The effect of music on pain perception in women scheduled for elective cesarean section: a systematic review and meta-analysis

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Keywords: Music, pain, cesarean section, anxiety, delivery

Abstract

Objective: *To study the effect of music on pain perception in women scheduled for elective cesarean section (CS)*

Search Strategy: *We used the following keywords ("music" or "music therapy" and any of the following: cesarean section OR cesarean delivery OR CS OR cesarean OR Caesarean OR "post-op*)*

Selection Criteria: *We included all studies satisfying the following criteria: (1) Population: pregnant women scheduled for cesarean section. (2) Intervention: the addition of any type of music to routine care compared with routine care alone. (3) Study design: randomized controlled trials (RCTs). We excluded the following: (1) non-randomized trials, (2) in vitro and animal studies, (3) studies in languages other than English, and (4) studies whose data were unreliable for extraction and analysis.*

Data Collection and Analysis: *Data extraction was independently performed using a standardized form. In case of discrepancies, a consensus was reached after the involvement of the senior investigator. Then, data were extracted from assessed articles and entered RevMan software for meta-analysis.*

Main Results*: Pooled data significantly favored the music group over the non-music one in terms of pain and anxiety scores (p<0.001). Heart rate, systolic and diastolic blood pressure did not differ significantly between both groups.*

Conclusion*: Music can be used during, before, and after cesarean section to reduce associated pain and anxiety.*

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Introduction

Delivery by cesarean section (CS) has become increasingly common and considered a life-saving procedure for both the mother and the infant in certain medical indications.[1] Previous evidence suggests that CS rates of 10-15% could be associated with reduced both maternal and perinatal morbidity and mortality rates.[2,3] Recent studies show that CS rates have dramatically increased throughout the 21st century particularly in developed countries.[4,5]

Some studies have addressed the effect of anxiety on birth outcomes and identified a negative impact on the duration of the operation and even selection of the type of anaesthesia,[6-10] which in turn highlighted the need for psychological interventions to overcome this anxiety.[10]

Another major concern of CS is post-operative pain which is more severe when compared to normal vaginal delivery.[11] In a questionnaire study of 220 patients who underwent a CS, 46.8% of the participants complained of immediate postoperative pain.[12] Besides being an irritant, postoperative pain could possibly interrupt with breastfeeding after the operation.[13,14]

More recently, studies have investigated the efficacy of non-clinical interventions to deal with the negative physiological and psychological aspects of surgical procedures which may reduce the need for pharmacological interventions.[15,16] One of the widely investigated interventions is music.[17] The impact of music on the negative aspects of surgical procedures including pain and pre- and postoperative anxiety has been thoroughly addressed over the last few decades.[18,19] Recent studies have identified a link between music and cesarean sections and shown a possible impact of a music intervention before, during or after surgery on peri-operative anxiety and postoperative pain.[20-27]

The purpose of this systematic review and meta-analysis is to investigate the effect of music with routine care versus routine care alone on postoperative pain and anxiety in women undergoing elective CS and also the impact of music on other physiological measures including: heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP).

Materials and Methods

We followed the PRISMA statement guidelines[28] during the preparation of this systematic review and meta-analysis and performed all steps in accordance with the Cochrane handbook of systematic reviews of intervention.[29] No informed consents or ethical committee approval were needed as this is a systematic review of previously published studies

Literature search strategy

We conducted an electronic search of databases including PubMed, Web of Science, SCOPUS, and Cochrane CENTRAL, using the following keywords

("music" or "music therapy" and any of the following: cesarean section OR cesarean delivery OR CS OR cesarean OR Caesarean OR "post-op*). All published articles were considered, and only English articles were selected. We searched the bibliography of included studies for additional relevant records.

Eligibility criteria and study selection

We included all studies satisfying the following criteria

1. *Population:* Pregnant women scheduled for planned cesarean sections.

2. *Intervention:* The addition of any type of music to routine care compared with routine care alone before or during CS.

3. *Outcomes:* The main outcome measures were pain intensity, anxiety during and after CS, blood pressure, and heart rate.

4. *Study design:* randomized controlled trials (RCTs).

We excluded the following

1. *non-randomized trials*

2. *in vitro and animal studies*

3. *studies whose data were unreliable for extraction and analysis*

Two authors independently removed duplicates. Three authors retrieved references and performed the screening in two steps; the first step was to screen titles/abstracts for matching our inclusion criteria and the second step was to screen the full-text articles of eligible abstracts for eligibility to meta-analysis.

Data extraction

Data extraction was independently performed using a standardized form. Data included first author, year of publication, post-operative pain, heart rate, systolic blood pressure, diastolic blood pressure, anxiety score, and morphine usage post-operatively. Two investigators independently scored the studies and collected the information. In case of discrepancies in scoring between the two investigators, a consensus was reached after the involvement of the senior investigator.

Risk of bias assessment

To assess the risk of bias in the retrieved clinical trials, we utilized the Cochrane risk of bias assessment tool, provided in Chapter 8.5 of the *Cochrane Handbook of Systematic Reviews of Interventions 5.1.0.*[30] Risk of bias assessment included the following domains: sequence generation (selection bias), allocation sequence concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective outcome reporting (reporting bias) and other potential sources of bias, the authors' judgment is categorized as 'Low risk', 'High risk' or 'Unclear risk' of bias. Any discrepancies between the two assessors were resolved through discussion. We utilized the quality assessment table provided in Chapter

8.5 part 2 of the same book.[30]

Data synthesis

Data were extracted from assessed articles and entered into RevMan software (Review Manager, version 5.3, The Cochrane Collaboration, 2011; The Nordic Cochrane Centre, Copenhagen, Denmark) for meta-analysis. Afterward, the weighted mean difference was calculated. Statistical heterogeneity between studies was assessed by I-square (I^2) statistics, and values of ≥50% were indicative of high heterogeneity. When heterogeneity was significant, a random-effects model was used for meta-analysis. Fixed effects model of meta-analysis was used when there was no significant heterogeneity.

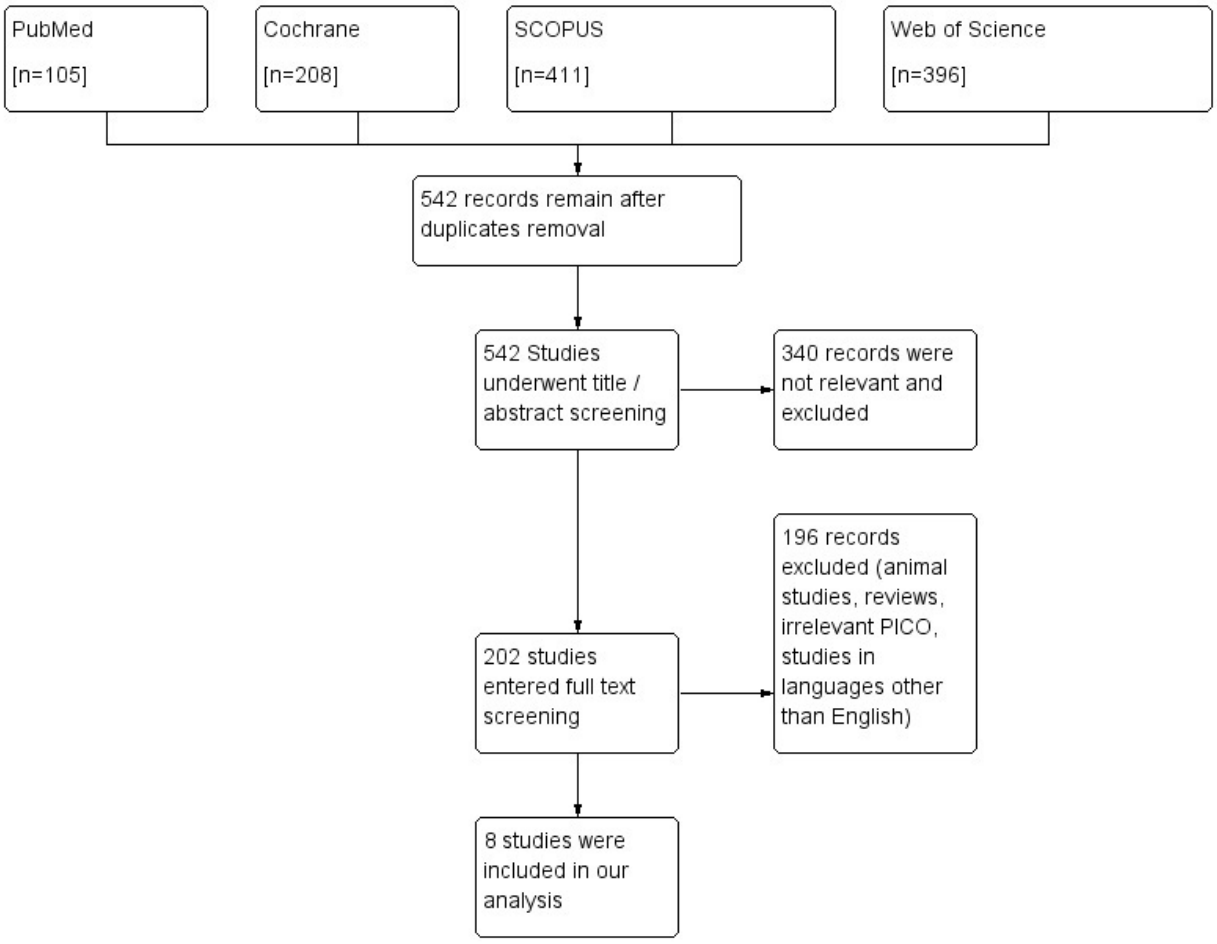

Figure 1: PRISMA flow chart of selected studies

Results

Results of literature search

Our search strategy resulted in 542 studies. After title and abstract screening, 202 articles were available for full-text screening. We excluded 196 of them, and finally, eight studies matched our inclusion criteria and were included in the final analysis.[20-27] The PRISMA flow diagram for study selection is shown in Figure 1. A total of eight RCTs met our inclusion criteria, which included 818 women. The summary of the included studies is presented in Table 1, and their main results are presented in Table 2.

The following were the sites of the included studies: One study in Israel,[20] one study in China,[22] one study in Turkey,[23] one study in Taiwan,[25] one study in Germany,[27] and three studies in Iran.[21,24,26] Kushnir et al.[20] and Li and Dong[22] tested the effect of music listening in the preoperative waiting area. Ebneshahidi and Mohseni[24] and Norouzi et al.[26] played music in the postoperative care unit. The remaining studies addressed the effect of music listening intra-operatively during CS.[21,23,25,27]

Table 1: Summary of the characteristics of included studies

Study ID	Site of the study	Time of music listening	Type of music	Duration of music listening	Choice of music	Type of anesthesia
Kushnir 2012[20]	Israel	Pre-operative	Light classical music, and Israeli tunes	40 min	Patient choice	Regional
Reza 2007[21]	Iran	Intra-operative	Spanish style guitar music	Variable	Research team choice	General
Li 2012[22]	China	Pre-operative	Chinese classical music	30 min	Patient choice	Regional
Handan 2017[23]	Turkey	Intra-operative	NA	Variable	Patient choice	Regional
Ebneshahidi 2008[24]	Iran	Post-operative	NA	30 min	Patient choice	General
Chang 2005[25]	Taiwan	Intra-operative	Western classical, new age, or Chinese religious music	87.59 ± 13.01	Patient choice	Regional
Norouzi 2013[26]	Iran	Post-operative	Soft instrumental	30 min	Research team choice	Regional
Hepp 2018[27]	Germany	Intra-operative	Lounge, classical, jazz, and meditation music	Variable	Patient choice	Regional

Table 2: Summary of the results included studies

Study ID	Population	Results
Kushnir 2012[20]	60 women underwent elective cesarean section	Women who listened to music before a cesarean section had a significant increase in positive emotions and a significant decline in negative emotions and perceived threat of the situation when compared with women in the control group, who exhibited a decline in positive emotions, an increase in the perceived threat of the situation, and had no change in negative emotions. Women who listened to music also exhibited a significant reduction in systolic blood pressure compared with a significant increase in diastolic blood pressure and respiratory rate in the control group.
Reza 2007[21]	100 women scheduled for elective cesarean section	There was not statistically significant difference in VAS for pain between two groups up to six hours postoperatively (P>0.05). In addition, morphine requirements were not different between two groups at different time intervals up to six hours postoperatively (P>0.05). There was not a statistically significant difference between two groups regarding postoperative anxiety score and vomiting frequency (P>0.05).
Li 2012[22]	60 women undergoing elective cesarean section	In the study group the mean HRV, as measured by the low frequency power (LF) value and the LF to high frequency power (LF/HF) ratio during Holter assessment, was significantly less after the music intervention but was not significantly changed in the control group. Moreover, the mean HF value was significantly increased, and the mean anxiety score was significantly decreased after the music intervention but not in the control group. Finally, the mean pain score obtained 6 hours after surgery was significantly lower in the study than in the control group
Handan 2017[23]	60 women undergoing elective cesarean section.	The Visual Analogue Scale (VAS) scores before and during the procedure showed significantly lower scores for the experimental group, compared to the control group ($p<0.05$). Music therapy reduces the physiological and cognitive responses of anxiety in patients undergoing multiple cesarean section, and can be used in the clinical practice
Ebneshahidi 2008[24]	80 Women who underwent cesarean section.	Pain score and postoperative cumulative opioid consumption were significantly lower among patients in the music group ($p < 0.05$), while there were no group differences in terms of anxiety score, blood pressure, or heart rate ($p < 0.05$).
Chang 2005[25]	64 women who were planning to have a cesarean delivery	No significant differences were found between the two groups in any of the physiological indexes. This controlled study provides evidence that music therapy can reduce anxiety and create a more satisfying experience for women undergoing cesarean delivery.
Norouzi 2013[26]	90 Women who underwent repeat cesarean section.	No significant difference in the overall mean scores of maternal state anxiety score (MSA) between the groups at 6 hours after CS, but the severity of MSA in the experimental groups was less than in the control group (P= 0.02).
Hepp 2018[27]	304 Women who underwent cesarean section.	At skin suture, significantly lower anxiety levels were reported in the intervention group regarding State anxiety (31.56 vs. 34.41; p = .004) and visual analogue scale for anxiety (1.27 vs. 1.76; p = .018). Two hours after surgery, the measured visual analogue scale for anxiety score in the intervention group was still significantly lower (0.69 vs. 1.04; p = .018).

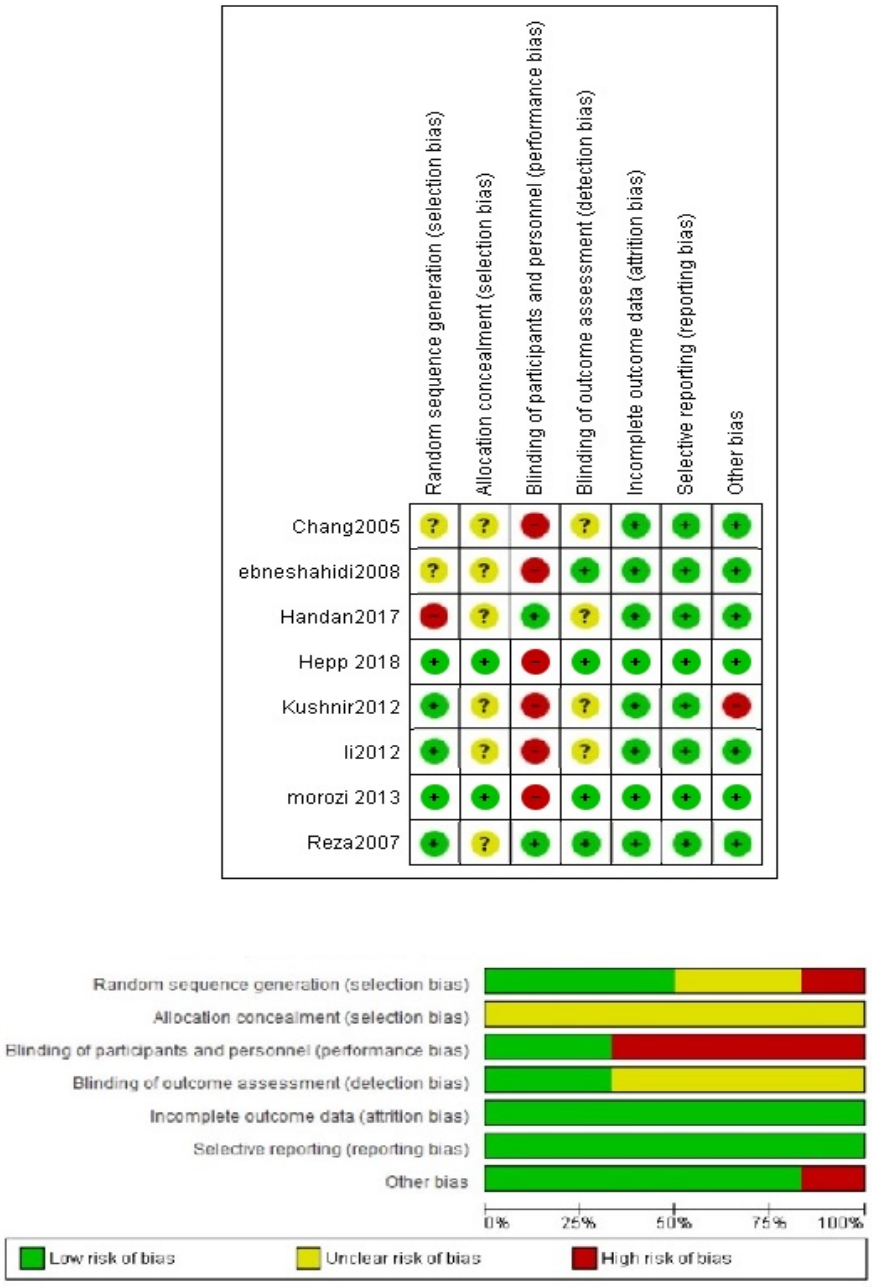

Figure 2: Risk of bias summary

Risk of bias assessment

We used Cochrane's risk of bias assessment tool and found an overall moderate risk of bias. All included studies reported adequate outcome reporting, proper selective reporting, and no missing data, therefore categorized as low risk of bias. Handan et al.[23] lacked randomization of patients; therefore, it was categorized as high risk. Due to the nature of the intervention (music), blinding of participants could not be achieved in our included studies. Therefore, they were categorized as high risk. Other improperly addressed domains were categorized as an unclear risk (Figure 2).

Post-operative Pain

The overall mean difference of post-operative pain favored the music group over the non-music one (MD = -1.28, 95% CI [-2.18, -0.38], p = 0.005). Pooled studies were heterogeneous (p = 0.04; I^2 = 69%). Heterogeneity was best resolved by excluding Reza et al.[21] (Figure 3).

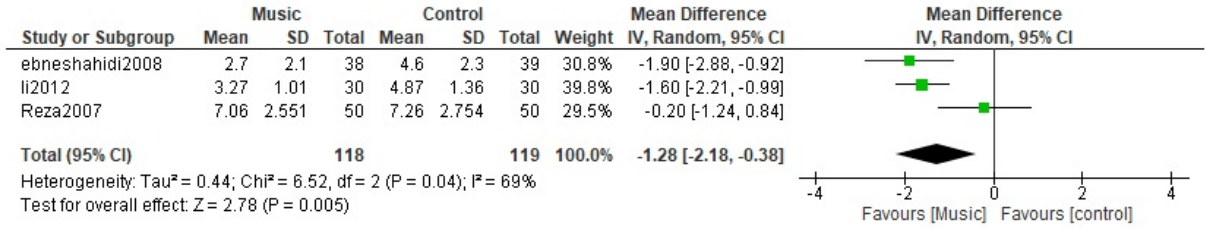

Figure 3: Forest plot of postoperative pain

Anxiety score

The overall mean difference of anxiety score favored the music group over the non-music one (MD= -0.36, 95% CI [-0.56, -0.16], p<0.001). Pooled studies were homogenous (p= 0.65; I^2 = 0%) (Figure 4).

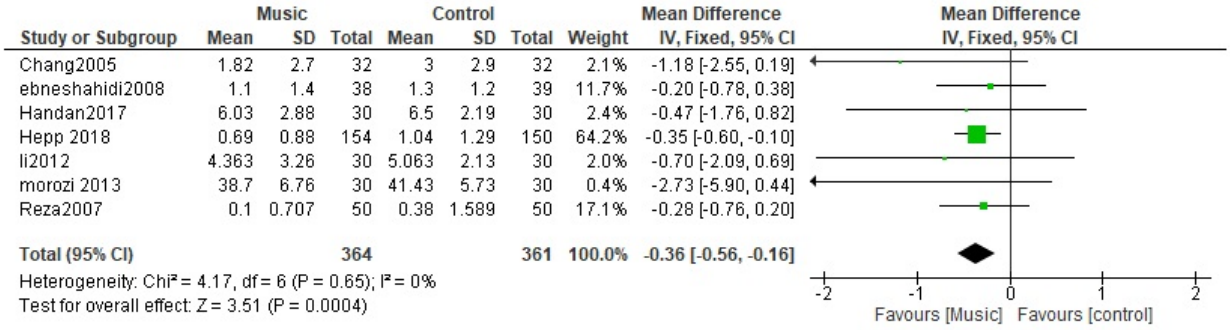

Figure 4: Forest plot of anxiety score

Systolic blood pressure

The overall mean difference of systolic blood pressure did not favor any of the two groups (MD= -2.07, 95% CI [-5.45, 1.31], p = 0.002). Pooled studies were homogenous (p = 0.31; I^2 = 16%) (Figure 5).

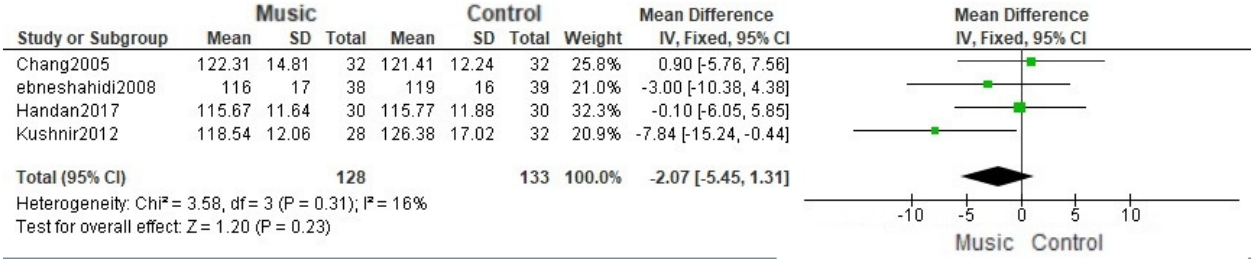

Figure 5: Forest plot of systolic blood pressure

Diastolic blood pressure

The overall mean difference of diastolic blood pressure did not favor any of the two groups (MD= -1.93, 95% CI [-4.53, 0.67], p = 0.15). Pooled studies were homogenous (p = 0.45; I^2 = 0%) (Figure 6).

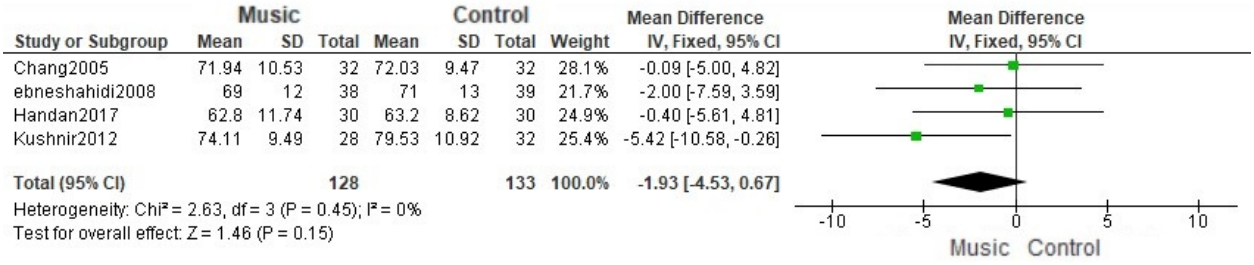

Figure 6: Forest plot of diastolic blood pressure

Heart rate

The overall mean difference of heart rate did not favor either of the two groups (MD = -1.46, 95% CI [-7.49, 4.56], p = 0.63). Pooled studies were heterogeneous (p = 0.003; I^2 = 78%) (Figure 7).

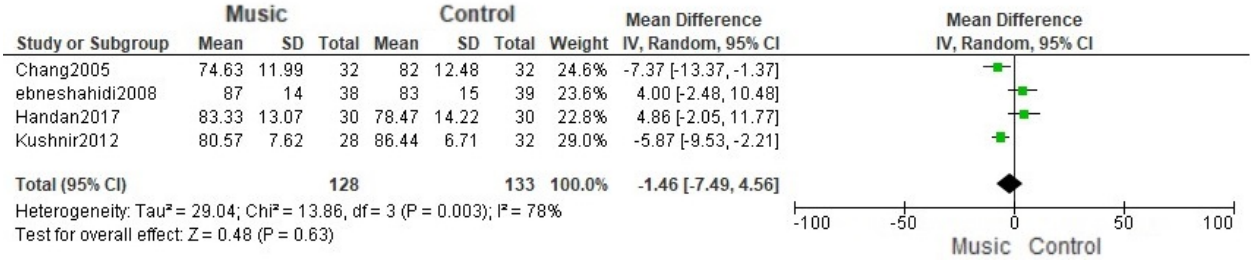

Figure 7: Forest plot of heart rate

Discussion

The present review showed that music significantly reduces postoperative pain after elective CS and helps in the reduction of anxiety in patients. Systolic and diastolic blood pressure (SBP & DBP) together with HR was not affected by music.

Three studies reported postoperative pain scores. Reza et al.[21] found no significant difference while the other two studies[22,24] found a significant decrease in the music group. The net analysis was highly significant in favor of the music group (p=0.005). As for the SBP, DBP, and heart rate outcomes; four studies reported these outcomes.[20,23-25] Two studies found a significant decrease in SBP in the music group,[20,25]

and the other two did not find any difference.[23,24] The net analysis showed no significant effect of music on SBP. Only one study found a significant decrease in DBP and HR in the music group,[20] while the other three did not.[23-25]

As for the anxiety score, seven studies reported a minor non-significant effect of music in reducing anxiety.[21-27] When combined into a single analysis, the results favored the music group significantly (p=0.04).

These findings are supported by other studies in the literature. Regarding the pain score, Nilsson et al.[31] performed a trial dividing their patients into three groups, two groups listened to music during CS and a control group. Pooled results showed a significant favor of the music groups over the control one. (p=0.001) in terms of pain scores. Good et al.[32] found similar results in their RCT after gynecological surgery, a total of 311 patients were included in the trial which were divided into three groups, the first received normal care, the second was to listen to music, and the third group was given other relaxation techniques. The interventions were delivered once for two days, with each lasting for a quarter an hour. Pooled results showed a significant reduction of pain scores in the music group over the control (p=0.001). Moreover, Laurion et al.[33] carried out a pilot study about the effect of music listening during gynaecological laparoscopy and found a significant decrease in pain scores in the music group (p=0.002).

Additionally, Good et al.[34] carried out a cross-cultural quasi-experimental pretest-posttest study to investigate the effect of music on pain in Korean women after gynecological surgery. Similarly, the results came in favor of the music group (p=0.04). Hook et al.,[35] Taylor et al.,[36] and Ikonomidou et al.[37] found the same results significantly favouring the music groups ($p<0.05$, 0.03, and 0.04 respectively).

Regarding other associated outcomes: Nilsson et al.[31] measured post-operative fatigue and nausea scores with self-measured 5-degrees, and 4-degrees scores respectively. Results showed that music was not effective in preventing postoperative nausea, however, the music group experienced significantly less fatigue (p=0.001). Hook et al.[35] measured anxiety scores in their study using the Visual Analogue Scale for Anxiety (VASA) and the State-Trait Anxiety Inventory (STAI). Results showed that the music groups had less incidence of anxiety than control groups (p=0.001).

Strengths and Limitations

Including only RCTs gives our study some strength. Our study is limited by the small sample size of the included studies with the total number of participants of 818. Furthermore, heterogeneity seems to be high in the heart rate outcome (I^2=78%). However, in our defence, this may be normal due to the nature of the study and the intervention. In addition, the risk of bias in the included studies was moderate according to the Cochrane's risk of bias assessment tool. Additionally, cultural differences may be an important confounder in the analysis of the results.

Despite the major differences among the eight studies in evaluation of pain, postoperative painkiller protocols, use of VAS and determination of anxiety, we plotted only data which can be aggregated. They are mixed and the protocol bias is not negligible. The meta-analysis could be improved by separating the expected benefits of music at the different periods (pre-intra- and post-operative); this would add some interesting and practical information. However, this was not possible because of the different methods of the included eight studies.

Conclusion

Our study has identified a clinically and statistically significant impact of music on pain scores and decreased anxiety levels in women scheduled for elective CS. Based on our results, we would recommend playing music before, during, and after CS.

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