Effect of Distraction Interventions on Anxiety in Children Undergoing Surgery: A Meta-Analysis

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Abstract

Due to the unfamiliarity of the surroundings, children having surgery endure worry and tension. Untreated anxiety in children impairs postoperative healing and causes changes in postoperative behavior. The purpose of this review was to determine the efficacy of distraction therapies on anxiety in children undergoing surgery. The systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses standards. PubMed via MEDLINE, CINAHL, ProQuest, Web of Science, and the Cochrane Central Register of Controlled Trials were used to find relevant trials. Full-text papers published in English from January 1, 2000 to December 31, 2021 were included. Children undergoing surgery aged 1 to 18 years were included. A data extraction form was created to extract data from the selected studies. According to the Cochrane risk of bias assessment tool, studies were classified as "low risk," "high risk," or "unclear risk." Review Manager software was used to do a quantitative meta-analysis. Thirteen studies looked at the effect of distraction intervention on children. Nine of them were selected for meta-analysis. The distraction interventions included in this review were: handheld video game, play dough and play with blocks and puzzles, tablet-based interactive distraction, animated video, painting and storytelling, age-appropriate video, distraction with video glasses, watching a movie, and bringing favorite toy during hospital stay. Meta-analysis showed that distraction interventions are effective on preoperative anxiety in children (standardized mean difference = –17.07, 95% confidence interval: 27.11–7.02, $p = 0.0009$).

Keywords
- children
- distraction
- review
- surgery

Introduction

Anxiety is an unpleasant condition over upcoming activities that can be linked to the body's reaction in the form of sympathetic, parasympathetic, and endocrine stimulation.[1] According to literature, 50 to 75% of children undergoing surgery have serious fear and anxiety before the procedure.[2] It starts as soon as the surgery is scheduled and continues until the surgery is completed.[3] However, anxiety in children may be exacerbated by a lack of information about the surgery to be done as well as anesthetic exposure.[4] It has been observed that preoperative anxiety has been linked to higher postoperative pain and analgesic dosage,[5] a longer and more difficult postoperative recovery,[6] and increased postoperative anxiety.[7] Also, perioperative anxiety leads to maladaptive behaviors after discharge,[8] such as separation anxiety,[9] bedwetting,[10] sleep problems,[11] increases distress in the

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perioperative period,[12] and delays postoperative wound healing among the children.[13]

Sedatives and other medications are often used to reduce anxiety and pain before surgery, but they also have undesirable side effects and can delay patient recovery.[14] Nonpharmacological interventions such as training programs,[15,16] hypnosis,[17] cognitive-behavioral interventions,[18–20] Web-based mobile interventions,[21,22] and clown interventions,[23,24] have proven to have a positive impact on reducing anxiety in children. Some of these nonpharmacological interventions are used regularly, while others are used less often due to negative side effects, time limits, or higher health care costs.

From the available evidence of distraction intervention, it is identified that applying age-appropriate distraction can be challenging and can raise the workload of hospital staff.[25] Most notably, previously used distractors (for example, music, cartoons, or toys) failed to offer total diversion to children as they were not motivated to actively participate.[26,27] These inconsistencies demonstrate the need for current review which serves to determine the age-appropriate and cost-effective distraction interventions which can engage the child during the postoperative period.

Through the preliminary search, the authors identified that evidence on distraction interventions to alleviate perioperative anxiety is limited and as per the author's knowledge, there are no systematic reviews that have proven the effect of distraction interventions on perioperative anxiety among children. This review aimed to identify the evidence on distraction interventions to reduce perioperative anxiety among children. Thus, this review aims to evaluate the effect of distraction interventions on anxiety among children undergoing surgery compared with usual care.

Methods

We reported the systematic review according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[28]

Search Methods

The following databases were searched to identify the relevant trials: PubMed, MEDLINE, CINAHL, ProQuest, Web of Science, and Cochrane Central Register of Controlled Trials. The search terms used were: "child", "children", "toddler", "preschooler", "adolescent", "schooler", "pediatric", "pediatric*", "picture book", "cartoon play", "video game", "watching television", "music", "play", "blowing bubbles", "reading books", "distraction", "virtual reality", "audio book", "toys", "anxiety", "randomized controlled trials". The search was conducted using the combination of Boolean operators "AND" and "OR."

Inclusion and Exclusion Criteria

Inclusion Criteria

(1) Participants:
Children between the ages of 1 and 18 years undergoing surgery.

(2) Interventions:
The children in the intervention group must receive distraction interventions that were done before or after the surgery to ease anxiety in children. Interventions including distraction techniques are picture books, cartoons, play, video games, watching television, music, blowing bubbles, virtual reality, audiobooks, and toys.

(3) Comparison:
Control groups included those who received no distraction intervention and only usual care and standard care were given.

(4) Outcome:
The outcome of this review was anxiety (preoperative or postoperative or perioperative anxiety). Studies that reported either preoperative or postoperative or included both preoperative and postoperative anxiety were included. The outcome that was measured by standardized scales. The anxiety measurements can be self-report, parental proxy reports, or researcher observational measures.

(5) Study design:
The randomized controlled trials (RCTs) published in the English language between January 1, 2000 and December 31, 2021 were included.

Exclusion Criteria

(1) Quasi-experimental studies, pilot studies, dissertations, and conference proceedings were not included.
(2) Studies published in languages other than English were excluded.
(3) Studies that did not report the adequate data required for this review were excluded.

Data Extraction and Quality Assessment

Two authors (E.M. and M.S.P.) independently extracted data from the databases and checked them based on the eligibility criteria. The data extraction form included author, year, country, sample size, type of surgery, details of the intervention, instruments, assessment time, and the outcome (►**Table 1**).

The risk of bias in this review was independently assessed by two authors (E.M. and M.S.P.) using the Cochrane risk of a bias assessment tool and followed the criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions.[29] Each study was assessed for the six items: Allocation concealment, incomplete outcome data, blinding of participants and personnel, selective reporting, random sequence generation, and blinding of outcome assessment. Based on the risk of bias assessment tool each criterion was evaluated in a study as "low risk," "high risk," or "unclear risk."

Nine studies[30–38] reported random sequence generation appropriately. Allocation concealment was reported in eight studies.[31,33–39] Blinding of participants and personnel was reported in nine studies.[30–32,34–36,39–41] Blinding of outcome assessment was reported in nine studies.[30–32,34–36,39–41] Incomplete outcome data was reported in eight studies.[31,33,34,36,38–40,42] Selective reporting was done by 10 studies.[36–38,43–45] Other bias was identified in eight studies.[32–37,39,42] The details of each study were entered

Table 1 Characteristics of included randomized controlled trials

Serial no.	Authors/ year/country	Aim	Population	Design	Sample size	Type of surgery	Intervention	Instruments	Assessment time	Study outcome
1.	Golden et al[40]	To determine whether giving a small toy to a child would decrease anxiety associated with oral premedication	Children aged 3 to 6 years	Prospective study with randomization	$N = 100$ (I-50, C-50)	Elective ambulatory surgery	Intervention group: Received toy at a designated preoperative time Control group: Not given toy at preoperative period but given at postoperative period to make them happy	mYPAS	At baseline, 3 minutes after baseline, the third score during the administration of midazolam	The median anxiety scores at baseline were 33 in intervention and 28 in the control group. The second score after 3 minutes was 28 in the control and 23 in the toy group. Third score 42 in control and 23 in the intervention group ($p < 0.05$)
2.	Patel et al[41]	To examine the efficacy of an interactive distraction a handheld video game (VG) to reduce preoperative anxiety in children	Children aged 4–12 years	Prospective randomized trial	$N = 112$ VG (38) M (38) PP (36)	Elective surgery	PP group: parents were dressed in a scrub, hat, and mask in the holding area Midazolam group (M): received midazolam 0.5 mg/kg orally Video game (VG) group: Provided with video game selected by the child for 20 minutes	mYPAS	Before intervention (T1) During the period of monitor placement the introduction of anesthesia mask, and induction of anesthesia (T2)	There was a statistically significant increase in anxiety ($p < 0.01$) in groups M and PP at induction of anesthesia compared with baseline, but not in the VG group The change of anxiety in the VG group was less than that in the PP group ($p = 0.04$) The increase of anxiety in the M group was not statistically different from other groups. The mean and SD of mYPAS scores: VG (37.4 ± 2.3), M (45.2 ± 3.1), PP (34.3 ± 2.0)
3.	Lee et al[30]	To determine the beneficial effects of viewing an animated cartoon and playing with a favorite toy on preoperative anxiety among children	Children aged 3 to 7 years	Prospective randomized trial	$N = 130$	Elective surgery	Group 1: Control Group 2: Brought their favorite toy with them to the preoperative holding room. Group 3: Watched their selected movie using a notebook or tablet personal computers until anesthesia induction	mYPAS Visual Analogue anxiety scale (parent recorded)	Preanesthetic visit, preanesthetic holding room, and operating room (OR)	In the preanesthetic holding room, the group 2 mYPAS and parent-recorded anxiety VAS scores were significantly lower than those of groups 1 and 3. There were significant correlations between mYPAS and parent recorded VAS score in all the groups in the OR
4.	Kerimoglu et al[31]	To compare the efficacy of oral midazolam and behavioral distraction with video glasses in managing preoperative anxiety in children	Children aged 4–9 years	Prospective, randomized study	$N = 96$ Midazolam group (32) M + VG group (32) VG group (32)	Ambulatory surgery	Midazolam group: Received midazolam HCL syrup 0.3 mg/kg. M + VG group: were given both medication and video glasses VG group: were given only video glasses	mYPAS	Before intervention (T1) At time of transport to the operating room 20 minutes later (T2) during mask induction in the OR (T3)	There was a significant difference at T2 ($p = 0.04$), with the lowest median anxiety scores recorded in the VG group A significant increase in anxiety was observed from T1 to T3 in the M and M + VG groups ($p = 0.02$ and 0.03, respectively) but not in the VG group ($p = 0.38$)
5.	Seiden et al[39]	To compare the effects of the tablet-based interactive distraction to oral midazolam on perioperative anxiety	Children aged 1–11 years	A prospective randomized controlled trial	$N = 108$ TBID (MG (	Outpatient surgical procedures	Tablet-based interactive distraction: Received age-appropriate videogame during induction period from parent separation to concluding of induction Midazolam group: Received oral premedication 15 minutes before	mYPAS	Anxiety was assessed at two points during parent separation and anesthetic induction	The mean difference (95% CI) in the increase of anxiety at the parental separation between the TBID platform group and the midazolam group was −9 (−2.6 to −16.4) The mean difference (95% CI) in the increase of anxiety at induction between the

(*Continued*)

Table 1 (*Continued*)

Serial no.	Authors/ year/country	Aim	Population	Design	Sample size	Type of surgery	Intervention	Instruments	Assessment time	Study outcome
							departure to the operating room			TBID platform group and the midazolam group was −6 (1.1 to −18)
6.	Kim et al[32]	To determine whether the effect of video distraction on alleviating preoperative anxiety is independent of parental presence and whether a combination of both interventions is more effective than either single intervention in alleviating preoperative anxiety and postoperative behavioral disturbances among preschool children	Children aged 2 to 7 years	Prospective RCT	$N = 104$ Group V (34) Group P (33) Group VP (37)	Elective minor surgeries	Group V - Children received animated video Group P - Parent presence Group VP - Video distraction + parent presence	mYPAS	Preoperative holding area (T0) Entering the OR (T1) During mask induction (T2)	Children in group V had lower anxiety compared with other groups T1 ($p < 0.001$ vs. group P and $p = 0.015$ vs. group VP) and T2 ($p = 0.012$ vs. group P and $p = 0.008$ vs. group VP)
7.	Al-Yateem et al[33]	Explore the effect of storytelling, pictures and coloring activity on anxiety of the child compared with traditional premedication	Children aged 3 to 8 years	Prospective RCT	$N =$ 168 (I-84, C-84)	Elective day surgery under general anesthesia	Intervention group: "Adam goes to surgery story" and coloring the pictures during theater journey with parent presence Control group: Presence of parent and midazolam oral administration 30 minutes prior to surgery	mYPAS STAI-C	During the anesthetic procedure and STAI-C filled by parents during discharge	The mean mYPAS anxiety in the intervention and control group was almost the same (10.95 ± 1.17 vs. 10.94 ± 1.22). The anxiety level was not significantly lower in the intervention group than in the control group ($p = 0.914$). The mean STAI-C of the intervention and control group is similar (20.90 ± 2.37 vs. 20.73 ± 2.25)
8.	Bumin Aydin et al[34]	To assess the role of distraction in the form of through playing with play dough on reducing premedication anxiety in children	Children aged 3 to 7 years	Prospective randomized clinical trial	$N = 104$ (I-52, C-52)	Elective surgery under general anesthesia	Intervention group: Play dough was provided for the children for 6 minutes in the preoperative holding area Control group: No intervention, however children in the control group were rewarded with a play dough after surgery	mYPAS	The level of anxiety was assessed immediately after entering the preoperative holding area (T0), just after playing with play dough (T1), and after 5 minutes of T1 during the administration of 0.5 mg/kg oral midazolam (T2)	Comparison of the scores within both groups among the three designated points was significant ($p < 0.001$)
9.	Mifflin et al[35]	To determine effect of video distraction to reduce anxiety among pediatric patients	Children aged 2 to 10 years	RCT	$N = 91$ (I-44, C-47)	Ambulatory surgeries	Video distraction group: Age-appropriate video Control group: Usual distraction techniques (imagery, storytelling, game playing, and non-procedural talk)	mYPAS	During the induction	There was no significant difference in the video distraction and control group on children's anxiety in the holding area ($p = 0.99$) A significant difference was observed between the control and video distraction group at anesthetic induction ($p < 0.001$) with children in the distraction group displaying less anxiety

Table 1 (*Continued*)

Serial no.	Authors/ year/country	Aim	Population	Design	Sample size	Type of surgery	Intervention	Instruments	Assessment time	Study outcome
10.	Dwairej et al[36]	Evaluate the effectiveness of combined video game distraction and anesthesia mask exposure and shaping intervention as compared with conventional preoperative preparation on the preoperative anxiety	Children aged 5 to 11 years	RCT	$N = 128$ (I-64, C- 64)	Day case surgery	Intervention group: Received handheld video game and anesthesia mask exposure and shaping intervention. Control group: Usual care	mYPAS	Baseline, postintervention, and at transfer to the operating room and anesthesia induction	The mean baseline anxiety was not statistically significant between the intervention and control groups The postintervention anxiety mean and SD in the intervention and control group (37.97 ± 8.36; 47.19 ± 14.23) The transfer to operating room mean and SD in the intervention and control group (35.89 ± 9.44; 53.88 ± 10.52) The anesthesia induction mean and SD in the intervention and control group (42.67 ± 13.91; 63.00 ± 15.66)
11.	Suzan et al[37]	Investigate the effect of puppet show during circumcision on the anxiety and pain level in children	Children aged 7 to 11 years	RCT	$N = 81$ (I-40, C-41)	Circumcision	Intervention group: A puppet show was performed with the puppet chosen by the child. Control group: No preliminary preparations and routine procedures were done	State-Trait Anxiety Inventory for Children	Before, during, and after the procedure	There was no statistically significant difference between the groups in terms of median anxiety score, while there was a significant difference between the groups during and after the procedure ($p < 0.05$)
12.	Forouzandeh et al[42]	Determine the effectiveness of interactive games and painting on preoperative anxiety in children	Children aged 3 to 12 years	RCT	$N = 172$ (Interactive group-64, Painting group-55, Control-53)	Elective surgery	The interactive game group played with the toys (play dough and play with blocks and puzzles) Painting group: were offered tools for painting Control group: routine care	mYPAS	Before the intervention and 5 minutes after intervention	The mean total anxiety score in the painting group ($p = 0.001$) and interactive game group ($p < 0.001$) The difference in mean total anxiety scores before and after intervention: Interactive group: 7.81 ± 12.35 Painting group: 8.56 ± 16.69 Control group: 11.29 ± 0.95
13.	Ünver et al[38]	Determine the effect of group game intervention on preoperative anxiety levels	Children aged 7 to 12 years	Randomized controlled trial	$N = 94$ (I-47, C-47)	Elective surgeries	Intervention group: Routine preoperative preparation and group game intervention with Jenga game Control group: Routine preoperative preparation	Visual Facial Anxiety Scale	Preintervention (after being dressed for surgery) and postintervention (before transfer to OR)	The decrease in the mean anxiety scores of the children before and after the intervention was significant ($Z = -4.980$; $p < 0.001$) In the control group, the mean anxiety score of the children after being dressed for surgery showed a significant increase ($Z = -4.563$; $p < 0.001$) before the transfer to the OR

Abbreviations: C, control; CI, confidence interval; HCL, hydrochloride; I, intervention; MG, midazolam group; mYPAS, modified Yale Preoperative Anxiety Scale; RCT, randomized controlled trial; SD, standard deviation; STAI-C, State Trait Anxiety Inventory for Children; TBID , tablet-based interactive distraction; VAS, Visual Analogue anxiety scale.

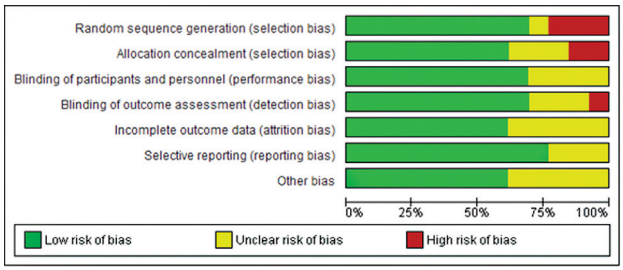

Fig. 1 Risk of bias graph.

into the RevMan software (The Cochrane collaboration's software version 5.3.5) to prepare the risk of bias graph (►**Fig. 1**) and risk of bias summary (►**Fig. 2**).

Statistical Analysis

A quantitative meta-analysis was performed using the RevMan software (The Cochrane collaboration's software version 5.3.5). In the meta-analysis, nine studies were included and four studies were excluded as they did not present results appropriately. The mean and standard deviation for anxiety were extracted from the selected studies. Studies that did not report standard deviation were calculated using median and interquartile range values. A random-effect model was chosen to pool the study-specific estimates.

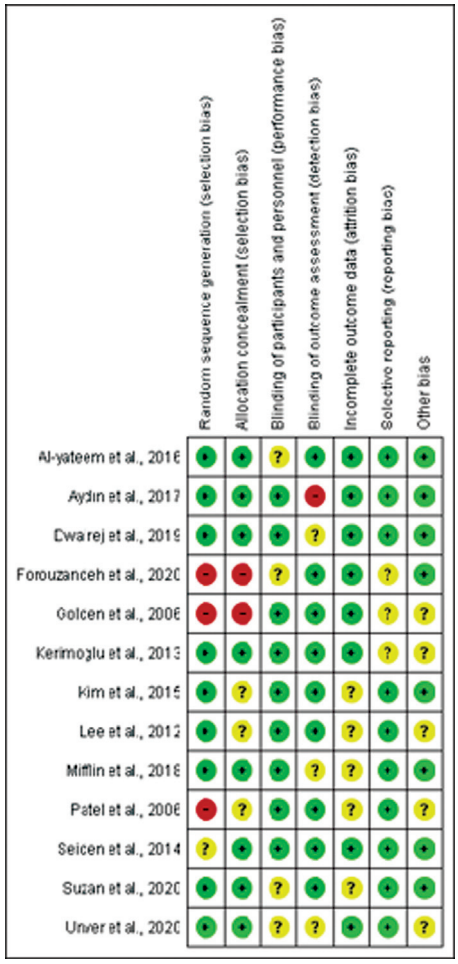

Fig. 2 Risk of bias summary.

Results

Search Results

The initial search of the electronic databases yielded 2,248 articles. Two authors (E.M. and M.S.P.) screened the 2,248 articles, out of which 13 duplicate articles were removed. After the removal of duplicates, 2,235 articles were retained for the title and abstract screening. A total of 1,861 articles were excluded by reading their titles and abstracts. A total of 374 articles remained for full-text screening. Of these 374 articles, 361 were excluded due to various reasons such as different study designs ($n = 146$), different outcomes ($n = 21$), systematic reviews ($n = 4$), ongoing trials ($n = 2$), and 161 did not meet the inclusion criteria. The search containing 13 full-text RCTs that met inclusion criteria were included in this review. Among the 13 articles 9 articles were included for quantitative analysis (►**Fig. 3**).

Characteristics of Included Studies

The sample size of the trials ranged from 50 to 172. Two studies each were conducted in the United States[36,38] and Korea,[30,32] and three in Turkey.[34,37,38] One each in New York,[40] Jordan,[34] Iran,[42] Canada,[35] United Arab Emirates,[33] and Brooklyn.[31] The sample characteristic shows that children were between the ages of 1 and 12 years. Most of the children had undergone elective surgeries.[30,32–34,37,38,40–42] Other surgeries were ambulatory surgeries[31,35,39] and day-care surgery.[36]

Thirteen studies identified the effect of distraction intervention among children. Among them, nine were included for meta-analysis. The outcome measured in the review was perioperative anxiety. Nine studies measured preoperative anxiety,[35–37,42,43,45] and four measured perioperative anxiety.[33,35,37,39] Most of the studies used the modified Yale Preoperative Anxiety Scale (mYPAS).[30–36,39–41] Other anxiety scales used were State Trait Anxiety Inventory for Children[33,37] and Visual Facial Anxiety Scale.[38] The description of the study characteristics is given in ►**Table 1**.

The Effect of Distraction Intervention on Anxiety among Children

A quantitative meta-analysis was performed using the RevMan software (The Cochrane collaboration's software version 5.3.5). Nine RCTs were included for meta-analysis.[30–33,35,36,39,41,42] A total of 1,109 children undergoing surgery were included. All the studies included for meta-analysis measured preoperative anxiety of the children. The anxiety of the children was measured using the mYPAS. The anxiety of children was measured either in the holding area or during anesthesia induction. In this review, the distraction interventions included were: handheld video game,[36,41] play dough and play with blocks and puzzles,[42] tablet-based interactive distraction,[39] animated video,[32] painting and storytelling,[33] age-appropriate video,[35] distraction with video glasses,[31] watched a movie, and brought favorite toy during hospital stay.[30]

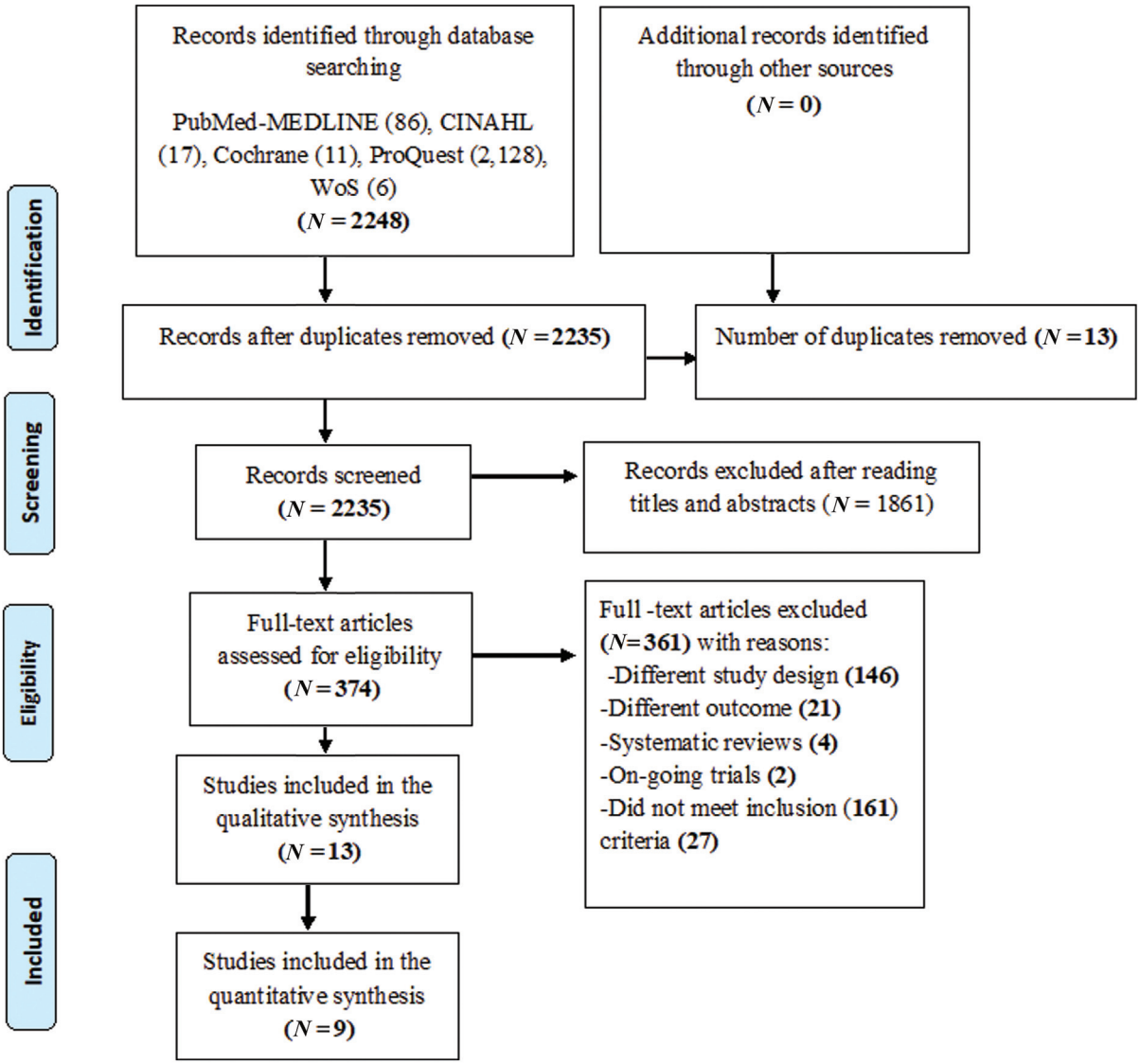

Fig. 3 Study selection process.

The result of the meta-analysis showed that distraction interventions are effective on preoperative anxiety in children (standardized mean difference = –17.07, 95% confidence interval: 27.11–7.02, $p = 0.0009$). Meta-analysis was computed using the random-effect model with heterogeneity ($p < 0.00001$, $I^2 = 100\%$) (►**Fig. 4**). The findings from the meta-analysis of nine studies indicate that distraction intervention provided before surgical procedures reduces anxiety levels among children. Moreover, games have the highest effect on children's anxiety levels, as studies indicate there is a strong statistical significance between children ($p < 0.001$). Audio or visual distractors have a less significant effect on anxiety levels than interactive games or collaborations. However, even such distractors significantly assist children in overcoming stress, reducing anxiety, and having better experiences before and after surgical procedures. However, we could not analyze the effect of distraction on postoperative anxiety due to the lack of studies to support the findings.

Discussion

This systematic review aimed to identify the evidence on distraction interventions to reduce perioperative anxiety among children. A total of 13 studies identified the effect of distraction interventions among children. Included studies were conducted in different parts of the world and most of the studies were conducted in South East Asia. However, nine studies in this review provided stronger evidence on the effect of distraction among children undergoing surgery. Most of the studies in our review included children aged 1 to 12 years and undergone elective ambulatory and outpatient surgeries, and day-care surgeries. In this review, most of the studies identified the effect of distraction on the preoperative period and few studies focused on postoperative anxiety. We had included nine studies for meta-analysis.

Our review suggests that distraction interventions are effective to reduce anxiety in children. The results of our review are supported by a Cochrane review conducted on

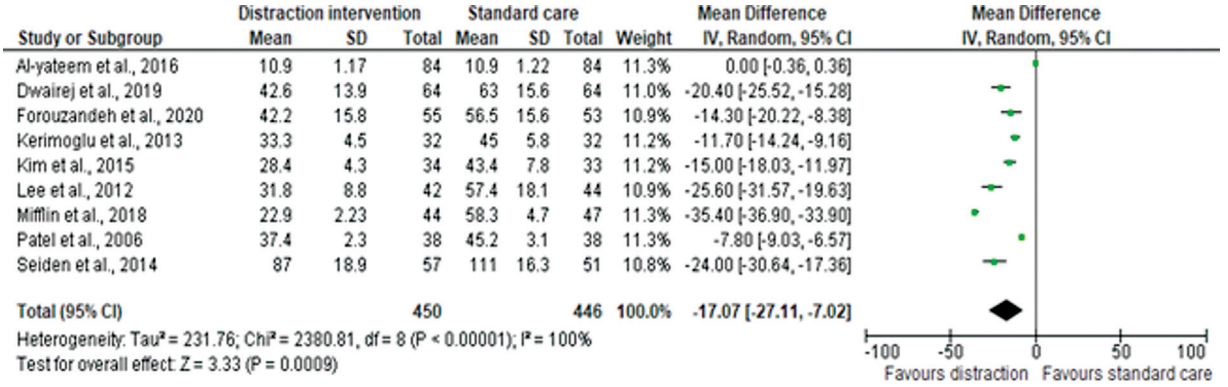

Fig. 4 Meta-analysis on effect of distraction on anxiety.

nonpharmacological interventions to reduce preoperative anxiety among children which concluded that nonpharmacological interventions are effective.[44] Another systematic review by Yip et al[45] identified that handheld video game is effective to reduce children's anxiety and decreases postoperative complications. Although, these reviews have not provided information on the implication for practice and concluded that large RCTs are required to conclude the effectiveness of nonpharmacological interventions.

To our knowledge, this is the first comprehensive systematic review to systematically investigate the effect of distraction intervention on perioperative anxiety of children. Evidence from this systematic review suggests that health professionals need to be trained regarding the practice of distraction interventions. As distraction interventions are user-friendly, they can be implemented easily in the pediatric surgical units to make a hospital stay memorable for a child. Parents need to be educated regarding the practice of distraction interventions which will also involve parents in the child care. We further suggest that if distraction interventions are used by the right person (nurses, health professionals, and parents) at the right time (preoperative or postoperative period) there will be a positive effect on child's anxiety. The current evidence provides a demand for future nurse-led distraction studies as a nonpharmacological intervention in the perioperative care of a child. The limitation of our review is we could not perform a meta-analysis on the effect of distraction on postoperative anxiety due to lack of data availability.

Conclusion

From our systematic review findings, we conclude that distraction interventions are effective to reduce anxiety among children. More RCTs are needed on the effect of distraction interventions on postoperative anxiety.

Ethical Approval

This review has obtained institutional research committee approval.

Funding

This review had not received any financial support.

Conflict of Interest

None declared.

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