The effect of music on anxiety in women undergoing cesarean delivery: a systematic review and meta-analysis

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OBJECTIVE: This study aimed to evaluate the effect of music on anxiety in patients undergoing cesarean delivery.

DATA SOURCES: An electronic search of PubMed, CINAHL, ClinicalTrials.gov, and the Cochrane Central Register of Controlled Trials was performed from inception to November 2020.

STUDY ELIGIBILITY CRITERIA: Eligibility criteria included all randomized controlled trials of pregnant women undergoing cesarean delivery who were randomized to either the music intervention or control. Studies needed to measure preoperative, intraoperative, or postoperative anxiety via a visual analog scale, State-Trait Anxiety Inventory, or Zung Self-Rating Anxiety Scale, for inclusion. The primary outcome was intraoperative anxiety during cesarean delivery. Secondary outcomes included preoperative and postoperative anxiety, postoperative pain, postoperative opioid requirements, blood pressure, and heart rate.

STUDY APPRAISAL AND SYNTHESIS METHODS: The methodologic quality of the included studies was evaluated using the Cochrane Handbook for Systematic Reviews of Interventions. A meta-analysis was performed using the random-effects model of DerSimonian and Laird to produce a summary of treatment effects in terms of mean difference with 95% confidence intervals. A prespecified subgroup analysis of patients undergoing a scheduled or an unscheduled cesarean delivery was carried out for the main outcomes.

RESULTS: Of the 1296 studies screened, 15 met the inclusion criteria (n=613 music group vs n=748 controls). Three trials (n=217 music group vs n=215 controls) reported on intraoperative anxiety specifically. Among studies using a visual analog scale for anxiety assessment, women in the intervention group had lower intraoperative anxiety levels than the controls (mean difference, −0.54; 95% confidence interval, −0.87 to −0.20; I^2=0%; n=2 studies). One trial used the State-Trait Anxiety Inventory and 1 trial used the Zung Self-Rating Anxiety Scale for intraoperative anxiety assessment. In both of these studies, music exposure was associated with lower anxiety levels when compared with the controls (State-Trait Anxiety Inventory: mean difference, −2.80; 95% confidence interval, −4.57 to −1.03; Zung Self-Rating Anxiety Scale: mean difference, −4.80; 95% confidence interval, −7.08 to −2.52). In the subgroup analyses, the same relationship persisted when the cesarean delivery was unscheduled and when the music was selected by the patient or by the study team. The effect of music on preoperative and postoperative anxiety varied depending on which anxiety assessment tool was used. Music was also associated with decreased opioid use (mean difference, −0.87; 95% confidence interval, −1.55 to −0.19; I^2=0%).

CONCLUSION: In patients undergoing a cesarean delivery, music is associated with decreased intraoperative anxiety.

Key words: anxiety, cesarean delivery, music, music therapy, sound

Introduction

Anxiety is one of the most common mental health disorders in the United States, and up to 25% of women report experiencing symptoms during pregnancy.[1,2] Anxiety in pregnancy is associated with poor outcomes, including an increased risk for preeclampsia, emergency cesarean delivery (CD), and operative deliveries.[3] In addition,

EDITOR'S CHOICE

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AJOG MFM at a Glance

Why was this study conducted?

We aimed to assess the efficacy of using music to decrease intraoperative anxiety during cesarean delivery.

Key findings

The use of music was associated with a decrease in intraoperative anxiety during cesarean delivery; however, the effect of music on preoperative and postoperative anxiety varied, depending on the anxiety assessment tool used. Postoperative opioid use was lower among those in the music group.

What does this add to what is known?

Previous literature has shown that music is effective in decreasing anxiety during pregnancy and labor. Our study suggests that music is also effective in decreasing intraoperative anxiety during cesarean delivery.

untreated anxiety is associated with an increased rate of elective CD.[3] Postpartum anxiety has also been associated with decreased rates of breastfeeding and anxiety in children.[4] Although the first-line treatments during pregnancy are medication and therapy, recent studies have shown benefits from using mind-body techniques, such as meditation, yoga, and hypnotherapy.[5,6] Music is another alternative treatment that can be considered to decrease anxiety.

Previous literature has shown that in the nonpregnant patient population, the use of music during procedures is effective at decreasing anxiety and pain severity.[7–9] This nonpharmacologic intervention has also been studied in patients during pregnancy,[10] labor,[11,12] and at the time of delivery.[13] A meta-analysis from 2009 looked at the effect of music on intraoperative anxiety scores during CD specifically; however, only 1 randomized controlled trial (RCT) was included for this outcome.[14] Since then, there have been several additional RCTs published in the literature assessing the effect of music on intraoperative, preoperative, and postoperative anxiety in patients undergoing CD.

The objective of this study was to assess whether music is an effective intervention to decrease intraoperative anxiety during CD and to assess the effect of music on preoperative and postoperative anxiety.

Materials and Methods

Search strategy and information sources

This meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement.[15] Before data collection, the research protocol was established, and the review was registered with the International Prospective Register of Systematic Reviews (CRD42020218168).

One author (S.J.W.), with the aid of a trained medical librarian, performed an electronic search in PubMed, CINAHL, ClinicalTrials.gov, and Cochrane Central Register of Controlled Trials from inception to November 2020. Our search strategy included a combination of key words including or related to "music therapy," "cesarean delivery," and "anxiety" (Appendix). No restrictions for language or geographic location were used. The reference lists of full-text articles were reviewed for additional studies that met the inclusion criteria. The full database search query is available on request.

Study selection

Two authors (S.J.W. and A.T.L.) independently screened all abstracts and the ull texts of all relevant studies were then reviewed. Eligibility criteria included all RCTs of pregnant women undergoing a CD who were randomized to either use of music (preoperatively, intraoperatively, or while in the postanesthesia care unit [PACU]) or control, as defined in the RCTs. Studies needed to report the measure of anxiety via a visual analog scale (VAS), State-Trait Anxiety Inventory (STAI), or Zung Self-Rating Anxiety Scale (SAS) to be included in this review. A VAS involves a 10-cm line (ranging from not at all anxious to very anxious) and the patient is instructed to put a dash on the line to indicate the degree of their anxiety. STAI and SAS both include 20 questions using a 4-point Likert scale. Scores for these 2 scales range from 20 to 80 with higher numbers corresponding to higher anxiety levels. STAI evaluates apprehension, tension, nervousness, and worry; SAS evaluates common symptoms of generalized anxiety disorder and panic disorder.

Studies that used music throughout the antenatal period were excluded. Observational, noncontrolled, and quasi-randomized trials were also excluded. Any disagreements between the reviewers were resolved with discussion involving the third author (V.B.).

Risk of bias

The risk of bias for each included study was assessed using the criteria suggested in the Cochrane Handbook for Systematic Reviews of Interventions.[16] This guideline uses the following 7 domains to evaluate the risk of bias: (1) random sequence generation; (2) allocation concealment; (3) blinding of participants and personnel; (4) blinding of outcome assessment; (5) incomplete outcome data; (6) selective reporting; and (7) other bias. The 2 reviewers (S.J.W. and A.T.L.) individually assessed the risk of bias and categorized each study's risk of bias as "low," "high," or "unclear." Any disagreements between the reviewers were resolved with discussion involving the third author (V.B.).

Data extraction and outcomes

The 2 reviewers (S.J.W. and A.T.L.) independently extracted data from the included studies, which were checked and confirmed by the third author (V.B.). The following data were

recorded without modification: study characteristics (authors, year of publication, location, sample size, inclusion and exclusion criteria, anxiety scales utilized, and primary study outcome); intervention details (timing, duration, type of music used, and by whom it was selected) and control group details; patient demographics (age, weight, height, gestational age, nulliparity); procedure characteristics (anesthesia type and duration of procedure); and study outcomes. When studies were missing information, the corresponding author was contacted directly to request the unpublished data.

The primary outcome was intraoperative anxiety during CD. Secondary outcomes included preoperative anxiety, postoperative anxiety, postoperative pain (using a VAS scale), opioid requirements, systolic blood pressure, diastolic blood pressure, and heart rate. Given the variance in the different anxiety assessment tools' scoring, only studies using the same scales were combined, and the anxiety outcomes for each assessment tool were analyzed separately. In previous literature, postoperative pain is typically assessed using the VAS scale; therefore, it was planned that data from studies using this scale only would be included in the postoperative pain analysis.

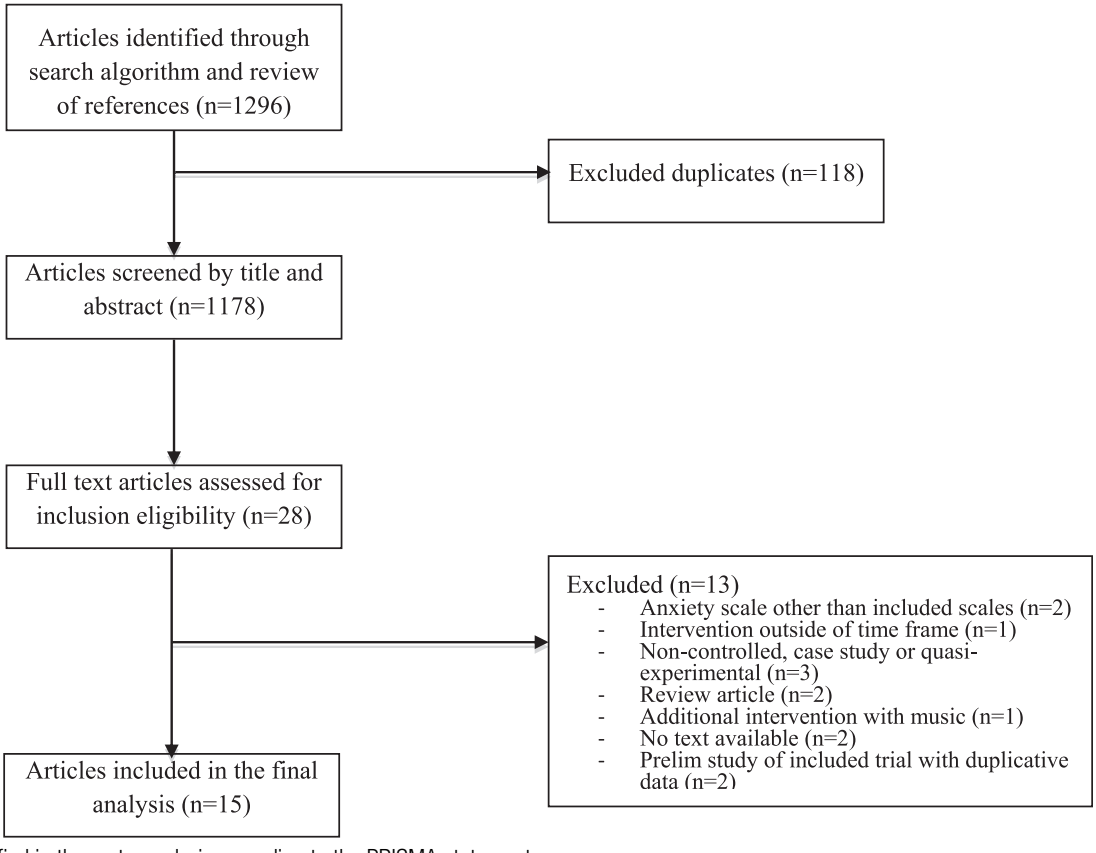
For the primary outcome and preoperative and postoperative anxiety, prespecified subgroup analyses were performed for patients undergoing scheduled and unscheduled CD. Post hoc analyses for when the music was selected by the patient and when music was selected by the study team were carried out for the same outcomes. We also performed post hoc subgroup analyses for patients undergoing CD under general endotracheal anesthesia (GETA).

Statistical analysis

Data from each study was analyzed using Review Manager 5.3.5 (The Nordic Cochrane Center, 2014, Copenhagen, Denmark). Baseline demographics and procedure characteristics were combined and described using descriptive statistics according to the algorithm described in the Cochrane Handbook for Systematic Reviews.[16] Differences between intervention and control groups at baseline were assessed using chi-square or *t* tests for categorical or continuous data, respectively. A *P* value of <.05 was considered statistically significant.

A meta-analysis was performed when at least 2 studies were available.

FIGURE 1
Flow diagram



Studies identified in the meta-analysis according to the PRISMA statement.

PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

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TABLE 1
Summary of included trials

Author, year	Location	Sample size (intervention vs control)	Primary vs repeat CD	Planned vs unplanned CD	Other inclusion criteria	Exclusion criteria	Anxiety scale[a]	Primary study outcome
Kwun and Kim,[27] 2000	Republic of Korea	65 (33 vs 32)	Primary or secondary	Planned	None	Disabilities (unspecified), difficulty hearing or speaking	STAI	Preoperative anxiety
Chang and Chen,[28] 2005	Taiwan	64 (32 vs 32)	NR	Planned	20–40 y old, married, singleton gestation	Preoperative or intraoperative nitrous oxide or sedative use, failed neuraxial anesthesia, emergency CD	VAS	Intraoperative and postoperative anxiety
Reza et al,[29] 2007	Iran	100 (50 vs 50)	NR	Planned	ASA I classification, elective CD	Emergency CD, preoperative pain, psychological disorders, drug use, hearing impairment, mental retardation, preoperative sedative or analgesic use	VAS	Postoperative morphine use
Ebneshahidi and Mohseni,[30] 2008	Iran	77 (38 vs 39)	NR	Planned	18–36 y old, ASA I–II classification, elective CD	Chronic pain, HTN, alcohol or drug abuse, psychological or memory disorder, perioperative medication allergy, previous anesthetic, impaired hearing, or surgical complication	VAS	Postoperative pain and anxiety
AjorPaz and Ranjbar,[31] 2010	Iran	80 (50 vs 30)	Primary	NR	None	Use of anxiolytic or pain medications	STAI	Preoperative anxiety
Li and Dong,[32] 2012	China	60 (30 vs 30)	NR	Planned	20–35 y old, ASA I–II classification, elective CD	Endocrine or CNS disease, drug allergy, anemia, malnutrition, hypoproteinemia, water-electrolyte or acid-base imbalance disorders	SAS	Preoperative HR variability and anxiety

(continued)

TABLE 1
Summary of included trials *(continued)*

Author, year	Location	Sample size (intervention vs control)	Primary vs repeat CD	Planned vs unplanned CD	Other inclusion criteria	Exclusion criteria	Anxiety scale[a]	Primary study outcome
Allameh et al,[33] 2013	Iran	64 (31 vs 33)	NR	Planned	Term singleton gestation and ASA I—II classification	Impaired hearing, psychological disorder, uncontrolled hypotension or HTN, PEC, bradycardia, arrhythmia, CD >1 h, additional procedure during CD (myomectomy, appendectomy, hysterectomy)	SAS	Intraoperative and postoperative pain and anxiety
Sharifi et al,[34] 2013	Iran	45 (30 vs 15)[b]	NR	NR	None	Use of anxiolytic medications	STAI	Preoperative anxiety
Choubsaz et al,[35] 2018	Iran	90 (30 vs 60)[c]	NR	Planned	ASA I—II classification, elective CD	Psychological disorder, psychotropic drug use, hearing disorder	STAI	Change in anxiety
Denney et al,[36] 2018	United States	50 (25 vs 25)	Primary or secondary	Planned	≥18 y old	CVD, IDDM, chronic HTN, fetal anomaly, multifetal gestation, psychological disorder, unstable postoperatively, emergency CD, intraoperative complication	STAI	Change in anxiety
Handan et al,[37] 2018	Turkey	60 (30 vs 30)	Repeat	Planned	≥1 previous CD that was within the previous 5 y	Communication and impaired hearing, psychiatric diagnoses	VAS	Preoperative and postoperative anxiety
Hepp et al,[38] 2018	Germany	304 (154 vs 150)	Primary	NR	None	Known surgical risk, serious fetal condition, GAD or other psychological disorders, hearing impairment	STAI and VAS	Preoperative and postoperative anxiety and stress, salivary cortisol levels
Kurdi and Gasti,[39] 2018	India	182 (120 vs 62)[d]	NR	Unplanned	≥18 y old, ASA I—II classification, emergency CD	Impaired hearing ear abnormalities, psychological disorders	VAS	Psychological well-being (survey)

(continued)

TABLE 1
Summary of included trials *(continued)*

Author, year	Location	Sample size (intervention vs control)	Primary vs repeat CD	Planned vs unplanned CD	Other inclusion criteria	Exclusion criteria	Anxiety scale[a]	Primary study outcome
Bansal et al,[40] 2019	India	60 (30 vs 30)	Repeat	Planned	None	Chronic pain, psychological disorders, previous head or neck surgery, history of CD >5 y ago, impaired hearing, belonging to family of musicians	VAS	Preoperative, intraoperative and postoperative HR and MAP, preoperative and postoperative anxiety
Parodi et al,[41] 2020	Italy	60 (40 vs 20)[e]	NR	Planned	Uncomplicated pregnancy, elective CD	Psychological disorder, neurologic impairment, epilepsy, deafness, drug or alcohol use during pregnancy, insufficient reading level	STAI	Preoperative anxiety

ASA, American Society of Anesthesiologists; *CD*, cesarean delivery; *CNS*, central nervous system; *CVD*, cardiovascular disease; *DM*, diabetes mellitus; *GAD*, generalized anxiety disorder; *HR*, heart rate; *HTN*, hypertension; *IDDM*, insulin-dependent diabetes mellitus; *MAP*, mean arterial pressure; *NR*, not recorded; *PACU*, postanesthesia care unit; *PEC*, preeclampsia; *SAS*, Zung Self-Rating Anxiety Scale; *STAI*, State-Trait Anxiety Inventory; *VAS*, visual analog scale.

[a] STAI tool uses a 20 to 80 point scale, VAS tool uses a 0 to 10 point scale, and SAS uses a 20 to 80 point scale; [b] Intervention group consisted of 30 patients in total—15 patients assigned to music intervention and 15 patients assigned to Quran recitation intervention; [c] Control group consisted of 60 patients in total—30 patients in the ear plug group and 30 patients in the control group; [d] Intervention group consisted of 61 patients assigned to soothing meditation music intervention and 59 patients assigned to binaural beat meditation music intervention; [e] Intervention group consisted of 20 patients assigned to binaural beat music intervention and 20 patients assigned to music intervention.

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The random-effects model of DerSimonian and Laird was used to produce summary treatment effects in terms of mean difference (MD) with 95% confidence intervals (CIs). Study heterogeneity was measured using Higgins I^2 statistics. It was planned that possible publication biases would be assessed statistically with Begg and Egger tests and graphically using funnel plots if >10 studies were included in the analysis of any 1 outcome.

Results

Study selection and study characteristics

Of the 1296 studies identified using the search strategy, 28 were reviewed for inclusion eligibility (Figure 1). Details of the 13 excluded publications[14,17–26] are shown in Figure 1. Reasons for exclusion were noncontrolled trial,[17] case study or quasi-experimental study designs,[18,19] review article,[14,20] use of additional intervention other than music as part of the intervention,[21] intervention performed after leaving the PACU,[22] use of a noneligible anxiety assessment tool,[23,24] and duplicative data from the preliminary study of an included trial.[25,26] Therefore, a total of 15 trials[27–41], including 1361 patients (613 intervention group vs 748 control group), met the eligibility criteria for inclusion in this review. A total of 4 authors[36–38,41] responded to our request to obtain missing data and were able to provide the requested information.

Characteristics of the 15 trials are presented in Table 1. The included studies were performed in 9 different countries and all were published between 2000 and 2020. All of the studies were RCTs that compared music intervention with no music controls among women undergoing a CD. Most of the studies included women undergoing planned CD; however, 1 study[39] included women undergoing an unplanned CD and 3 studies[31,34,38] did not specify. One trial[35] included 3 groups in which the participants were randomized to either the use of music, earplugs, or standard of care (no music or ear plugs). The earplug group and

control group were combined for the purpose of data analysis. Similarly, 3 trials[34,39,41] included 2 music intervention groups (using different types of music) and a control group. The 2 intervention groups were combined for the purpose of data analysis. Regarding the anxiety assessment tools used, 6 studies[28–30,37,39,40] used a VAS, 6 studies[27,31,34–36,41] used the STAI, 2 studies[32,33] used the SAS, and 1 study[38] used both a VAS and STAI.

TABLE 2
Summary of intervention and control groups

Authors, year	Timing of intervention	Duration of intervention	Choice of music	Type of music	Control group details
Kwun and Kim,[27] 2000	Preoperative	3 sessions of 30 min	Patient	Any	Routine care
Chang and Chen,[28] 2005	Intraoperative	Entire length of surgery	Patient	Western classical, new age, or Chinese religious	Routine care
Reza et al,[29] 2007	Intraoperative	Entire length of surgery	Study investigators	Soft instrumental, 15 segments of a Spanish style guitar	White noise played through occlusive headphones
Ebneshahidi and Mohseni,[30] 2008	Postoperative (within 15 min of arrival to PACU)	30 min	Patient	Any	Regular headphones without sound
AjorPaz and Ranjbar,[31] 2010	Preoperative	20 min	Study investigators	Sung verses of the Quran	Quiet room for same duration
Li and Dong,[32] 2012	Preoperative	30 min	Patient	Chinese classical music	Quiet environment for same duration
Allameh et al,[33] 2013	Intraoperative	Entire length of surgery plus 10 min after	Study investigators	Recited verses of the Quran	Regular headphones without sound
Sharifi et al,[34] 2013	Preoperative (within 2 h of CD)	20 min	Study investigators	Instrumental music or recitation of the Quran	Routine care
Choubsaz et al,[35] 2018	Intraoperative	Entire length of surgery	Study investigators	Sedative musical piece of the Iranian Music Therapy Association	Ear plugs or routine care
Denney et al,[36] 2018	Preoperative and in the PACU	≥30 min preoperatively and ≥30 min in the PACU	Patient	Classical, country, pop or top 40, R&B, gospel, or soft rock	Routine care
Handan et al,[37] 2018	Intraoperative	Entire length of surgery	Patient	Any	Routine care
Hepp et al,[38] 2018	Intraoperative	Entire length of surgery	Patient	Lounge, classical, jazz, or meditation	Routine care
Kurdi and Gasti,[39] 2018	Intraoperative	Entire length of surgery	Study investigators	Meditation music or binaural beat meditation music	Noise-canceling headphones without sound
Bansal et al,[40] 2019	Intraoperative	Entire length of surgery	Patient	Any	Regular headphones without sound
Parodi et al,[41] 2020	Preoperative (within 1 h of CD)	12 min	Study investigators	Engineered audio track with dynamic multi-spectrum phase shift or same soundtrack without engineered audio	Routine care

CD, cesarean delivery; *PACU*, post anesthesia care unit; *R&B*, rhythm and blues.

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Details regarding the included studies' intervention and control groups are shown in Table 2. The music intervention was used either preoperatively,[27,31,32,34,41] intraoperatively,[28,29,33,35,37–40] while in the PACU,[30] or both preoperatively and while in the PACU.[36] In approximately half of the trials, the music was selected by the patients, whereas in the other half, it was chosen by the study investigators. The duration of intervention ranged from 12 minutes to the entire length of surgery. There was a large variety in the type of music used in each trial.

Patient demographics and procedure characteristics of the included trials are shown in Table 3. Within the pooled data, there were no baseline differences between the groups. Most of the studies included participants undergoing CD with neuraxial anesthesia, whereas 2 studies[29,30] included only participants who underwent CD under GETA and 3 studies[27,31,34] did not specify the type of anesthesia used.

TABLE 3
Patient demographics and procedure characteristics

Authors, year	Age (y)	Weight (kg)	Height (cm)	Gestational age (d)	Nulliparity	Anesthesia type	Duration of procedure (min)
Kwun and Kim,[27] 2000	31.2±4.5 vs 31.8±4.1	NR	NR	NR	12/33 (36.4) vs 10/32 (31.2)	NR	NR
Chang and Chen,[28] 2005	30.3±4.2 vs 32.3±4.5	NR	NR	269.5±7.7 vs 268.1±4.9[a]	NR	Neuraxial	87.6±13.0 vs 85.9±13.8
Reza et al,[29] 2007	26.0±5.2 vs 25.0±4.2	NR	NR	NR	NR	GETA	23.7±6.4 vs 21.6±5.2
Ebneshahidi and Mohseni,[30] 2008	25.6±4.3 vs 24.8±4.4	66.7±8.7 vs 67.1±9.4	161.4±9.3 vs 162.6±10.5	NR	NR	GETA	32.1±2.7 vs 32.7±2.9
AjorPaz and Ranjbar,[31] 2010	NR[b]	NR	NR	NR	NR[c]	NR	NR
Li and Dong,[32] 2012	NR	NR	NR	NR	NR	Neuraxial	NR
Allameh et al,[33] 2013	28.4±3.6 vs 28.1±5.7	NR	NR	NR	0/31 (0) vs 0/33 (0)	Neuraxial	NR
Sharifi et al,[34] 2013	NR[d]	NR	NR	NR	NR[e]	NR	NR
Choubsaz et al,[35] 2018	27.1±4.9 vs 28.4±7.1[f]	NR	NR	NR	18/30 (60) vs 40/60 (66.7)	Neuraxial	NR
Denney et al,[36] 2018	29.9±1.3 vs 31.2±1.2	96.0±24.7 vs 82.9±17.7	NR	NR	NR	Neuraxial	72±17.5 vs 63±16.6
Handan et al,[37] 2018	30.6±5.6 vs 30.0±5.4	NR	NR	268.8±7.0 vs 270.2±5.6[a]	0/30 (0) vs 0/30 (0)	Neuraxial	66.0±54.0 vs 84.0±156.0[g]
Hepp et al,[38] 2018	33.5±5.4 vs 33.7±5.4	78.5±15.3 vs 81.5±18.8	168.5±7.2 vs 167.2±11.7	269±7.2 vs 268±7.3	53/154 (34.4) vs 59/150 (39.3)	Neuraxial	43±10.4 vs 41.6±10.5
Kurdi and Gasti,[39] 2018	25.0±3.1 vs 24.5±2.7	NR	NR	NR	NR	Neuraxial	NR
Bansal et al,[40] 2019	28.7±5.3 vs 28.0±4.2	61.3±12.8 vs 56.9±10.0	NR	NR	NR	Neuraxial	50.7±12.0 vs 50.5±11.5
Parodi et al,[41] 2020	36.1±4.2 vs 36.5±4.8	NR	NR	273±4 vs 273± 4	NR	Neuraxial	NR
Total	29.5±5.8 vs 29.7±6.1	76.4±17.9 vs 76.3±18.8	167.1±8.1 vs 166.3±11.6	269.7±7.0 vs 268.7±6.7	83/278 (29.9) vs 109/305 (35.7)	NA	47.7±25.8 vs 47.6±49.8
P value	.28	.95	.44	.11	.13	NA	.97

Data are expressed as intervention vs control with n/N (%) or mean±standard deviation.

GETA, general endotracheal anesthesia; *NR*, not recorded.

[a] Data are reported in the study as weeks but converted to days in Table 3; [b] Age ranges provided for intervention and control group as follows: age of 15 to 24 years, 16 (32) vs 9 (30); age of 25 to 34 years, 22 (44) vs 14 (46.6); age of 35 to 44 years, 12 (24) vs 7 (23.3); [c] Nulliparity noted in 58% of all subjects; [d] Average age for entire study population is 28.9±4.8; [e] Gravidity provided for both intervention and control groups are as follows: 40% first pregnancy, 46.7% second pregnancy, 13.3% third pregnancy; [f] Age of each control group was averaged (ear plug group 30.17±8.11; routine care group 26.6±5.59); [g] Data were reported in hours and converted to minutes.

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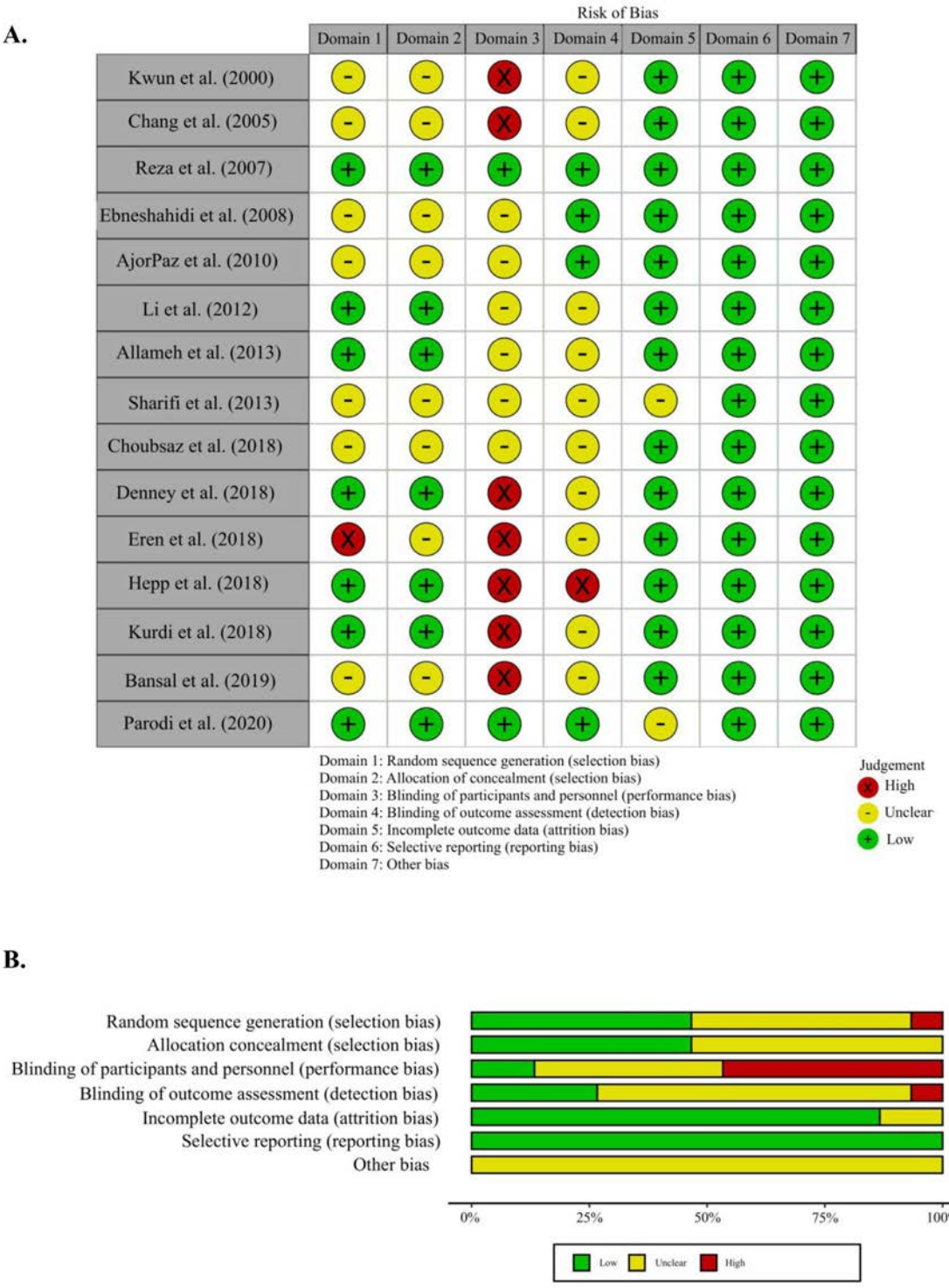
FIGURE 2
Assessment of risk of bias



A, Risk of bias for each trial. The *plus sign* indicates low risk of bias, the *question mark* indicates unclear risk of bias, and the *minus sign* indicates high risk of bias. **B,** Risk of bias items presented as percentages across all included studies.

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Study quality and risk of bias

An assessment of the risk of bias is shown in Figure 2. All trials except for 4[27,31,33,34] mentioned receiving institutional review board approval. Most of the studies had a low or unclear risk of "random sequence generation" and "allocation concealment" bias. Because of the nature of the intervention, blinding of participants and personnel was often not possible, and thus many studies had a high or unclear risk of bias for this domain. Conversely, regarding "blinding of outcome assessment," only 1 study was determined to have a high risk of bias for this category.[38] Most of the trials had a low risk of bias for "incomplete outcome data" and "selective reporting."

Synthesis of results

The results for the primary outcome of intraoperative anxiety and the results for preoperative and postoperative anxiety for each anxiety assessment tool used are shown in Table 4. In addition, a forest plot of the primary outcome is shown in Figure 3. A total of 3 trials[28,33,38] (n=217 music group vs n=215 control group) contributed to the primary outcome. In all 3 studies, the music intervention and anxiety assessment occurred intraoperatively. With regards to the anxiety assessment tools used, 1 study used a VAS,[28] 1 used the SAS,[33] and 1 used both a VAS and the STAI.[38] Among studies utilizing a VAS for anxiety assessment, women in the intervention group had lower intraoperative anxiety scores than the control group (MD, −0.54; 95% CI, −0.87 to −0.20; $I^2 = 0\%$; 2 studies). For the 1 study that used the STAI for intraoperative anxiety assessment, use of music was associated with lower anxiety scores than those of the no music controls (MD, −2.80; 95% CI, −4.57 to −1.03; 1 study). Similarly, in the 1 study that used the SAS to assess intraoperative anxiety, the authors found significantly lower anxiety scores among the

TABLE 4
Anxiety scores in women randomized to use of music compared with controls

Anxiety assessment scale	Timing of anxiety assessment	Author, year	Intervention group	Control group	I^2	Mean difference (95% CI)
VAS[a]	Intraoperative	Chang and Chen,[28] 2005	1.8±2.7	2.9±2.9	0%	−0.54 (−0.87 to −0.20)[b]
		Hepp et al,[38] 2018	1.3±1.2	1.8±1.8		
	Postoperative	Chang and Chen,[28] 2005	1.0±1.9	1.8±2.6	0%	−0.38 (−0.53 to −0.23)[b]
		Reza et al,[29] 2007	0.1±0.7	0.4±1.6		
		Ebneshahidi and Mohseni,[30] 2008	1.1±1.4	1.3±1.2		
		Handan et al,[37] 2018	6.0±2.9	6.5±2.2		
		Hepp et al,[38] 2018	0.7±0.9	1.0±1.3		
		Kurdi and Gasti,[39] 2018	0.8±0.7[c]	1.2±0.9		
		Bansal et al,[40] 2019	2.2±1.8	3.4±1.3		
STAI	Intraoperative	Hepp et al,[38] 2018	31.6±6.3	34.4±9.2	NA	−2.80 (−4.57 to −1.03)[b]
	Preoperative	Kwun and Kim,[27] 2000	47.3±9.1	48.8±7.6	22%	−3.95 (−9.07 to 1.18)
		AjorPaz and Ranjbar,[31] 2010	35.2±6.2	41.4±8.3		
		Sharifi et al,[34] 2013	37.5±6.9[d]	48.1±8.6		
		Parodi et al,[41] 2020	46.9±12.8	42.9±10.8		
	Postoperative	Choubsaz et al,[35] 2018	13±8.0	18.4±9.4[e]	58%	−2.1 (−6.38 to 2.18)
		Denney et al,[36] 2018	32±9.0	29.6±6.5		
		Hepp et al,[38] 2018	29.5±5.9	30.9±7.1		
		Parodi et al,[41] 2020	39.4±11.8	43.3±12.4		
SAS	Intraoperative	Allameh et al,[33] 2013	23.6±4.0	28.4±5.2	NA	−4.80 (−7.08 to −2.52)[b]
	Preoperative	Li and Dong,[32] 2012	43.6±3.3	50.6±2.1	NA	−7.00 (−8.43 to −5.57)[b]
	Postoperative	Allameh et al,[33] 2013	23±4.1	27.5±5.1	NA	−4.50 (−6.82 to −2.18)[b]

Data are expressed as mean±standard deviation unless otherwise specified.

CI, confidence interval; *NA*, not applicable; *SAS*, Zung Self-Rating Anxiety Scale; *STAI*, State-Trait Anxiety Inventory; *VAS*, visual analog scale.

[a] No studies assessed the effect of music on preoperative anxiety using the VAS scale; [b] Statistically significant finding.; [c] The patients assigned to the meditation music group and patients assigned to the binaural beat music group were combined in the intervention group; [d] The patients assigned to the instrumental music group and patients assigned to the Quran recitation group were combined in the intervention group; [e] The patients in ear plug group and routine care group were combined in the control group.

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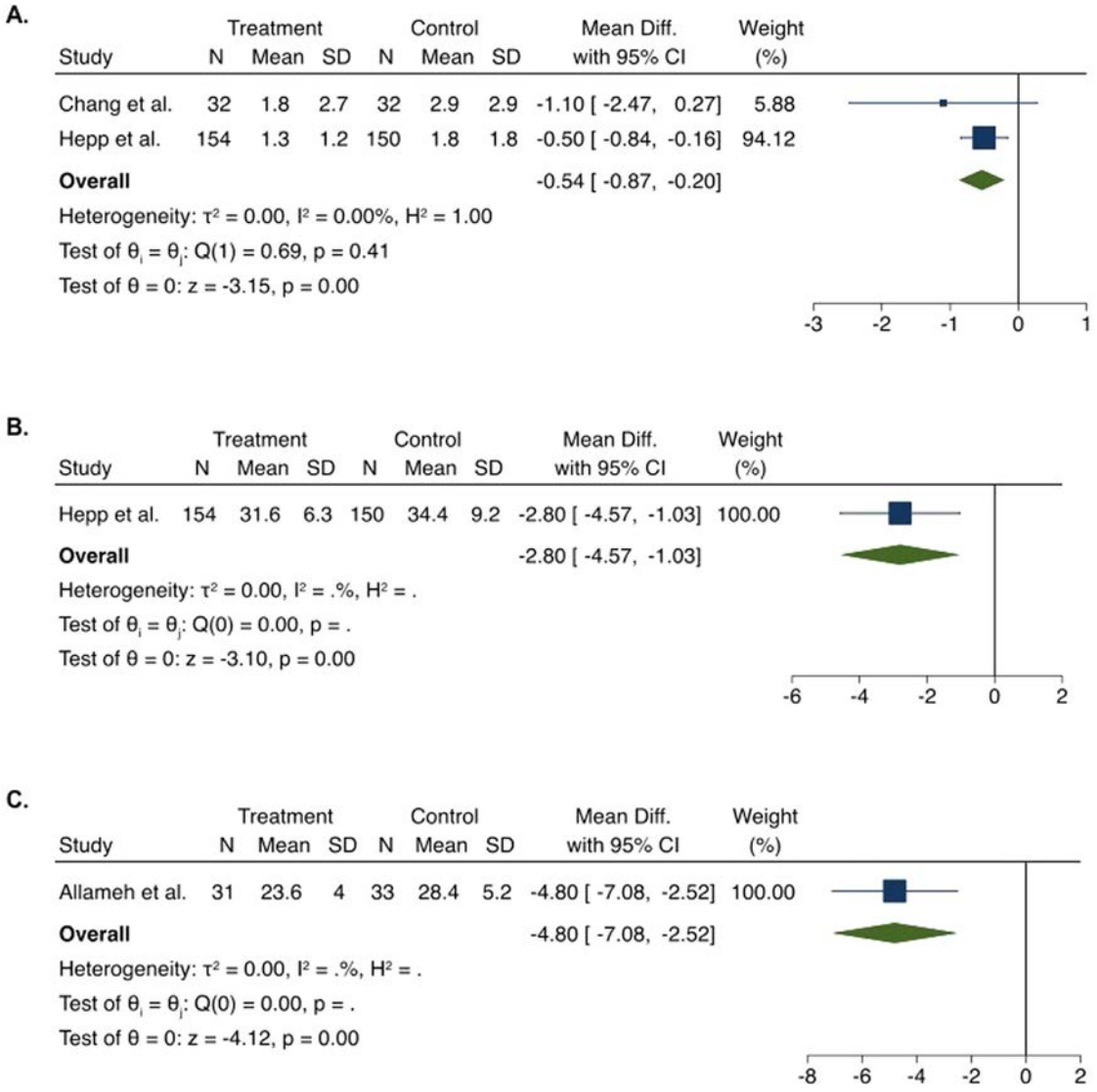
intervention group (MD, −4.80; 95% CI, −7.08 to −2.52; 1 study).

The effect of music on preoperative and postoperative anxiety varied depending on which assessment tool was used (Table 4). Among studies using a VAS, music was associated with lower postoperative anxiety scores (MD, −0.38; 95% CI, −0.53 to −0.23; I^2=0%; 7 studies), but no studies assessed preoperative anxiety using this tool. Among studies using the STAI assessment tool, use of music did not affect preoperative or postoperative anxiety levels. Finally, only 1 study assessed preoperative anxiety and 1 study assessed postoperative anxiety using the SAS for anxiety assessment. In each of these studies, music was associated with lower preoperative (MD, −7.00; 95% CI, −8.43 to −5.57) and postoperative (MD, −4.50; 95% CI, −6.82 to −2.18) anxiety.

Additional secondary outcomes are shown in Table 5. Forest plots of the secondary outcomes are shown in Supplemental Figures 1 to 5. Music does not seem to affect systolic blood pressure, diastolic blood pressure, heart rate, or postoperative pain; however, use of music was associated with lower postoperative opioid use (MD, −0.87; 95% CI, −1.55 to −0.19; I^2=0%; 2 studies).

Outcomes for the prespecified subgroup analyses are shown in Table 6. Among women undergoing a scheduled CD, music decreased preoperative (MD, −7.00; 95% CI, −8.43 to

FIGURE 3
Forest plot of the primary outcome (intraoperative anxiety)



A, Studies that used a VAS anxiety assessment tool. **B,** Study that used the STAI anxiety assessment tool. **C,** Study that used the SAS anxiety assessment tool. Meta-analysis only performed if 2 studies contributed to the outcome.

CI, confidence interval; *SAS*, Zung Self-Rating Anxiety Scale; *SD*, standard deviation; *STAI*, State-Trait Anxiety Inventory; *VAS*, visual analog scale.

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−5.57; 1 study), intraoperative (MD, −4.80; 95% CI, −7.13 to −2.47; 1 study), and postoperative (MD, −4.5; 95% CI, −6.82 to −2.18; 1 study) anxiety when the SAS anxiety tool was used. Moreover, among studies using VAS for anxiety assessment in the subgroup of patients undergoing a scheduled CD, music was associated with decreased postoperative anxiety (MD, −0.49; 95% CI, −0.85 to −0.13; I^2=18%; 5 studies) but did not significantly affect intraoperative anxiety. No studies contributed to the outcome of preoperative anxiety using the VAS assessment tool. Lastly, among studies using the STAI tool for the same subgroup of women, music was not associated with a decrease in preoperative or postoperative anxiety, and no studies used this tool to assess intraoperative anxiety in this subgroup of women. Among those undergoing an unscheduled CD, only 1 study assessed the effect of music on anxiety.[39] This study used the VAS anxiety assessment tool and noted lower postoperative anxiety in the music intervention group than in the controls (MD, −0.40; 95% CI, −0.64 to −0.16)

Data for the post hoc analyses are included in Table 7. In the post hoc subgroup analysis for when music was selected by the patient, the intervention group had significantly lower

TABLE 5
Secondary outcomes

Author, year	Systolic blood pressure	Diastolic blood pressure	Heart rate	Postoperative pain (VAS scale)	Opioids in PACU (mg)
Kwun and Kim,[27] 2000	113.3±12.4 vs 111.9±9.7	70.9±9.5 vs 71.9±7.4	80.0±6.0 vs 79.4±3.7	NR	NR
Chang and Chen,[28] 2005	122.3±14.8 vs 121.4±12.2	71.9±10.5 vs 72.0±9.5	74.6±12.0 vs 82.0±12.5	NR	NR
Reza et al,[29] 2007	NR	NR	NR	7.1±2.6 vs 7.3±2.8	4.5±2.7 vs 5.3±3.7
Ebneshahidi and Mohseni,[30] 2008	116±17 vs 119±16	69±12 vs 71±13	87±14 vs 83±15	2.7±2.1 vs 4.6±2.3	1.6±1.7 vs 2.5±1.9
AjorPaz and Ranjbar,[31] 2010	NR	NR	NR	NR	NR
Li and Dong,[32] 2012	NR	NR	NR	3.3±1.0 vs 4.9±1.4	NR
Allameh et al,[33] 2013	NR	NR	84.9±10.2 vs 92.8±11.0	NR[a]	NR
Sharifi et al,[34] 2013	NR	NR	NR	NR	NR
Choubsaz et al,[35] 2018	NR	NR	NR	NR	NR
Denney et al,[36] 2018	115.8±12.3 vs 117.7±14.0	63.3±11.9 vs 68.5±9.2	83.1±12.8 vs 82.3±13.1	NR	NR
Handan et al,[37] 2018	115.7±11.6 vs 115.8±11.9	62.8±11.7 vs 63.2±8.6	83.3±13.1 vs 78.5±14.2	6.0±2.9 vs 6.5±2.2	NR
Hepp et al,[38] 2018	121.4±12.9 vs 121.6±13	64.7±9.6 vs 65.0±9.2	78.0±13.9 vs 80.5±14.2	NR	NR
Kurdi and Gasti,[39] 2018	NR	NR	NR	1.6±1.3 vs 1.5±1.2	NR
Bansal et al,[40] 2019	NR	NR	74.0±12.0 vs 84.0±12.0	NR	NR
Parodi et al,[41] 2020	NR	NR	NR	NR	NR
I^2	0%	0%	74%	86%	0%
Mean difference (95% CI)	−0.21 (−2.25 to 1.84)	−0.85 (−2.39 to 0.69)	−2.30 (−5.65 to 1.04)	−0.82 (−1.74 to 0.11)	−0.87 (−1.55 to −0.19)[b]

Data are shown as intervention vs control with mean±standard deviation.

CI, confidence interval; *NR*, not recorded; *PACU*, postanesthesia care unit; *VAS*, visual analog scale.

[a] Data are not included because it was reported in median with interquartile range format; [b] Statistically significant finding.

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TABLE 6
Subgroup analyses for scheduled and unscheduled CDs

Subgroup population	Outcome	Anxiety Scale	Included studies	I^2	Mean difference (95% CI)
Scheduled CD	Intraoperative anxiety	VAS	Chang and Chen,[28] 2005	NA	−1.10 (−2.50 to 0.30)
		STAI	None	NA	NA
		SAS	Allameh et al,[33] 2013	NA	−4.80 (−7.13 to −2.47)[a]
	Preoperative anxiety	VAS	None	NA	NA
		STAI	Kwun and Kim,[27] 2000 Parodi et al,[41] 2020	48%	0.63 (−4.62 to 5.89)
		SAS[b]	Li and Dong,[32] 2012	NA	−7.00 (−8.43 to −5.57)[a]
	Postoperative anxiety	VAS	Chang and Chen,[28] 2005 Reza et al,[29] 2007 Ebneshahidi and Mohseni,[30] 2008 Handan et al,[37] 2018 Bansal et al,[40] 2019	18%	−0.49 (−0.85 to −0.13)[a]
		STAI	Choubsaz et al,[35] 2018 Denney et al,[36] 2018 Parodi et al,[41] 2020	15%	−2.22 (−7.44 to 2.99)
		SAS	Allameh et al,[33] 2013	NA	−4.50 (−6.82 to −2.18)[a]
Unscheduled CD[c]	Postoperative anxiety	VAS	Kurdi and Gasti,[39] 2018	NA	−0.40 (−0.64 to −0.16)[a]
		STAI	None	NA	NA
		SAS	None	NA	NA

CD, cesarean delivery; *CI*, confidence interval; *NA*, not applicable; *SAS*, Zung Self-Rating Anxiety Scale; *STAI*, State-Trait Anxiety Inventory; *VAS*, visual analog scale.

[a] Statistically significant finding.; [b] Subgroup is the same as the full meta-analysis; [c] No studies including patients undergoing unscheduled CD reported preoperative or intraoperative anxiety outcomes using any of the 3 anxiety assessment tools.

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intraoperative anxiety (VAS: MD, −0.54; 95% CI, −0.87 to −0.20, I^2=0%, 2 studies; STAI: MD, −0.50; 95% CI, −0.84 to −0.16, 1 study). Similarly, when the study team selected the music, intraoperative anxiety was significantly lower with the use of music (SAS: MD, −4.80; 95% CI, −7.17 to −2.43; 1 study). For the subgroup of women undergoing CD under GETA, there was no difference between the groups in postoperative anxiety.

Comment

Main findings

The results of this systematic review and meta-analysis suggest that the use of music is effective in decreasing intraoperative anxiety during CD. This finding persisted regardless of who chose the music and among the subgroup of women undergoing a scheduled CD, although only for studies that used the SAS anxiety assessment tool. The effect of music on preoperative and postoperative anxiety varied depending on which scale was used. Among studies using the STAI anxiety assessment tool, music did not seem to affect preoperative or postoperative anxiety. Conversely, among studies that used SAS for anxiety assessment, music was associated with lower preoperative and postoperative anxiety; however, only 1 trial contributed to each of these outcomes. We also found that the use of music was associated with significantly decreased postoperative opioid use. No other secondary outcomes were found to have statistically significant results.

Strengths and limitations

This is a large meta-analysis that assessed the use of music to decrease anxiety before, during, and after CDs. The strength of our study lies in its detailed literature review and data analysis. Our study estimated the effect of music on anxiety during multiple time points and among a variety of subgroups. We also included objective measures to better assess overall anxiety and its physiological effect on the study participants.

Our study has several limitations. First, as a result of the different anxiety assessment tools used in the individual trials, there was a limited amount of data available for each outcome. Ideally, these studies could have been combined into a single group; however, given the varying scales, this was not possible and thus the 3 anxiety assessment tools had to be analyzed separately. In addition, because of the limited number of studies that contributed to each outcome, publication bias was not assessed. Finally, there was some methodologic heterogeneity between the studies, such as differences in duration, genre of music used within the intervention groups, and timing of anxiety assessment. Although the limited number of studies contributing to each outcome did not allow us to address these differences by subgroup analyses, we feel these variations are small and unlikely to significantly affect our findings.

TABLE 7
Post hoc subgroup analyses

Subgroup population	Outcome	Anxiety Scale	Included studies	I^2	Mean difference (95% CI)
Music selected by patient	Intraoperative anxiety	VAS	Chang and Chen,[28] 2005 Hepp et al,[38] 2018	0%	−0.54 (−0.87 to −0.20)[a]
		STAI	Hepp et al,[38] 2018	NA	−0.50 (−0.84 to −0.16)[a]
		SAS	None	NA	NA
	Preoperative anxiety	VAS	None	NA	NA
		STAI	Kwun and Kim,[27] 2000	NA	−1.50 (−5.66 to 2.66)
		SAS	Li and Dong,[32] 2012	NA	−7.00 (−8.43 to −5.57)[a]
	Postoperative anxiety	VAS	Chang and Chen,[28] 2005 Ebneshahidi and Mohseni,[30] 2008 Handan et al,[37] 2018 Hepp et al,[38] 2018 Bansal et al,[40] 2019	26%	−0.45 (−0.78 to −0.12)[a]
		STAI	Hepp et al,[38] 2018	62%	−0.08 (−3.62 to 3.47)
		SAS	None	NA	NA
Music selected by study team	Intraoperative anxiety	VAS	None	NA	NA
		STAI	None	NA	NA
		SAS	Allameh et al,[33] 2013	NA	−4.80 (−7.17 to −2.43)[a]
	Preoperative anxiety	VAS	None	NA	NA
		STAI	AjorPaz and Ranjbar,[31] 2010 Sharifi et al,[34] 2013 Parodi et al,[41] 2020	84%	−4.70 (−11.48 to 2.07)
		SAS	None	NA	NA
	Postoperative anxiety	VAS	Reza et al,[29] 2007 Kurdi and Gastiy,[39] 2018	0%	−0.38 (−0.59 to −0.17)[a]
		STAI	Choubsaz et al,[35] 2018 Parodi et al,[41] 2020	0%	−4.99 (−8.35 to −1.64)
		SAS	Allameh et al,[33] 2013	NA	−4.50 (−6.87 to −2.13)[a]
CD performed under GETA[b]	Postoperative anxiety	VAS	Reza et al,[29] 2007 Ebneshahidi and Mohseni,[30] 2008	0%	−0.26 (−0.63 to 0.11)
		STAI	None	NA	NA
		SAS	None	NA	NA

CI, confidence interval; *GETA*, general endotracheal anesthesia; *NA*, not applicable; *SAS*, Zung Self-Rating Anxiety Scale; *STAI*, State-Trait Anxiety Inventory; *VAS*, visual analog scale.

[a] Statistically significant finding.; [b] No studies including patients undergoing cesarean delivery under GETA reported preoperative or intraoperative anxiety outcomes using any of the 3 anxiety assessment tools.

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Comparison with existing literature

Our findings expand on what has been shown in previous literature. Previous studies have shown that music is effective in decreasing anxiety during pregnancy[10] and labor.[11,12] A meta-analysis of 5 studies that included 392 primiparous women in labor found that the use of music was associated with decreased pain and anxiety when compared with controls.[11] Another meta-analysis showed decreased pain and anxiety during the latent phase of labor, but no change during active labor for women in the music group when compared with the control group.[12] A meta-analysis by Lin et al[13] included studies in which music was used for women either undergoing a CD or during labor to decrease anxiety symptoms. The authors found that there was an overall decreased rate of anxiety in the intervention group, but they did not stratify the data by mode of delivery. One systematic review specifically assessed the effect of music on anxiety among women undergoing a scheduled CD and concluded that there was no change in the anxiety levels with or without music, but this review only included 1 trial of 64 women. Our study included more patients and suggests that music is, in fact, effective at decreasing intraoperative anxiety during CD.

Two studies were excluded from our review because they did not use 1 of the

3 anxiety scales that we included. Drzymalski et al[24] was excluded from our meta-analysis because a numeric rating scale was used to assess anxiety. This study had 2 groups of music exposure, namely Mozart and patient-selected Pandora music; only the Mozart group was found to have significantly decreased anxiety before the CD. In addition, Kushnir et al[23] used a 7-point mood states scale to assess anxiety and other emotions before CD. They found that women who listened to music preoperatively had a significant increase in positive emotions and a decrease in negative emotions and perceived threat. Although these studies were excluded, their results are similar to our findings and do not contradict our outcomes.

Music genre was not uniformly reported in the individual studies and therefore a post hoc subgroup analysis was not possible. However, we did note that the 3 studies[31,33,34] that used verses of the Quran as their music of choice found decreased anxiety compared with the control group. In addition, our study found no difference in vital signs between the groups, yet previous literature reports that music is associated with significant decreases in blood pressure[13,14] and heart rate.[13] The differing findings are likely caused by the differing eligibility criteria for studies included in these reviews. For example, our study assessed only women undergoing CD under anesthesia (neuraxial or GETA), whereas the other studies included women during labor who may not have received anesthesia. Mode of delivery and the use of anesthesia are known to affect vital signs, thus, potentially explaining the difference in our findings.

Conclusion and implications

This systematic review and meta-analysis found that in patients undergoing CD, the use of music is associated with a decrease in intraoperative anxiety; however, the effect of music on preoperative and postoperative anxiety varied. Overall, music is a low-risk and inexpensive intervention to incorporate into practice. Future research is needed on the optimal timing, duration, and type of music used to decrease anxiety in women undergoing CD. ■

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ajogmf.2021.100435.

Appendix

Search strategy

PubMed
((music) OR (song)) AND ((labor) OR (peripartum) OR (childbirth) OR (cesarean) OR (caesarean) OR (c-section) OR (c section)) AND ((anxiety) OR (stress))
CINAHL
(music) OR (song)
AND
(labor) OR (peripartum) OR (childbirth) OR (cesarean) OR (caesarean) OR (c-section) OR (c section)
AND
(anxiety) OR (stress)
Cochrane, ClinicalTrials.gov
(MeSH descriptor: [Music] explode all trees) OR (song)
AND
(MeSH descriptor: [Labor, Obstetric] explode all trees) OR (MeSH descriptor: [Cesarean Section] explode all trees) OR (labor or peripartum or childbirth)
AND
(MeSH descriptor: [anxiety] explode all trees) OR (stress)

■

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