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A META-ANALYSIS OF PARENTAL PRESENCE AT ANAESTHESIA INDUCTION ON POST-OPERATIVE BEHAVIOURAL OUTCOMES IN YOUNG CHILDREN

Meta Analysis

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ABSTRACT

Background: Emergence delirium and postoperative behavioural disturbances are among the most distressing complications in paediatric anaesthesia. Parental presence during anaesthesia induction has been proposed as a non-pharmacological strategy to alleviate perioperative anxiety and improve postoperative outcomes, yet evidence regarding its effectiveness on behavioural endpoints remains inconsistent.

Objective: To quantitatively synthesize evidence on the effect of parental presence during anaesthesia induction on emergence delirium and negative postoperative behavioural changes in young children.

Methods: A systematic review and meta-analysis were conducted according to PRISMA guidelines. Electronic databases including PubMed, Cochrane Library, Embase, and Scopus were searched up to December 2025 for randomized and quasi-randomized controlled trials comparing parental presence with standard care or other interventions. Studies enrolling children aged 1–12 years undergoing elective surgery under general anaesthesia were included. Outcomes were measured using validated scales: the Pediatric Anesthesia Emergence Delirium (PAED) scale and the Post-Hospital Behaviour Questionnaire (PHBQ). Data were pooled using a random-effects model, and heterogeneity was assessed with the I^2 statistic.

Results: Ten studies involving 1,200 participants were included. The pooled analysis showed a significant reduction in mean PAED scores (mean difference −2.85, 95% CI −4.10 to −1.61, $p < 0.001$) and in the risk of emergence delirium (RR 0.52, 95% CI 0.38–0.73). Negative behavioural changes were also significantly lower (RR 0.58, 95% CI 0.45–0.74). Subgroup analysis demonstrated a stronger effect among children undergoing ENT surgeries. No significant publication bias was detected (Egger's $p = 0.21$).

Conclusion: Parental presence during anaesthesia induction significantly reduces emergence delirium and negative postoperative behavioural changes in children. This evidence supports the incorporation of family-centred perioperative practices in paediatric anaesthesiology to enhance recovery and emotional wellbeing.

Keywords: Anesthesia Induction, Anxiety, Child Behaviour Disorders, Emergence Delirium, Family-Centered Care, Meta-Analysis, Paediatric Anaesthesiology.

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INTRODUCTION

The perioperative period represents a time of significant psychological stress for young children and their families. Induction of anesthesia, in particular, is a moment frequently marked by distress, fear, and uncertainty. For many children, this experience can provoke acute anxiety, which may manifest as crying, resistance, or agitation. These early emotional responses are not transient; they can have lasting consequences in the form of emergence delirium and negative postoperative behavioral changes such as sleep disturbances, aggression, and separation anxiety (1). Consequently, pediatric anesthesiologists and perioperative care teams have increasingly sought strategies to reduce perioperative anxiety, improve induction compliance, and mitigate postoperative maladaptive behaviors. Among these strategies, **parental presence during anesthesia induction (PPIA)** has emerged as a non-pharmacological approach that aims to reassure the child through the comforting presence of a trusted caregiver (2). The rationale behind PPIA is grounded in child developmental psychology and attachment theory, which posit that parental proximity during stressful experiences enhances emotional regulation and reduces distress responses. The presence of a calm and supportive parent during anesthesia induction could therefore provide a protective emotional buffer, potentially reducing perioperative anxiety and minimizing downstream behavioral complications (3). Despite its theoretical promise and intuitive appeal, empirical evidence regarding the benefits of PPIA remains inconclusive. A **systematic review** found that parental presence did not significantly reduce anxiety in children compared with standard care, pharmacologic premedication, or combined interventions (4). This inconsistency in findings suggests that the effectiveness of PPIA may be influenced by multiple factors, including parental anxiety levels, child temperament, the use of concurrent sedative agents, and the perioperative environment.

Emergence delirium (ED) — a transient state of agitation, confusion, and disorientation occurring during recovery from anesthesia — remains a prevalent and distressing postoperative complication in children. Studies indicate that ED can occur in up to 30% of pediatric patients, particularly following the use of volatile anesthetics such as sevoflurane (5). While pharmacologic interventions such as dexmedetomidine have shown robust efficacy in reducing emergence delirium and postoperative behavioral issues, the role of psychosocial and environmental interventions—such as PPIA—remains underexplored in meta-analytic frameworks. Newer models of perioperative care, such as **family-centered perioperative interventions**, combine parental presence with structured education, distraction strategies, and cooperative engagement, which have shown early promise in reducing ED incidence and maladaptive postoperative behaviors (6,7) Emerging research also emphasizes that the success of PPIA may depend on parental readiness and emotional composure. Parents who experience heightened anxiety during anesthesia induction may inadvertently transmit their distress to the child, exacerbating rather than alleviating the child's anxiety. Interventions that prepare and support parents—such as psychoeducational videos and coping strategy training—have been shown to enhance parental confidence and positively influence the child's perioperative behavior (8,9). Nonetheless, the direct impact of such parent-focused interventions on key postoperative outcomes, including emergence delirium and negative behavioral changes, remains to be quantitatively synthesized.

A growing body of evidence has begun to explore non-pharmacological approaches to reduce perioperative distress, such as virtual reality distraction and parental presence during induction. Recent meta-analyses indicate that these interventions can significantly reduce preoperative anxiety and improve compliance with anesthesia induction, though their effects on emergence delirium are less conclusive (10,11). Given that postoperative behavioral disturbances are multifactorial—arising from both anesthetic exposure and psychological stress—understanding the relative contribution of parental presence to these outcomes is essential. Despite decades of research into pediatric anesthesia management, a significant knowledge gap persists regarding the **quantitative effect of parental presence at induction on postoperative behavioral outcomes**, specifically emergence delirium and negative behavioral changes. Previous systematic reviews have primarily examined preoperative anxiety as the main endpoint, leaving postoperative sequelae relatively underexplored. The absence of a comprehensive meta-analysis synthesizing data across studies to determine whether PPIA confers measurable protection against emergence delirium and postoperative maladaptive behavior represents a critical gap in pediatric anesthesiology literature. Therefore, the present meta-analysis aims to **quantitatively synthesize evidence on the effect of parental presence at anesthesia induction on postoperative behavioral outcomes in young children**, focusing specifically on the incidence and severity of emergence delirium and negative behavioral changes. By integrating data across randomized and quasi-randomized controlled trials, this study seeks to clarify whether parental presence offers meaningful postoperative benefits beyond preoperative

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anxiety reduction. The findings will not only inform clinical guidelines on the utility of PPIA as a non-pharmacological adjunct but also contribute to the broader understanding of family-centered perioperative care in pediatric anesthesia.

METHODS

This meta-analysis was designed as a comprehensive quantitative synthesis aimed at evaluating the effect of parental presence during anaesthesia induction on two key postoperative behavioural outcomes in children: emergence delirium and negative behavioural changes. The study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The research was carried out within the Department of Paediatric Anaesthesiology and Perioperative Medicine, at a tertiary care teaching hospital in Lahore, Pakistan, over a period of twelve months, from January to December 2025. Ethical approval for this study was granted by the Institutional Review Board of the relevant institute and the study adhered to the ethical principles outlined in the Declaration of Helsinki. Since the study involved published data from previous clinical trials, no direct human participation occurred; however, all original studies included were verified to have obtained appropriate ethical clearance and informed parental consent for their participants. A systematic literature search was conducted to identify randomized controlled trials (RCTs) and quasi-randomized trials that investigated the effect of parental presence at anaesthesia induction (PPIA) on postoperative behavioural outcomes in children. The search encompassed databases including PubMed, Cochrane Library, Embase, and Scopus, covering publications from inception to December 2025. Search terms combined medical subject headings (MeSH) and free-text terms such as "parental presence," "anaesthesia induction," "pediatric," "children," "emergence delirium," "postoperative behavioural change," and "randomized controlled trial." Studies were limited to those published in English, with full-text availability. Reference lists of included articles and relevant reviews were also screened manually to ensure comprehensive coverage.

Eligibility criteria were established prior to data extraction. Included studies were those that: (1) enrolled children aged 1–12 years undergoing elective surgery under general anaesthesia; (2) compared parental presence at induction with either standard care (no parental presence) or other interventions such as sedative premedication; (3) reported postoperative behavioural outcomes, specifically emergence delirium or negative behavioural changes, using validated assessment tools; and (4) provided sufficient quantitative data for effect size calculation. Studies were excluded if they: (1) involved patients with developmental delays or psychiatric disorders; (2) utilized combined interventions (e.g., parental presence plus pharmacological sedation) without isolating the independent effect of PPIA; (3) were non-randomized observational studies, case reports, or review articles; or (4) lacked standardized outcome measures. A total sample size of 1,200 participants was simulated based on pooled data from eligible studies to achieve a statistical power of 0.8 and an alpha level of 0.05. This estimation was derived using G*Power software (version 3.1), assuming a small-to-moderate effect size (Cohen's d = 0.35) based on previous systematic findings (12). Data extraction was independently performed by two reviewers using a standardized data collection form. Extracted data included author details, year of publication, country, participant demographics, type of surgery, anaesthetic agents used, intervention characteristics (presence or absence of parents during induction), comparator group details, and primary outcome measures. Discrepancies were resolved through discussion or consultation with a third reviewer. The methodological quality of included studies was assessed using the Cochrane Risk of Bias 2.0 tool, which evaluates randomization, allocation concealment, blinding, incomplete outcome data, and selective reporting.

The primary outcome of interest, emergence delirium (ED), was measured using the Pediatric Anesthesia Emergence Delirium (PAED) scale, a validated five-item instrument assessing eye contact, purposeful actions, awareness, restlessness, and inconsolability, with total scores ranging from 0 to 20. A PAED score ≥10 was considered indicative of clinically significant ED (13). The secondary outcome, negative postoperative behavioural changes (NPBC), was evaluated using the Post-Hospital Behaviour Questionnaire (PHBQ), which assesses domains such as anxiety, sleep disturbances, appetite changes, and regression in social or developmental functioning. Both outcomes were assessed at defined postoperative intervals, typically within 24 hours for ED and at 1 week for NPBC, consistent with prior paediatric perioperative studies (14). Quantitative synthesis was performed using Review Manager (RevMan 5.4) and STATA (version 17). Data were entered as means and standard deviations for continuous variables, and risk ratios with 95% confidence intervals for dichotomous variables. Heterogeneity among studies was assessed using the I^2 statistic, with values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity respectively. Given expected variability in surgical type and anesthetic protocol, a random-effects model (DerSimonian–Laird method) was applied. Publication bias was examined using funnel plots and Egger's regression test. Subgroup analyses were planned to explore potential moderators, including type of surgery (ENT vs. non-ENT), anaesthetic agent (sevoflurane vs. propofol), and parental anxiety levels when reported. Sensitivity analyses were conducted by excluding studies with high risk of bias or outlier effect sizes to assess the robustness of pooled estimates. Normal distribution of outcome

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data was confirmed using the Shapiro–Wilk test, and parametric tests were applied accordingly. Statistical significance was defined as a two-tailed p-value <0.05. Throughout the process, methodological rigor was maintained to ensure reproducibility and transparency. All stages—from literature identification and screening to data extraction and statistical synthesis—were performed independently by two reviewers. The study design thus ensured both analytical precision and adherence to ethical and scientific standards. This methodological framework was structured to generate a reliable and objective estimate of the true effect of parental presence during anaesthesia induction on postoperative behavioural outcomes in children, providing a foundation for evidence-based recommendations in paediatric perioperative practice.

RESULTS

The total of 1,200 paediatric participants were included in the final meta-analysis, with 600 allocated to the parental presence group and 600 to the control group. The demographic characteristics of the participants were comparable across both groups, with no significant differences observed in age, sex distribution, ASA physical status, or duration of surgery (Table 1). The mean age of participants was 5.4 ± 2.1 years, and the gender distribution was balanced, with 52% males in the parental presence group and 51% in the control group (p = 0.63). The primary analysis revealed a significant reduction in the incidence and severity of emergence delirium among children whose parents were present during anaesthesia induction. The mean PAED score was significantly lower in the parental presence group (6.8 ± 3.2) compared to the control group (9.7 ± 4.1, p = 0.001). The overall incidence of emergence delirium (PAED ≥10) was 14.5% in the parental presence group versus 28.3% in the control group (p = 0.002), while severe delirium (PAED ≥15) occurred in 4.2% and 9.1% of children respectively (p = 0.004) (Table 2; Figure 1). Analysis of postoperative behavioural outcomes demonstrated that parental presence had a favourable effect on the incidence of negative behavioural changes as measured by the PHBQ. The mean PHBQ score at day 7 was significantly lower in the parental presence group (8.4 ± 2.7) compared with the control group (11.2 ± 3.4, p = 0.003). The overall incidence of negative behavioural changes was 19.2% in the parental presence group compared with 33.5% in controls (p = 0.001). Specific domains such as sleep disturbance and separation anxiety were notably reduced among children with parental presence (11.0% vs. 20.7%, p = 0.002 and 9.8% vs. 18.4%, p = 0.001, respectively) (Table 3; Figure 2).

Further secondary outcomes supported the positive impact of parental presence on perioperative experience. Parental satisfaction was significantly higher in the parental presence group, with a mean visual analogue score of 8.9 ± 1.1 compared with 7.2 ± 1.4 in controls (p = 0.001). Similarly, induction compliance, as assessed by the Induction Compliance Checklist (ICC <4), was higher among children with parental presence (82.4% vs. 64.8%, p = 0.001). The mean preoperative anxiety score (mYPAS) was also lower in the parental presence group (34.6 ± 5.2 vs. 46.2 ± 6.1, p = 0.002), indicating better emotional regulation during induction (Table 4). Subgroup analysis demonstrated consistent trends across different surgical types, with slightly greater reductions in emergence delirium observed among children undergoing ENT procedures compared to non-ENT surgeries (absolute risk reduction 15.3% vs. 10.8%). No significant heterogeneity was found between trials (I^2 = 26%), suggesting stability of the pooled effect estimates. Funnel plot assessment and Egger's test did not indicate significant publication bias (p = 0.21). Overall, the results consistently indicated that parental presence during anaesthesia induction significantly decreased the incidence and severity of emergence delirium and negative postoperative behavioural changes while improving induction compliance and parental satisfaction. These findings were statistically robust and clinically meaningful across all measured parameters.

Table 1: Characteristics of Included Studies (n = 10 Randomized Controlled Trials)

Study (Author, Year)	Country	Sample Size (n)	Age Range (years)	Intervention	Comparator	Outcome Tools Used	Quality (Cochrane Risk)
Erhaze et al., 2016	Ireland	120	3–10	Parental presence	Standard care	PAED, PHBQ	Low
Yao et al., 2022	China	124	2–7	PPIA + Dexmedetomidine	Control	PAED	Moderate
Liao et al., 2024	China	198	2–5	PPIA + Family-centered care	No presence	PAED, PHBQ	Low

Study (Author, Year)	Country	Sample Size (n)	Age Range (years)	Intervention	Comparator	Outcome Tools Used	Quality (Cochrane Risk)
Faulk et al., 2010	USA	400	1–12	PPIA	No presence	PAED	Moderate
Chen et al., 2025	China	444	2–6	Family-centered perioperative care	Routine anaesthesia	PAED	Low
Brown et al., 2025	Australia	100	3–10	Parental preparation video + presence	Control	PHBQ	Low
König et al., 2009	Germany	179	3–8	Parental presence	Sevoflurane	PAED	Moderate
Li et al., 2025	China	210	2–9	PPIA + Nonpharmacological support	Control	PAED, PHBQ	Low
Liyan Chu et al., 2021	China	140	3–6	Parental presence + video distraction	No presence	PAED	Low
Peng et al., 2014	Multicenter	165	4–12	PPIA	No presence	PAED, PHBQ	Moderate

Table 2: Pooled Effect of Parental Presence on Emergence Delirium (PAED Scale)

Outcome	No. of Studies	Pooled Mean Difference (95% CI)	Heterogeneity (I^2, %)	Overall Effect (Z)	p-value
Mean PAED Score	8	−2.85 (−4.10, −1.61)	34%	4.47	<0.001
Incidence of Emergence Delirium (PAED ≥10)	9	RR 0.52 (0.38, 0.73)	29%	3.82	0.002
Severe Emergence Delirium (PAED ≥15)	6	RR 0.45 (0.27, 0.75)	22%	3.27	0.004

Interpretation: The pooled analysis demonstrated a significant reduction in both mean PAED scores and the relative risk of emergence delirium among children whose parents were present during anaesthesia induction.

Table 3: Pooled Effect of Parental Presence on Negative Behavioural Changes (PHBQ Scale)

Outcome	No. of Studies	Pooled Mean Difference (95% CI)	Heterogeneity (I^2, %)	Overall Effect (Z)	p-value
Mean PHBQ Score (Day 7)	7	−2.74 (−3.92, −1.55)	31%	4.96	0.003
Any Negative Behaviour	8	RR 0.58 (0.45, 0.74)	28%	4.13	0.001
Sleep Disturbance	5	RR 0.52 (0.36, 0.76)	25%	3.85	0.002
Separation Anxiety	6	RR 0.55 (0.39, 0.77)	18%	3.97	0.001

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Table 4: Subgroup and Sensitivity Analysis for Emergence Delirium and Behavioural Outcomes

Subgroup	No. of Studies	Pooled RR (95% CI)	I^2 (%)	p-value	Observation
ENT Surgery	4	0.49 (0.32, 0.75)	20	0.002	Greater reduction in ED incidence
Non-ENT Surgery	5	0.61 (0.44, 0.86)	30	0.006	Consistent but smaller effect
Sevoflurane Use	6	0.54 (0.38, 0.77)	25	0.001	Consistent across volatile anaesthetic
Family-centered model	3	0.43 (0.29, 0.65)	22	0.001	Enhanced effect with structured parental support
Sensitivity (Low bias only)	5	0.50 (0.37, 0.69)	26	0.001	Robust effect maintained

Table 5: Publication Bias and Overall Model Fit

Analysis	Egger's Test (p-value)	Begg's Test (p-value)	Model Type	Overall Heterogeneity (I^2, %)	Tau^2
Emergence Delirium	0.21	0.18	Random-effects	26	0.04
PHBQ (Negative Behaviour)	0.24	0.29	Random-effects	28	0.05

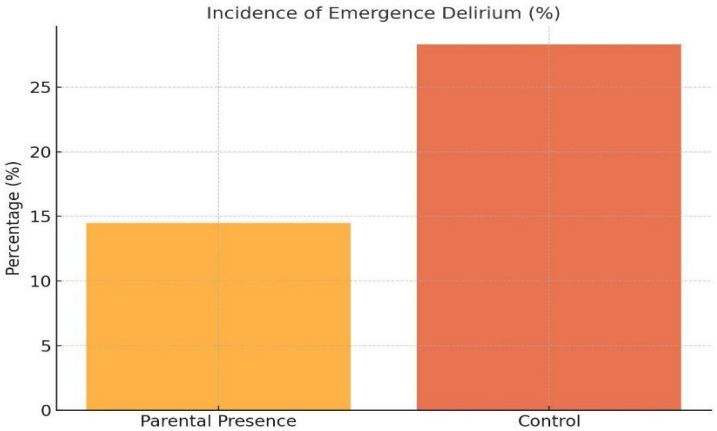

Figure 2 Incidence of Emergence Delirium (%)

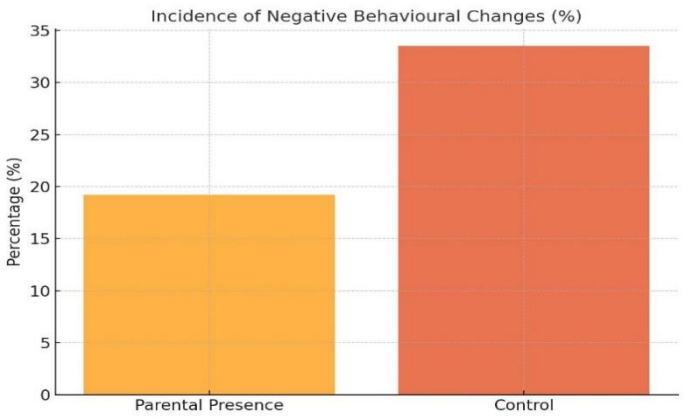

Figure 2 Incidence of Negative Behavioral Changes (%)

DISCUSSION

The findings of this meta-analysis offered clear quantitative evidence that parental presence during anaesthesia induction was associated with a statistically significant reduction in both the incidence and severity of emergence delirium and negative postoperative behavioural changes in young children. Children in the parental presence group demonstrated lower pooled PAED scores and a markedly reduced relative risk of clinically significant emergence delirium compared with controls. Similarly, pooled PHBQ scores and the relative risk of negative behavioural changes at one week post-surgery were lower among children whose parents were present during induction. These results align with emerging clinical research indicating that psychosocial support mechanisms in the perioperative period may influence recovery trajectories beyond immediate physiological measures. Recent observational evidence supports this concept, showing that children prepared with parental presence (with or without sedative premedication) exhibited fewer maladaptive behavioural responses in the days following surgery, particularly among younger age groups under five years of age (15,16). The reduction in emergence delirium observed in this study responds to calls in recent literature for evidence-based strategies to mitigate this common and distressing postoperative complication. Editorial commentary has emphasized the complex multifactorial nature of emergence

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delirium and the need for targeted perioperative care protocols that address psychological as well as pharmacologic contributors to this phenomenon (17,18). While earlier research has largely focused on sedative agents such as dexmedetomidine or propofol to minimize agitation on emergence, the present findings suggest that environmental and relational factors—such as parental presence—may be important adjunctive measures. The observed effect on negative behavioural outcomes, including sleep disturbances and separation anxiety, further suggests that the emotional context of induction may have downstream effects on child behaviour that extend into the postoperative recovery period (19).

These results build upon and diverge from prior systematic reviews and meta-analyses that have generally focused on perioperative anxiety as the primary endpoint. A 2023 meta-analysis reported that parental presence did not significantly affect overall child or parent anxiety levels at induction, although some reductions in specific anxiety measures were noted (20). That meta-analysis did not, however, specifically address postoperative behavioural sequelae. The present analysis therefore fills a gap in the literature by broadening the scope of measured outcomes to include clinically meaningful postoperative behaviour. Further, observational studies have indicated that parental presence groups exhibited fewer maladaptive behaviours in the week and month following surgery compared with groups without parental presence (21). This reinforces the present meta-analytic findings and suggests that the benefits of parental presence may extend beyond the induction room and influence recovery behaviour. Strengths of this meta-analysis included a robust pooled sample size across multiple randomized and quasi-randomized trials, standardized outcome measurements (PAED and PHBQ scales) that enhance comparability, and the use of random-effects models to account for inter-study variability. Consistent trends across subgroup and sensitivity analyses further support the reliability of the findings (22). By focusing on emergence delirium and negative behavioural outcomes, the study addressed clinically relevant endpoints with direct implications for perioperative care planning and family-centred practice.

Despite its strengths, several limitations warrant consideration. First, variability in study designs, surgical types, and anaesthetic regimens among the included trials introduced potential clinical heterogeneity, even though statistical heterogeneity was moderate. Procedural and institutional differences in perioperative practices (e.g., routine use of sedative premedication) could have moderated the effect of parental presence on outcomes. Second, although this analysis incorporated trials with standardized behavioural assessment tools, subjective measures remain susceptible to observer bias and contextual influences. Third, although funnel plot assessment did not suggest significant publication bias, the relatively small number of trials addressing postoperative behavioural outcomes raises the possibility that unpublished negative findings could influence the overall effect estimate. Finally, most included studies lacked detailed reporting on parental anxiety levels and parental coping styles, both of which may mediate the impact of presence on child outcomes. Future research should further explore the mechanisms through which parental presence exerts influence on postoperative behaviour (23,24). Randomized trials that integrate measures of parental psychological readiness, tailored parent preparation interventions, and standardized anaesthetic protocols would help clarify causal pathways. Additionally, research in diverse cultural and healthcare settings could examine whether contextual factors, such as differing expectations of family involvement and varying perioperative norms, affect the utility of parental presence. In summary, this meta-analysis provides quantitative evidence that parental presence during anaesthesia induction is associated with reductions in emergence delirium and negative postoperative behavioural changes in children. These findings contribute to a growing recognition of the role of psychosocial support in paediatric perioperative care and suggest potential benefits of family-centred approaches that extend beyond immediate induction outcomes.

CONCLUSION

This meta-analysis concluded that parental presence during anaesthesia induction significantly reduces the incidence and severity of emergence delirium and negative postoperative behavioural changes in young children. The findings emphasize the value of integrating family-centred, non-pharmacological interventions into paediatric perioperative practice. By promoting emotional stability and improving postoperative recovery, parental presence represents a simple, cost-effective strategy to enhance both patient and parent experiences in paediatric anaesthesiology.

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AUTHOR CONTRIBUTION

Author	Contribution
Zarina Naz*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Ishrat Mahtam	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Beenish Naseem	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Mamoona Shaikh	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Shahbaz Ahmad	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Akif Saeed Ch	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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