methods

Study Design and Participants

This cross-sectional study was conducted between April and May 2024 across multiple healthcare facilities in China. Using convenience sampling, we recruited healthcare workers from anaesthesiology departments, pediatrics department, operating theatres, or other clinical areas involved in pediatric general anaesthesia. The study received ethical approval from the Medical Ethics Committee of Yongchun County Hospital (Approval number: EC of YCCH2024 [05]) and written informed consent was obtained from all participants.

Inclusion criteria: 1) Possession of a valid professional qualification certificate; 2) Minimum of one year’s clinical experience in pediatric general anaesthesia; 3) Willingness to participate voluntarily.

Exclusion criteria: 1) currently on leave or otherwise unavailable during the study period.

Sample size determination: The sample size was calculated based on the principle that questionnaire-based studies require a minimum of 10 respondents per item to ensure sufficient statistical power and reliable factor analysis. As the questionnaire contained 32 items (16 knowledge items, 8 attitude items, and 8 practice items), a minimum of 320 participants was necessary. To accommodate for potential incomplete responses and improve the sample’s representativeness across diverse healthcare settings, we targeted a recruitment of at least 600 participants.

Questionnaire

The questionnaire ([supplementary Figure 1](#)) was developed through a rigorous three-stage process. First, a comprehensive literature review was conducted to identify key domains related to POBC in pediatric anaesthesia, incorporating relevant guidelines and published studies.¹⁵ Second, the initial draft was evaluated and refined through expert consultation, involving two senior anaesthesiologists and one pediatric specialist, each with over 15 years of clinical experience. Third, the questionnaire was validated using a two-step process: (1) a content validity assessment conducted by an expert panel comprising three senior anaesthesiologists, two pediatric specialists, and one methodologist, and (2) a pilot test involving 69 healthcare workers to evaluate reliability. The pilot test revealed excellent internal consistency, with a Cronbach's α of 0.92 for the questionnaire. The expert panel's review ensured that the questionnaire items comprehensively reflected the intended domains of knowledge, attitudes, and practices.

The final Chinese version of the questionnaire comprised four sections: demographic information and three assessment dimensions (knowledge, attitude, and practice). The knowledge dimension contained 16 items, with responses scored according to comprehension level: 2 points for "understand", 1 point for "partially understand", and 0 points for "do not understand". This yielded a total possible score range of 0 to 32 points. The attitude dimension comprised eight items assessed using a five-point Likert scale ranging from "strongly agree" (5 points) to "strongly disagree" (1 point), yielding a total score range of 8–40 points. The practice dimension similarly contained eight items, though item 6 was excluded from scoring. The remaining seven items were evaluated using a five-point Likert scale from "always" (5 points) to "never" (1 point), producing a total possible score range of 7–35 points. Participants were categorised according to their percentage scores relative to the total possible points based on Bloom's cutoff value. Specifically, those achieving >80% of the maximum score were classified as demonstrating knowledge, positive attitudes and proactive practices. Scores between 60% and 80% indicated moderate levels across these domains, while scores <60% reflected inadequate knowledge, negative attitudes and inactive practices.^{16,17} The Bloom's cutoff value has been widely applied in previous KAP studies.^{16,18,19} These selected thresholds provide meaningful discrimination between performance levels while retaining sufficient sensitivity to detect variations in professional knowledge, attitudes, and practices.

Data Collection

The questionnaires were administered via the online platform "Wenjuanxing". The study was promoted through the official account of local Anaesthesia Society, enabling potential participants to contact the research team and facilitate questionnaire distribution within their respective hospitals. Each participating hospital appointed a designated coordinator who communicated the study's purpose, content, and completion guidelines to relevant staff members. This process emphasised the voluntary nature of participation and assured confidentiality of personal data. To enhance response quality, participants received a small incentive upon questionnaire completion.

Statistical Analysis

Data analysis was conducted using SPSS 27.0 and AMOS 26.0 (IBM, Armonk, NY, USA). Continuous variables were presented as means \pm standard deviations (SD). Independent samples *t*-tests were used to compare KAP scores between two groups (eg, gender, education level, participation in training). One-way ANOVA was applied to compare KAP scores across multiple groups (eg, departments, professional titles, frequency of participation in pediatric anaesthesia). Categorical variables were presented as frequencies and percentages [n (%)].

Spearman correlation analysis was used to examine the relationships between knowledge, attitude, and practice scores. Structural equation modelling was performed using AMOS 26.0 to assess the direct and indirect effects among KAP dimensions in the overall population, as well as in physicians and nurse subgroups across all knowledge, attitude, and practice items to identify profession-specific differences that could guide tailored educational interventions. Model fit was evaluated using multiple indices, including the comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardised root mean square residual (SRMR). For all analyses, a two-sided P-value of <0.05 was considered statistically significant.

Results

Demographics

This study included 618 healthcare workers with a mean age of 34.00 (SD = 6.16) years and mean professional experience of 9.44 (SD = 6.36) years. The cohort comprised 312 female (50.49%) and 374 participants (60.52%) with a Bachelor's degree or lower qualification. Of these, 467 (75.57%) were physicians and 384 (62.14%) worked in the anaesthesiology departments. Regarding clinical experience, 227 participants (36.73%) had been involved in 1–10 cases of pediatric general anaesthesia (or postoperative care) per month during the preceding year. Additionally, 271 respondents (43.85%) reported minimal involvement with cases of POBC in pediatric anaesthesia, while 265 (42.88%) had participated in relevant training. The majority (524, 84.79%) practised in hospitals with a dedicated post-anaesthesia care unit.

Knowledge, Attitude, and Practice

The mean scores for knowledge, attitude, and practice were 20.49 (SD = 6.35), 34.21 (SD = 5.25), and 19.89 (SD = 7.42), respectively. Demographic analysis revealed significant variations in knowledge scores according to: educational attainment ($P = 0.006$), professional role ($P < 0.001$), department ($P < 0.001$), involvement in pediatric general anaesthesia procedures ($P < 0.001$), experience of managing patients with POBC ($P < 0.001$), and training participation ($P < 0.001$). Attitude scores demonstrated significant associations with: professional role ($P < 0.001$), department ($P < 0.001$), professional title ($P = 0.011$), involvement in pediatric general anaesthesia ($P < 0.001$), experience of managing patients with POBC ($P < 0.001$), hospital type ($P = 0.004$), and presence of a dedicated post-anaesthesia care unit ($P < 0.001$). Practice scores showed significant variation by: department ($P = 0.002$), professional title ($P = 0.009$), involvement in pediatric general anaesthesia ($P < 0.001$), experience of managing patients with POBC ($P < 0.001$), training participation ($P < 0.001$), hospital type ($P < 0.001$), and teaching hospital status ($P < 0.001$) (Table 1).

The distribution of knowledge dimensions revealed that the three questions with the highest proportion of participants selecting the *Not Familiar* option were: “The gold standard for evaluating POBC is the Post Hospital Behavioral Questionnaire (PHBQ)” (K6) (34.14%); “Emergence agitation can be assessed using the Pediatric Anesthesia

Table 1 Demographic Characteristics and KAP Scores

Characteristics	N(%)	Knowledge	P	Attitude	P	Practice	P
N=618							
Total Score		20.49(6.35)		34.21(5.25)		19.89(7.42)	
Gender			0.195		0.707		0.878
Male	306 (49.51)	20.81(6.18)		34.24(5.02)		19.85(7.54)	
Female	312 (50.49)	20.17(6.49)		34.17(5.47)		19.92(7.31)	
Education			0.006		0.143		0.986
Bachelor's degree or below	374 (60.52)	19.92(6.60)		34.61(4.64)		19.90(7.62)	
Master's degree or above	244 (39.48)	21.36(5.84)		33.59(6.02)		19.88(7.12)	
Occupation			<0.001		<0.001		0.233
Physician	467 (75.57)	21.07(6.12)		34.60(4.99)		20.04(7.15)	
Nurse	151 (24.43)	18.70(6.70)		33.01(5.84)		19.42(8.21)	
Department			<0.001		<0.001		0.002
Anaesthesiology	384 (62.14)	21.57(5.89)		35.17(4.38)		20.70(6.99)	
Pediatrics	59 (9.55)	21.53(4.94)		31.54(7.00)		17.93(7.76)	
Operating room	83 (13.43)	20.41(5.40)		31.96(6.52)		18.57(7.24)	
Others	92 (14.89)	15.39(7.30)		33.92(4.82)		18.96(8.61)	
Professional title			0.177		0.011		0.009
Junior	266 (43.04)	20.91(5.83)		33.47(5.97)		19.00(7.80)	
Intermediate	282 (45.63)	20.24(6.68)		34.51(4.81)		20.49(7.03)	
Senior	70 (11.33)	19.87(6.82)		35.81(3.20)		20.83(7.23)	

(Continued)

Table 1 (Continued).

Characteristics	N(%)	Knowledge	P	Attitude	P	Practice	P
Participation in pediatric general anaesthesia procedures (or postoperative care) during the past year			<0.001		<0.001		<0.001
Almost never (<1 case/month)	101 (16.34)	15.92(7.15)		33.86(4.57)		17.52(7.99)	
1-10 cases/month	227 (36.73)	20.39(6.37)		35.33(4.17)		20.42(6.94)	
11-20 cases/month	111 (17.96)	21.92(5.23)		33.69(6.31)		20.63(7.13)	
21-30 cases/month	85 (13.75)	22.28(4.91)		32.48(6.49)		18.52(7.58)	
31-50 cases/month	42 (6.80)	22.50(4.37)		33.29(5.54)		19.10(7.34)	
>50 cases/month	52 (8.41)	22.17(5.98)		34.62(4.77)		23.44(7.07)	
Participation in postoperative behavioral changes (including emergence agitation) in pediatric anaesthesia during the past year			<0.001		<0.001		<0.001
Almost none (<1 case/month)	271 (43.85)	18.96(7.06)		35.05(4.10)		20.00(7.49)	
1-5 cases/month	189 (30.58)	20.85(6.28)		34.81 (4.79)		21.28(6.74)	
6 cases or more/month	158 (25.57)	22.69(4.03)		32.04(6.74)		18.03(7.72)	
Participation in training related to postoperative behavioral changes			<0.001		0.582		<0.001
Yes	265 (42.88)	22.59(5.21)		33.99(6.00)		21.43(7.83)	
No	353 (57.12)	18.91(6.66)		34.37(4.60)		18.73(6.88)	
Hospital level			0.115		0.004		<0.001
Public tertiary hospital	411 (66.50)	20.30(6.59)		34.82(4.47)		20.52(7.13)	
Non-public tertiary hospital	207 (33.50)	20.86(5.83)		32.99(6.36)		18.63(7.83)	
Teaching hospital			0.488		0.832		<0.001
Yes	452 (73.14)	20.63(6.49)		34.21(5.34)		20.51(7.43)	
No or unclear	166 (26.86)	20.09(5.94)		34.19(4.99)		18.19(7.15)	
Dedicated anaesthesia recovery room			0.685		<0.001		0.099
Yes	524 (84.79)	20.49(6.44)		34.57(4.92)		20.10(7.42)	
No or unclear	94 (15.21)	20.47(5.83)		32.18(6.44)		18.73(7.35)	

Emergence Delirium (PAED) scale” (K15) (20.55%); and “Emergence agitation is a pathological state characterised by psychomotor agitation, excessive activity, and perceptual disturbances, most commonly observed in children aged 2 to 5 years” (K8) (12.46%) (Table 2).

In the attitude dimension, over 90% of participants selected *strongly agree* or *agree*, except for items A6 and A7. Specifically: for “Different anaesthesiologists have varying standards for postoperative analgesia in children, and the administration of pediatric analgesia is primarily based on individual experience” (A6), 31.23% agreed, 23.62% were neutral, and 13.92% disagreed. Regarding the need for follow-up after discharge (A7), 10.52% expressed neutrality (Table 3).

Regarding practices, 22.82% of respondents never informed parents about the assessment methods for POBC or recommended follow-up upon discharged (P8). Additionally, 20.39% did not administer analgesia for children (P6), and 17.64% never encouraged parental involvement in preventing POBC, including emergence agitation (P3) (Table 4).

Interactions Among KAP and Subgroup Analysis

SEM analysis revealed that, for the overall population, knowledge showed both direct and indirect associations. Specifically, knowledge was associated with attitude ($\beta = 0.15$, $P = 0.010$); knowledge was associated with practice ($\beta = 0.35$, $P = 0.018$). Attitude was associated with practice ($\beta = 0.10$, $P = 0.017$), while knowledge showed an additional indirect association with practice mediated through attitude ($\beta = 0.02$, $P = 0.008$) (Figure 1). The physician group displayed a similar pattern to the overall population (Figure 2). However, among nurses (Figure 3), only the direct association of knowledge and practice remained significant ($\beta = 0.27$, $P = 0.012$), with all other pathways being non-significant (Table 5).

Table 2 Participant Responses in the Knowledge Section of Physician and Nurse

	Physician N (%)			Nurse N (%)		
	Very Familiar	Quite Familiar	Not Familiar	Very Familiar	Quite Familiar	Not Familiar
1. Postoperative behavioral changes refer to adverse reactions occurring in children during and after hospitalisation.	168 (35.97)	256 (54.82)	43 (9.21)	41 (27.15)	86 (56.95)	24 (15.89)
2. Postoperative behavioral changes include anxiety, nightmares, eating disorders, tantrums, and enuresis.	177 (37.9)	260 (55.67)	30 (6.42)	54 (35.76)	84 (55.63)	13 (8.61)
3. Risk factors for postoperative behavioral changes comprise age, gender, type of surgery, preoperative anxiety, and intraoperative cerebral oxygen saturation.	193 (41.33)	246 (52.68)	28 (6)	57 (37.75)	83 (54.97)	11 (7.28)
4. The adjunctive administration of dexmedetomidine reduces the incidence of postoperative behavioral changes.	212 (45.4)	215 (46.04)	40 (8.57)	46 (30.46)	73 (48.34)	32 (21.19)
5. Postoperative behavioral changes are associated with adverse outcomes and may impair children's emotional and cognitive development.	179 (38.33)	236 (50.54)	52 (11.13)	42 (27.81)	90 (59.6)	19 (12.58)
6. The gold standard for evaluating postoperative behavioral changes is the Post Hospital behavioral Questionnaire (PHBQ).	93 (19.91)	211 (45.18)	163 (34.9)	39 (25.83)	64 (42.38)	48 (31.79)
7. Postoperative behavioral changes are linked to children's pain tolerance, and effective analgesia plays a preventive role in mitigating them.	200 (42.83)	241 (51.61)	26 (5.57)	49 (32.45)	80 (52.98)	22 (14.57)
8. Emergence agitation is a pathological state characterised by psychomotor agitation, hyperactivity, and perceptual disturbances, predominantly affecting children aged 2 to 5 years.	140 (29.98)	272 (58.24)	55 (11.78)	40 (26.49)	89 (58.94)	22 (14.57)
9. Factors influencing postoperative behavioral changes include incomplete anaesthesia recovery, anaesthetic techniques, surgical type, and the child's temperament.	219 (46.9)	219 (46.9)	29 (6.21)	47 (31.13)	84 (55.63)	20 (13.25)
10. Emergence agitation can lead to complications such as accidental removal of catheters or dressings, resulting in subsequent wound bleeding.	276 (59.1)	178 (38.12)	13 (2.78)	67 (44.37)	73 (48.34)	11 (7.28)
11. Emergence agitation may be associated with pain, hypoxia, and an unfamiliar environment.	270 (57.82)	180 (38.54)	17 (3.64)	65 (43.05)	76 (50.33)	10 (6.62)
12. The adjunctive use of dexmedetomidine also reduce the incidence of emergence agitation.	200 (42.83)	232 (49.68)	35 (7.49)	29 (19.21)	90 (59.6)	32 (21.19)
13. Non-pharmacological interventions, such as parental accompaniment or psychological support.	240 (51.39)	211 (45.18)	16 (3.43)	58 (38.41)	80 (52.98)	13 (8.61)
14. Effective analgesia also plays a role in preventing emergence agitation.	214 (45.82)	225 (48.18)	28 (6)	42 (27.81)	91 (60.26)	18 (11.92)
15. The Pediatric Anaesthesia Emergence Delirium (PAED) scale is a validated tool for assessing emergence agitation.	127 (27.19)	245 (52.46)	95 (20.34)	39 (25.83)	80 (52.98)	32 (21.19)
16. Proactive follow-up and management of postoperative behavioral changes—both after returning to the ward and discharge—support children's postoperative recovery and rehabilitation.	166 (35.55)	263 (56.32)	38 (8.14)	37 (24.5)	97 (64.24)	17 (11.26)

Table 3 Attitude Section Responses of Physician and Nurse

	Physician N (%)					Nurse N (%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Preventing postoperative behavioral changes and emergence agitation is vital for the optimal postoperative recovery of children.	281 (60.17)	153 (32.76)	19 (4.07)	4 (0.86)	10 (2.14)	57 (37.75)	73 (48.34)	11 (7.28)	4 (2.65)	6 (3.97)
2. Effective prevention of behavioral changes and emergence agitation helps improve family satisfaction with the treatment.	296 (63.38)	141 (30.19)	15 (3.21)	6 (1.28)	9 (1.93)	66 (43.71)	65 (43.05)	14 (9.27)	4 (2.65)	2 (1.32)
3. Non-pharmacological interventions such as parental accompaniment and psychological interventions are crucial in the prevention and management of postoperative behavioral changes and emergence agitation.	266 (56.96)	160 (34.26)	27 (5.78)	8 (1.71)	6 (1.28)	64 (42.38)	64 (42.38)	12 (7.95)	4 (2.65)	7 (4.64)
4. Securing understanding from the parents of children has a positive significance for the prevention of postoperative behavioral changes and emergence agitation.	286 (61.24)	153 (32.76)	16 (3.43)	3 (0.64)	9 (1.93)	65 (43.05)	69 (45.7)	11 (7.28)	4 (2.65)	2 (1.32)
5. Before surgery, it is essential that potential adverse reactions be comprehensively communicated to patients and families.	280 (59.96)	146 (31.26)	25 (5.35)	6 (1.28)	10 (2.14)	77 (50.99)	55 (36.42)	12 (7.95)	3 (1.99)	4 (2.65)
6. Standards for postoperative analgesia in children vary among anesthesiologists, and the administration of pediatric analgesia is primarily based on individual experience.	118 (25.27)	150 (32.12)	112 (23.98)	67 (14.35)	20 (4.28)	44 (29.14)	43 (28.48)	34 (22.52)	19 (12.58)	11 (7.28)
7. Postoperative behavioral can manifest occur after discharge and necessitate ongoing monitoring.	187 (40.04)	213 (45.61)	49 (10.49)	11 (2.36)	7 (1.5)	56 (37.09)	69 (45.7)	16 (10.6)	4 (2.65)	6 (3.97)
8. Prior to discharge, it is imperative that parents of children be well-informed about potential postoperative behavioral changes.	242 (51.82)	188 (40.26)	21 (4.5)	11 (2.36)	5 (1.07)	63 (41.72)	68 (45.03)	12 (7.95)	4 (2.65)	4 (2.65)

Table 4 Practice Section Responses of Physician and Nurse

	Physician N (%)					Nurse N (%)				
	Always	Often	Sometimes	Occasionally	Never	Always	Often	Sometimes	Occasionally	Never
1. Your frequency of actively learning about perioperative care in pediatric anaesthesia.	47 (10.06)	112 (23.98)	121 (25.91)	143 (30.62)	44 (9.42)	21 (13.91)	26 (17.22)	27 (17.88)	49 (32.45)	28 (18.54)
2. Your frequency of educating parents about emergence agitation and postoperative behavioral changes prior to surgery.	58 (12.42)	116 (24.84)	114 (24.41)	122 (26.12)	57 (12.21)	16 (10.6)	33 (21.85)	29 (19.21)	45 (29.8)	28 (18.54)
3. Your frequency of involving parents in preventing postoperative behavioral changes and emergence agitation in children.	53 (11.35)	97 (20.77)	108 (23.13)	136 (29.12)	73 (15.63)	15 (9.93)	28 (18.54)	30 (19.87)	42 (27.81)	36 (23.84)
4. Your frequency of providing psychological interventions to patients (and parents) during the perioperative period.	53 (11.35)	118 (25.27)	102 (21.84)	134 (28.69)	60 (12.85)	17 (11.26)	33 (21.85)	26 (17.22)	42 (27.81)	33 (21.85)
5. Your frequency of using other non-pharmacological methods (such as distraction techniques, white noise therapy, etc.) to prevent postoperative behavioral changes and emergence agitation.	47 (10.06)	117 (25.05)	101 (21.63)	128 (27.41)	74 (15.85)	17 (11.26)	38 (25.17)	31 (20.53)	33 (21.85)	32 (21.19)
6. Your frequency of using analgesic treatments (such as patient-controlled analgesia) in children.	45 (9.64)	101 (21.63)	88 (18.84)	147 (31.48)	86 (18.42)	12 (7.95)	29 (19.21)	24 (15.89)	46 (30.46)	40 (26.49)
7. You routinely assess whether children develop postoperative behavioral changes and emergence agitation.	47 (10.06)	114 (24.41)	100 (21.41)	127 (27.19)	79 (16.92)	19 (12.58)	36 (23.84)	33 (21.85)	35 (23.18)	28 (18.54)
8. When children are discharged, you inform parents about the assessment methods for behavioral changes and recommend a schedule for follow-up.	46 (9.85)	93 (19.91)	81 (17.34)	140 (29.98)	107 (22.91)	24 (15.89)	33 (21.85)	21 (13.91)	39 (25.83)	34 (22.52)

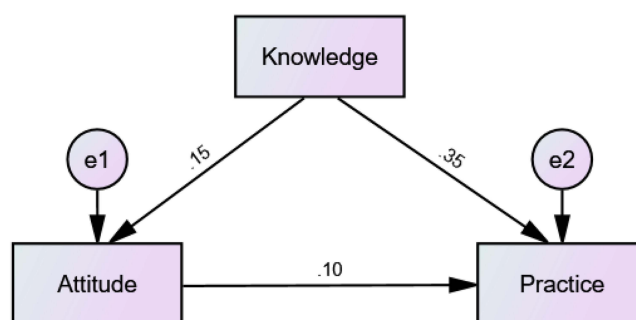


Figure 1 Path Analysis among overall population.

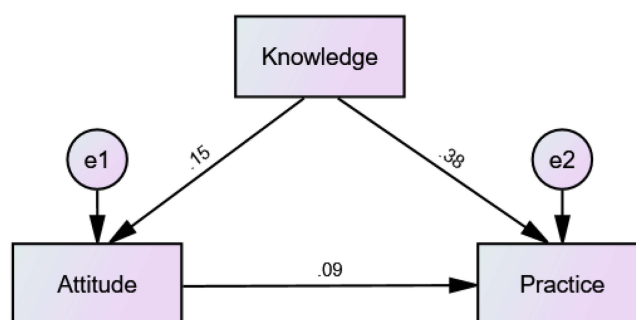


Figure 2 Path analysis among physicians.

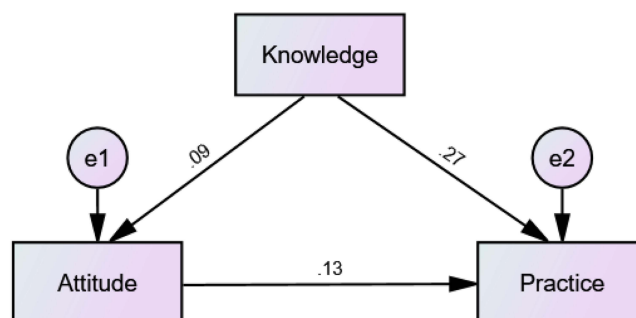


Figure 3 Path analysis among nurses.

Correlation analysis revealed statistically significant positive associations between: knowledge and attitude ($r = 0.29$, $P < 0.001$), knowledge and practice ($r = 0.28$, $P < 0.001$), attitude and practice ($r = 0.17$, $P < 0.001$) (Table S1).

Subgroup Analysis by Professional Role

Comparative analysis between physicians and nurses revealed significant interprofessional differences across knowledge, attitude, and practice domains. Regarding knowledge, physicians exhibited consistently higher familiarity with core concepts than nurses. The most pronounced disparity concerned pharmacological interventions, where 42.83% of physicians reported being “very familiar” with dexmedetomidine’s role in mitigating emergence agitation (K12), compared to only 19.21% of nurses. Similarly, 45.4% of physicians, compared with 30.46% of nurses, reported being “very familiar” with its effects on POBC (K4). Notable differences were also observed in items specifically addressing emergence agitation. While 29.98% of physicians claimed to be “very familiar” with the pathophysiology of emergence agitation (K8), only 26.49% of nurses reported the same level of familiarity. The disparity was more pronounced

Table 5 Interaction Among KAP

Model Paths	Standardized Total Effects		Standardized Direct Effects		Standardized Indirect Effects	
	β (95% CI)	P	β (95% CI)	P	β (95% CI)	P
Overall population						
K→A	0.15 (0.07–0.23)	0.010	0.154 (0.07–0.23)	0.010		
K→P	0.37 (0.28–0.44)	0.019	0.35 (0.27–0.43)	0.018		
A→P	0.10 (0.03–0.19)	0.017	0.10 (0.03–0.19)	0.017		
K→P					0.02 (0.01–0.03)	0.008
Physician						
K→A	0.15 (0.08–0.23)	0.008	0.15 (0.08–0.23)	0.008		
K→P	0.40 (0.30–0.45)	0.046	0.38 (0.29–0.44)	0.046		
A→P	0.09 (0.00–0.17)	0.047	0.09 (0.00–0.17)	0.047		
K→P					0.01 (0.00–0.03)	0.031
Nurse						
K→A	0.01 (–0.12–0.27)	0.333	0.01 (–0.12–0.27)	0.333		
K→P	0.28 (0.08–0.42)	0.009	0.27 (0.08–0.41)	0.012		
A→P	0.13 (–0.02–0.25)	0.079	0.126 (–0.02–0.25)	0.079		
K→P					0.01 (–0.01–0.05)	0.168

regarding knowledge of assessment tools, with 27.19% of physicians compared to 25.83% of nurses reporting themselves as “very familiar” with the Pediatric Anaesthesia Emergence Delirium (PAED) scale (K15). These differences likely reflect the systematic inclusion of emergence agitation management in physician residency training programmes, which is not equally emphasised in nursing education curricula (Table 2).

Regarding attitude-related items, physicians demonstrated stronger agreement with the importance of prevention and management strategies. Notably, 60.17% of physicians strongly agreed that preventing POBC is crucial for optimal recovery, compared with 37.75% of nurses (A1). A similar disparity was observed for attitudes toward non-pharmacological interventions (A3), with 56.96% of physicians strongly agreeing with their importance versus 42.38% of nurses (Table 3).

Practice patterns also revealed more pronounced differences in educational and preventive activities. Nurses consistently reported higher frequency of “never” responses across multiple practice items. This was particularly evident for involving parents in preventing POBC (23.84% of nurses compared with 15.63% of physicians, P3) and providing psychological interventions (21.85% of nurses versus 12.85% of physicians, P4) (Table 4).

Discussion

Healthcare workers exhibited moderate knowledge and positive attitudes but inactive practices concerning POBC in pediatric anaesthesia. These findings underscore the necessity for targeted educational interventions to bridge the gap between knowledge and practice, thereby improving clinical outcomes in pediatric anaesthesia.

The findings from our study on healthcare workers’ KAP reveal several key insights. Correlation analyses demonstrate significant positive relationships between knowledge and attitude, knowledge and practice, and attitude and practice, suggesting that enhancing knowledge and attitudes may improve practice behaviours. Furthermore, SEM indicates that knowledge showed both direct and indirect associations with practice (mediated by attitudes), and the strength of these associations varied across profession groups. For physicians, both the direct and mediated pathways from knowledge to practice were statistically significant. In contrast, among nurses, only the direct effect of knowledge on practice was significant, with no evidence of mediation through attitudes. This discrepancy may reflect physicians’ greater decision-making autonomy and clinical authority, which likely facilitates more direct implementation of knowledge and attitudes into practice.²⁰ Our detailed subgroup analysis further distinct knowledge disparities between professions, particularly concerning pharmacological interventions such as dexmedetomidine, with substantially fewer nurses demonstrating familiarity with these agents.

In the knowledge section, a concerning proportion of professionals demonstrate limited familiarity with critical aspects, such as standard tools for assessing POBC. This is evidenced by over one-third of respondents being unaware of the Post Hospital Behavioral Questionnaire (PHBQ). Additionally, understanding of dexmedetomidine's role and its benefits in mitigating postoperative behavioral alterations remains low, underscoring a knowledge gap in contemporary pharmacological interventions. Regarding attitudes, while most responses are positive, a small yet significant proportion of participants exhibit reluctance or neutrality towards the prevention and management of POBC. In practice, a substantial proportion of respondents report only occasional or intermittent engagement in key activities, such as educating parents, involving them in preventive measures, and employing non-pharmacological methods. This is particularly concerning, as consistent implementation of these practices is essential for effective management of POBC. Healthcare workers frequently encounter significant time constraints and heavy patient workloads, which may hinder their ability to: conduct thorough educational discussions with parents; fully involve them in preventive measures; or consistently implement non-pharmacological approaches. Previous research demonstrates that clinical workload pressures often restrict the time available for such preventive healthcare measures.^{21,22} Furthermore, the physical and mental fatigue resulting from demanding clinical responsibilities can reduce both the motivation and capacity of professionals to consistently adopt and maintain best evidence-based practices.^{23,24}

To improve KAP regarding POBC in pediatric anaesthesia, a targeted and pragmatic dual-level strategy (individual and institutional) is required. At the healthcare professional level, we propose structured educational interventions comprising: Comprehensive modules covering: pathophysiology of POBC, risk factors identification, and evidence-based prevention strategies; Skills-based training featuring: standardised assessment tools (eg, [PHBQ] and [PAED] scales), video demonstrations and interactive case-based scenarios; and Specialised workshops addressing: evidence-based use of dexmedetomidine, optimal dosing regimens, administration timing, and potential complications and mitigation strategies. Furthermore, considering the identified disparity in knowledge regarding emergence agitation between physicians and nurses, we recommend incorporating profession-specific components within training modules. Nursing staff would benefit from focused instruction on pharmacological mechanisms and clinical benefits of agents such as dexmedetomidine. Conversely, physicians may require more specialised training in: implementation of standardised behavioral assessment tools and structured post-discharge follow-up protocols. Interprofessional training programmes featuring simulation-based exercises for early identification and coordinated management of emergence agitation should be implemented. This approach would foster and enhance clinical collaboration and potentially improve patient outcomes. In resource-limited settings, more scalable approaches such as short online modules, integration of key content into existing continuing education, and provision of standardized parent education materials could serve as practical alternatives.

At the institutional level, hospitals should implement standardised pediatric perioperative care protocols to ensure consistent practice across all departments. These protocols must incorporate: (1) mandatory behavioral assessment – Systematic postoperative evaluation using validated tools; (2) evidence-based intervention guidelines – Clear algorithms for both pharmacological and non-pharmacological management, tailored to assessment scores; and (3) structured family engagement – Standardised parent education materials and discharge instructions. We further recommend that hospitals institutions: establish quality improvement programmes featuring regular audits and feedback mechanisms to monitor protocol adherence,^{10,25} form interdisciplinary pediatric anaesthesia teams to enhance care coordination and standardisation.

Furthermore, we propose specific communication-focused interventions to address the finding that 22.82% of respondents did not inform parents about assessment methods and follow-up procedures for POBC. Healthcare institutions should adopt structured communication protocols between parents and healthcare professionals, including: (1) standardised preoperative education outlining covering expected POBC and management strategies; (2) role-playing workshops for healthcare workers to practice effective communication techniques; and (3) digital resources, such as smartphone applications or online platforms, to facilitate post-discharge monitoring and communication. Given that 17.64% of respondents did not encourage parental involvement in preventing POBC, we recommend implementing family-centred care initiatives. These should include: designated spaces for parental presence during induction and recovery; structured guidelines for parent participation in distraction techniques; and parent mentor programs, where experienced parents can support families of first-time pediatric surgery patients. These findings highlight several areas for improvement. Targeted educational interventions should be developed to

address specific knowledge and practice gaps across professional roles. For instance: nursing staff may require enhanced training in pharmacological management; physicians could benefit from structured behavioral assessment and follow-up tools; interprofessional collaboration and simulation-based training could help standardise clinical practice. At the institutional level, implementation of the following measures would improve early identification and consistent management of POBC: standardised protocols; family-centred care models; and enhanced parent communication strategies.

This study has several limitations. First, the use of self-administered questionnaires may introduce response bias, as participants might overestimate their knowledge and practices. Second, the cross-sectional design precludes assessment of temporal changes or causal relationships. Third, our sample demographics indicated limited recent experience among respondents: 16.34% reported minimal participation in pediatric anaesthesia procedures during the past year, while 43.85% reported minimal experience with POBC. This restricted clinical exposure to the study's focus may affect the generalisability of our findings and could limit the practical insights from participants lacking recent relevant experience. Moreover, the use of convenience sampling may introduce selection bias and limit the representativeness of the sample relative to the broader population of healthcare workers. Fourth, the study's conduct in China may constrain the generalisability of findings to other populations or healthcare settings. Additionally, as this was a cross-sectional study, causal relationships cannot be established; the observed pathways only reflect associations.

Conclusion

In conclusion, this study revealed that healthcare workers in our sample exhibited: moderate knowledge, positive attitudes, and suboptimal practices regarding POBC in pediatric anaesthesia. While acknowledging the limitations inherent in our convenience sampling approach, these findings suggest that role-specific targeted training programmes could enhance healthcare professionals' knowledge and clinical practices in this domain. Future research employing more diverse samples across different healthcare systems would help validate these findings and establish their generalisability to broader clinical settings.

Data Sharing Statement

All datasets generated or analysed during this study are included in full within this published article.

Ethics Approval and Consent to Participate

All procedures were conducted in compliance with the ethical principles established by the 1964 Declaration of Helsinki and its subsequent amendments. Ethical approval for this study was granted by the Medical Ethics Committee of Yongchun County Hospital (Approval number: EC of YCCH2024 [05]). Written informed consent was obtained from all participants prior to their involvement in the study. The research was performed in strict adherence to all applicable guidelines and regulations.

Author Contributions

All authors made a significant contribution to the work reported, whether 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; 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

Jianxing Chen, Zanhui Gong, and Shuhui Hu are co-first authors for this study. Zanhui Gong's recent affiliation is at the Department of Anesthesiology, Xinglin Hospital of Xiamen, Xiamen, People's Republic of China. The authors report no conflicts of interest in this work.

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