S1 Prisma checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	1
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	2
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	2
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	S2
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	2
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	2
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	2

Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	2
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	2
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	3

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	3
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	3
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	3
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	3
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	3
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	4-6
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	4-6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	3
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	5 + 6
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	6 + 7
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	7
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	7

FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	8

S2 Search Strategy

Database	Records identified	After de-duplication
embase.com	671	662
Medline Ovid	378	135
Web of science	250	93
Cochrane CENTRAL	138	66
Google scholar	100	62
Total	1537	1018

embase.com

(music/de OR 'acoustic stress'/de OR 'music therapy'/de OR singing/de OR musician/de OR 'auditory stimulation'/de OR 'MP3 player'/de OR 'tape recorder'/de OR 'compact disk'/de OR (music* OR (melod* NOT (melody NEXT/2 valve*)) OR song* OR singing* OR ((audi* OR acoustic* OR sound*) NEAR/6 (stimul* OR stress)) OR mp3 OR earphone* OR headphone* OR ((ear OR head) NEXT/1 phone*) OR 'compact disk' OR ((cd OR cassette) NEXT/1 player*) OR speaker*):ab,ti) AND ('thorax surgery'/exp OR 'thoracic surgeon'/de OR 'heart disease'/exp/dm_su OR 'lung disease'/exp/dm_su OR 'cardiovascular surgery'/de OR 'cardiopulmonary bypass'/de OR (((thorax OR thoracic OR heart OR cardiac OR cardiothora* OR coronar* OR valve* OR cardiovasc* OR lung OR pulmonar* OR cardiopulmonar*) NEAR/6 (surg* OR operati* OR replacement* OR bypass OR postsurg* OR

postoperati* OR presurg* OR preoperati* OR intrasurg* OR intraoperati* OR transplant* OR implant* OR prosthe* OR bioprosthe*)) OR cabg OR pleurectom* OR sternotom* OR thoracotom* OR sternotom*):ab,ti) NOT ([animals]/lim NOT [humans]/lim)

Medline Ovid

(Music / OR Music Therapy / OR Singing / OR Acoustic Stimulation / OR MP3-Player / OR Compact Disks / OR (music* OR (melod* NOT (melody ADJ2 valve*)) OR song* OR singing* OR ((audi* OR acoustic* OR sound*) ADJ6 (stimul* OR stress)) OR mp3 OR earphone* OR headphone* OR ((ear OR head) ADJ phone*) OR compact disk OR ((cd OR cassette) ADJ player*) OR speaker*).ab,ti.) AND (exp Heart Diseases /su OR exp Lung Diseases /su OR exp Cardiovascular Surgical Procedures / OR Cardiopulmonary Bypass / OR (((thorax OR thoracic OR heart OR cardiac OR cardiothora* OR coronar* OR valve* OR cardiovasc* OR lung OR pulmonar* OR cardiopulmonar*) ADJ6 (surg* OR operati* OR replacement* OR bypass OR postsurg* OR postoperati* OR presurg* OR preoperati* OR intrasurg* OR intraoperati* OR transplant* OR implant* OR prosthe* OR bioprosthe*)) OR cabg OR pleurectom* OR sternotom* OR thoracotom* OR sternotom*).ab,ti.) NOT (exp animals/ NOT humans/)

Web of science

TS=(((music* OR (melod* NOT (melody NEAR/2 valve*)) OR song* OR singing* OR ((audi* OR acoustic* OR sound*) NEAR/5 (stimul* OR stress)) OR mp3 OR earphone* OR headphone* OR ((ear OR head) NEAR/1 phone*) OR "compact disk" OR ((cd OR cassette) NEAR/1 player*) OR speaker*)) AND ((((thorax OR thoracic OR heart OR cardiac OR cardiothora* OR coronar* OR valve*

OR cardiovasc* OR lung OR pulmonar* OR cardiopulmonar*) NEAR/5 (surg* OR operati* OR replacement* OR bypass OR postsurg* OR postoperati* OR presurg* OR preoperati* OR intrasurg* OR intraoperati* OR transplant* OR implant* OR prosthe* OR bioprosthe*)) OR cabg OR pleurectom* OR sternotom* OR thoracotom* OR sternotom*)))

Cochrane CENTRAL

((music* OR (melod* NOT (melody NEXT/2 valve*)) OR song* OR singing* OR ((audi* OR acoustic* OR sound*) NEAR/6 (stimul* OR stress)) OR mp3 OR earphone* OR headphone* OR ((ear OR head) NEXT/1 phone*) OR 'compact disk' OR ((cd OR cassette) NEXT/1 player*) OR speaker*):ab,ti) AND ((((thorax OR thoracic OR heart OR cardiac OR cardiothora* OR coronar* OR valve* OR cardiovasc* OR lung OR pulmonar* OR cardiopulmonar*) NEAR/6 (surg* OR operati* OR replacement* OR bypass OR postsurg* OR postoperati* OR presurg* OR preoperati* OR intrasurg* OR intraoperati* OR transplant* OR implant* OR prosthe* OR bioprosthe*)) OR cabg OR pleurectom* OR sternotom* OR thoracotom* OR sternotom*):ab,ti)

Google scholar (top 100 ranked)

music|musical|musicotherapy thorax|thoracic|heart|cardiac|cardiothoracic|coronary|valve|cardiovascular surgery|operative|replacement|bypass|postsurgical|postoperative|presurgical|preoperative|intrasurgical|intraoperative|cabg

S3 Study characteristics

Study	Country	Surgery type	Total study population	Race (% white)	Marital status (% married)	Educational level	Mean age (SD)		% Male		Outcome assessment
							Intervention	Control	Intervention	Control	
Ahmadabad, 2016	Iran	First time CABG	48	NR	93.8	Illiterate 8.3, primary school 47.9, high school 33.3, graduate 10.4	55.5(9.5)	59.3(11.8)	76.0	60.9	Pain (NRS), RR, HR, SBP, DBP
Barnason, 1995	USA	CABG	67	NR	NR	NR	67.0(9.9)	67.0(9.9)	67.7	67.7	Anxiety (STAI and NRS), HR, SBP, DBP
Bauer, 2011	USA	First time CABG and/or valve	100	NR	NR	NR	65.6(12.9)	60.2(12.4)	75.7	78.4	Anxiety and pain (VAS), HR, SBP, DBP, opioid use
Blankfield, 1995	USA	CABG and valve or valve	61	93.4	77.0	Less than high school 19.7, High school 37.7, some college 22.9, college 19.7	60.0(10.4)	65.0(7.8)	72.0	72.0	SICU stay (days), analgesics use
Cigerci, 2015	Turkey	CABG	68	NR	91.2	Primary school 79.4, secondary school 19.1, university 1.5	62.3(11.3)	60.8(10.3)	73.5	79.4	Anxiety (STAI) and pain (VAS), HR, RR, SBP, DBP, SpO_2, opioid use
Heidari, 2015	Iran	First time CABG	60	NR	88.3	Literate 65.0, illiterate 35.0	56.3(13.5)	60.9(8.7)	50.0	60.0	Anxiety (VAS), HR, SBP, DBP, MAP
Jafari, 2012	Iran	First time CABG and/or valve	60	NR	NR	NR	57.0(11.6)	58.6(9.6)	46.7	40.0	Pain (NRS)
Janardan, 2016	India	Open heart surgery*	60	NR	NR	NR	NR	NR	NR	NR	Anxiety (STAI), HR, RR, SBP, DBP
Kar, 2015	India	Open heart surgery**	34	NR	NR	NR	NR	NR	NR	NR	Opioid use
Mirbagher, 2014	Iran	First time CABG or valve	60	NR	80.0	Secondary education 33.3, diploma 38.3, academic 28.3	46.0(11.25)	45.5(11.25)	40.0	56.7	Pain (VAS)
Nilsson, 2009A	Sweden	First time CABG and/or	40	NR	NR	NR	64.0(10.0)	67.0(7.5)	85.0	75.0	HR, MAP, SaO_2

		valve									
Nilsson, 2009B	Sweden	First time CABG and/or valve	58	NR	NR	NR	64.0(11.5)	69.0(7.5)	NR	NR	Anxiety and pain (NRS), HR, RR, MAP, SaO_2
Schou, 2008	Denmark	CABG and valve or valve	41	NR	NR	NR	64.1(10.9)	64.3(8.9)	31.9	31.9	Anxiety and pain (VAS), LOS (days)
Schwartz, 2009	USA	CABG	67	NR	NR	NR	63.5(10.6)	64.8(10.6)	65.7	78.1	Time on MV (minutes), ICU LOS (minutes)
Sendelbach, 2006	USA	CABG and/or valve	85	NR	NR	NR	62.3(14.8)	64.7(11.4)	62.0	80.6	Anxiety (STAI), pain (NRS), HR, SBP, DBP, opioid use (ME)
Stein, 2010	USA	CABG or CABG and valve	36	91.7	Employed 33.3, retired 44.4, disabled 16.7, unemployed 5.6	High school 30.6, college 47.2, postgraduate 22.2	64.3(11.4)	65.4(11.0)	58.8	94.7	Anxiety (HADS)
Twiss, 2006	USA	CABG or valve	60	NR	NR	NR	72.6(2.1)	75.1(3.4)	33.0	33.0	Anxiety (STAI), time on MV (minutes)
Voss, 2004	USA	CABG or valve***	40	NR	NR	NR	63.0(13.0)	63.0(13.0)	64.0	64.0	Anxiety and pain (VAS), distress (VAS), opioid use (ME)
Zeydi, 2011	Iran	CABG or valve	60	NR	98.3	NR	57.0(11.6)	58.6(9.6)	46.7	40.0	HR, RR, SBP, DBP, MAP, SpO_2
Zimmerman, 1996	USA	CABG	64	100	NR	NR	67.0(11.8)	67.0(11.8)	64.0	64.0	Pain (VRS)
Summary of all studies			58.5(16.1)				61.8(5.8)	63.1(6.1)	59.0(15.7)	63.3(18.2)	

NR = not reported, USA = United States of America, CABG = coronary artery bypass graft, (S)ICU = (surgical) intensive care unit, LOS = length of stay, VAS = visual analogue scale, NRS = numeric rating scale, VRS = verbal rating scale, STAI = state- trait anxiety inventory, HADS = hospital anxiety and depression scale, HR = heart rate, RR = respiratory rate, SBP = systolic blood pressure, DBP = diastolic blood pressure, MAP = mean arterial pressure, ME = morphine equivalent, MV = Mechanical Ventilation, SaO_2 = arterial oxygenation, SpO_2 = oxygen saturation, PaO_2 = partial pressure of oxygen.
*Atrial septal defect (ASD), ventricular septal defect (VSD), aortic valve diseases, mitral valve disease, tricuspid valve disease, CABG and congenital heart disease and post-operative open heart surgery
** Under cardiopulmonary bypass, surgery type not specified
*** Coronary artery bypass grafting (CABG) procedures (80%), valve repair (14%), replacement of pulmonary homograft (2%), resection of atrial myxoma (2%), and resection of a right coronary artery aneurysm (2%)

Music intervention characteristics

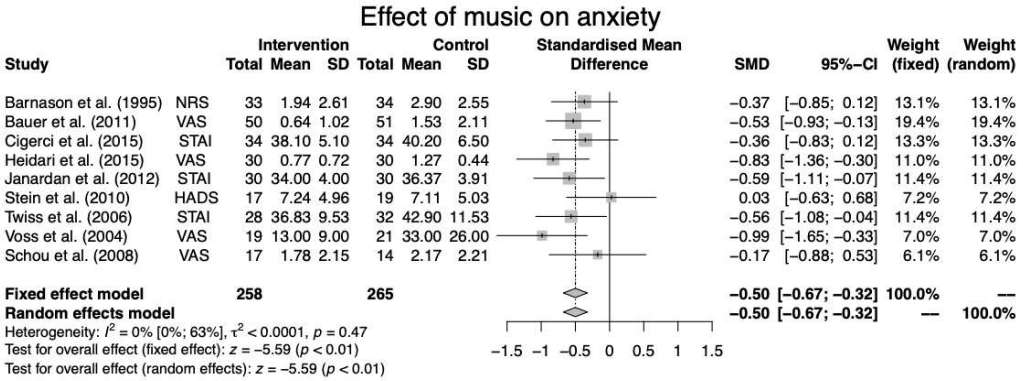
Study	Timing intervention	Location	Delivery	Frequency (per day) x duration (min.)	Total duration (min.)	Music description	Intervention choice	N intervention group	Control	N control group
Ahmadabad, 2016	POD 2	ICU	Headphones	2 x 30	60	Based on cultural conditions of the society, 60-80 beats/min, general absence of strong rhythms or percussion	Patient preference	25	Standard care	23
Barnason, 1995	POD 2-3	Ward	Headphones	1 x 30	60	Country western instrumental, fresh aire (by Mannheim Steamroller), winter into spring (by George Winston), prelude and comfort zone (both by Steven Halpern); soothing, facilitates relaxation	Option out of lists	33	Scheduled rest	34
Bauer, 2011	POD 2-4	ICU and ward	CD player	2 x 20	120	Summer song, autumn song, bird song, night song in combination with music	Option out of lists	49	Scheduled rest	51
Blankfield, 1995	Intra-op Post-op LOS	OR, ICU, ward	Headphones	2 x 30	390	Dreamflight II by Herb Ernst	Researcher	32	Intra-op blank tape, post-op standard care	29
Cigerci, 2015	Pre-op Post-op LOS	ICU, ward	Headphones	1 x 1.5h Pre, 1 x 30 ICU, 1 x 30 ward	NR	Turkish classical and folk music	Patient preference	34	Standard care	34
Heidari, 2015	POD 1	ICU	Headphones	1 x 30	30	Light music, sounds of nature including sea and bird noises	Researcher	30	Standard care	30
Jafari, 2012	POD 1	ICU	Headphones	1 x 30	30	Relaxation music pieces, 60-80bmp	Option out of lists	30	Headphones without music	30
Janardan, 2016	POD NS	NR	Headphones	1 x 20	20	Breathing exercises + music	Patient preference	30	Breathing exercises	30
Kar, 2015	Pre-op Intra-op Post-op	OR	Earphones	NR	NR	Raga therapy	Researcher	17	Earphones with blank CD.	17
Mirbagher, 2014	POD 0/1	ICU	Headphones	1 x 30	30	Sedative music without lyrics, with sustained melodic quality, 60-80bpm, absence of strong rhythms or percussions	Researcher	30	Headphones without music	30
Nilsson, 2009A	POD 1	NR	Music pillow	1 x 30	30	Soft, relaxing, 60-80bpm	Researcher	20	Scheduled rest	20
Nilsson, 2009B	POD 1	NR	Music pillow	1 x 30	30	Soft, relaxing, 60-80bpm, included different melodies in new age style	Researcher	28	Scheduled rest	30

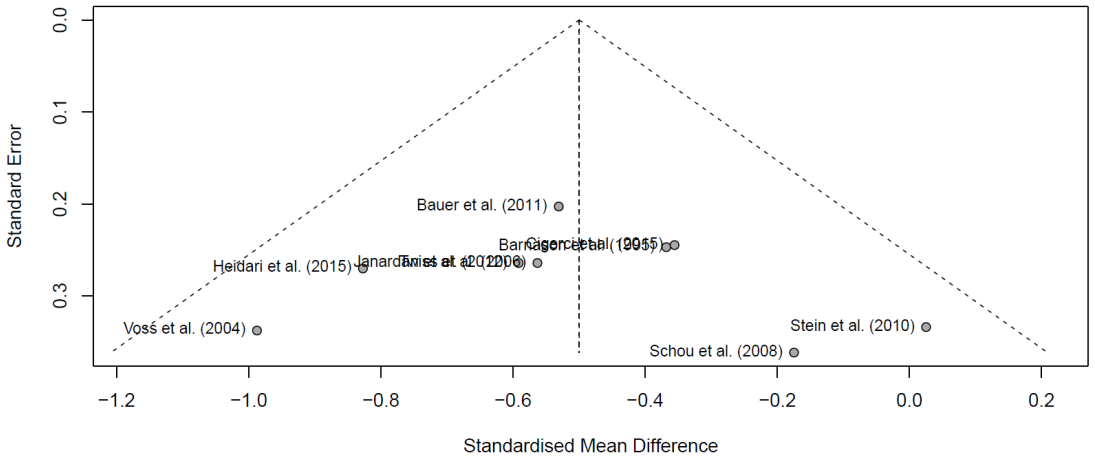
Schou, 2008	Pre-op POD 5/6	Ward	Music pillow	4 x 35	140	Easy listening, classical, specially composed, new age	Option out of lists	22	Scheduled rest	19
Schwartz, 2009	POD 0-1	ICU	Headphones	Average 2-3 sessions	259	Light music	Researcher and option out of lists	35	Standard care	32
Sendelbach, 2006	POD 1-3	NR	Headphones	2 x 20	120	Easy listening, classical, or jazz (no dramatic changes, instrumental music, 60-70bpm) + brief session of relaxation before music	Option out of lists	49	Scheduled rest	36
Stein, 2010	Pre-op Intra-op	Home, OR	NR	NR	NR	Relaxing music	Researcher	17	Standard care	19
Twiss, 2006	Intra-op Post-op	OR, ICU	Headphones	NR	NR	Relaxing and calming music (songs available)	Intra-op option out of lists and post-op own music	28	Standard care	32
Voss, 2004	POD 1	ICU	Headphones	1 x 30	30	Sedative music defined as without lyrics, sustained melodic quality, 60-80bpm, general absence of strong rhythms or percussion. Lists: Synthesizer, harp, piano, orchestra, slow jazz, flute.	Option out of lists	19	Scheduled rest	21
Zeydi, 2011	POD 0-1	ICU	Headphones	1 x 30	30	Relaxing music, 60-80bpm	Option out of lists	30	Headphones without music	30
Zimmerman, 1996	POD 2-3	Ward	Headphones	1 x 30	60	Country western instrumental, fresh aire (by Mannheim Steamroller), winter into spring (by George Winston), prelude and comfort zone (both by Steven Halpern); facilitates relaxation)	Option out of lists	32	Scheduled rest	32

NR = not reported, NS = not specified, ICU = intensive care unit, OR = operation room, POD = postoperative day, Pre-op = preoperative, Intra-op = intraoperative, Post-op = postoperative, LOS = length of stay, min. = minutes.

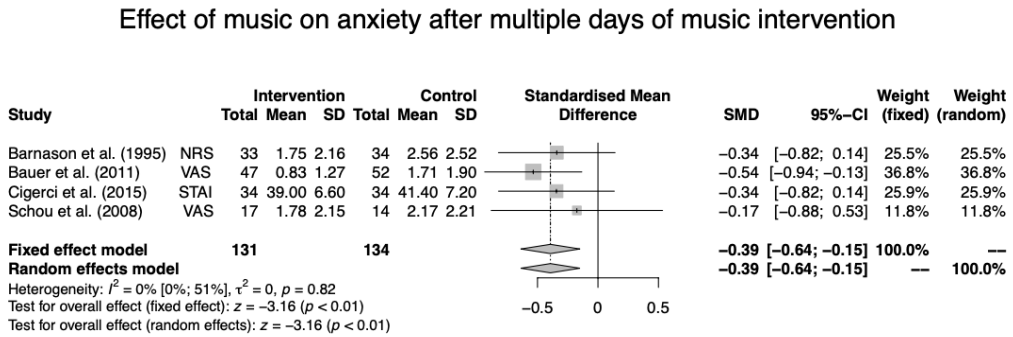
S4 Effect of music on anxiety

Forest and funnel plots presenting the effect of the first postoperative music session on postoperative anxiety score.



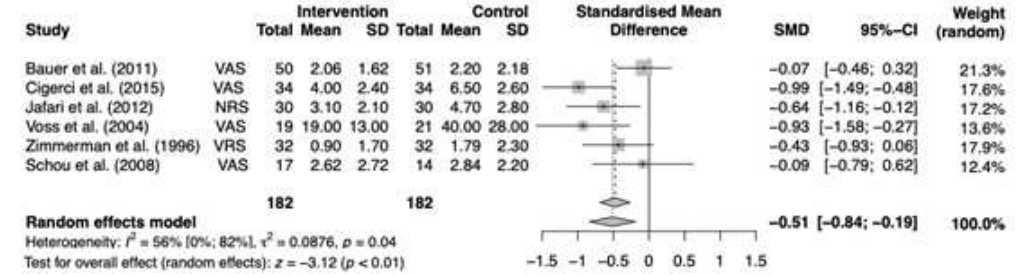

Standard Error
0.0
0.1
0.2
0.3
Bauer et al. (2011)
Heidari et al. (2015)
Voss et al. (2004)
Stein et al. (2010)
Schou et al. (2008)
−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
0.0
0.2
Standardised Mean Difference

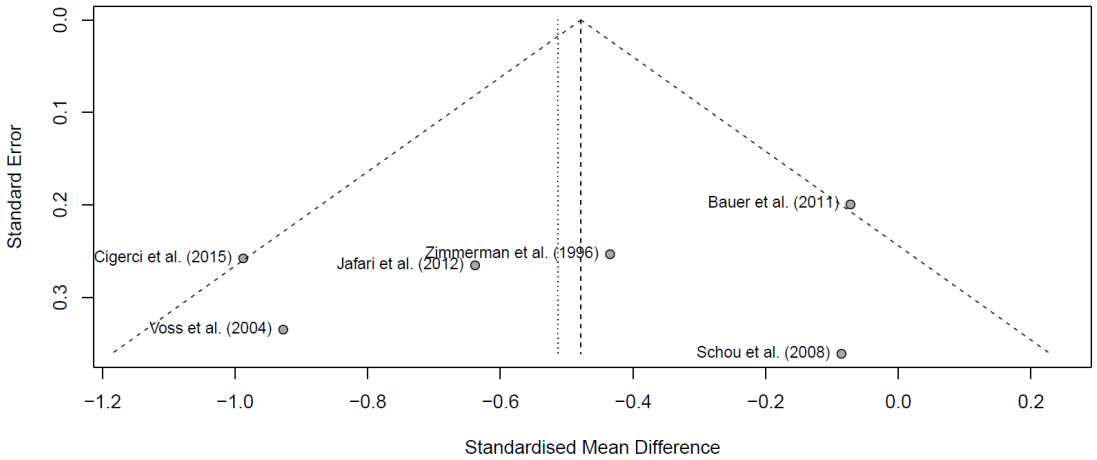
Forest plot of the effect of music intervention on postoperative anxiety scores after the last music session.



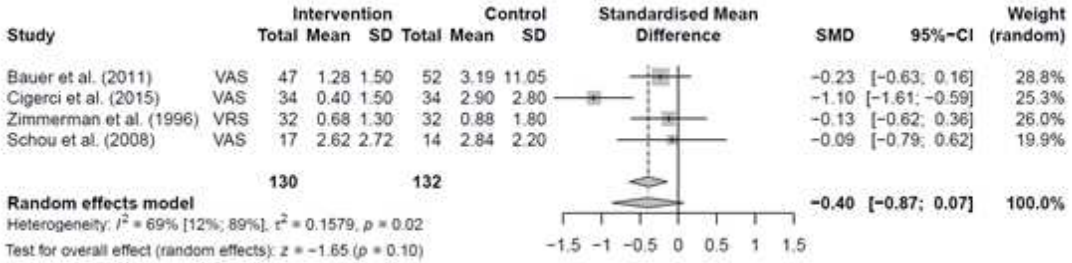
S5 Effect of music on pain

Forest and funnel plots presenting the effect of the first postoperative music session postoperative music intervention on postoperative pain score.



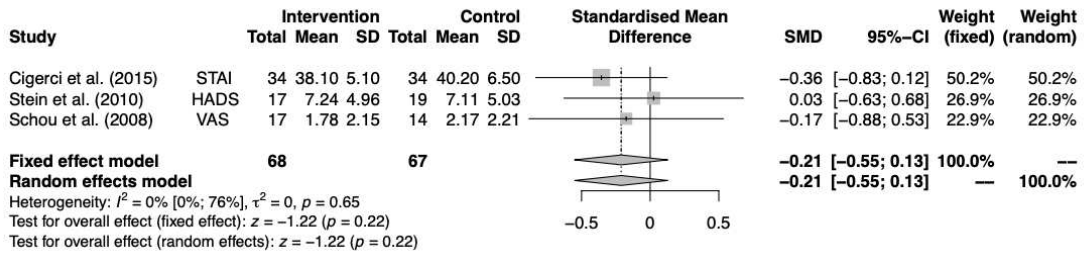


Forest plot of the effect of music intervention on postoperative pain scores after the last music session.

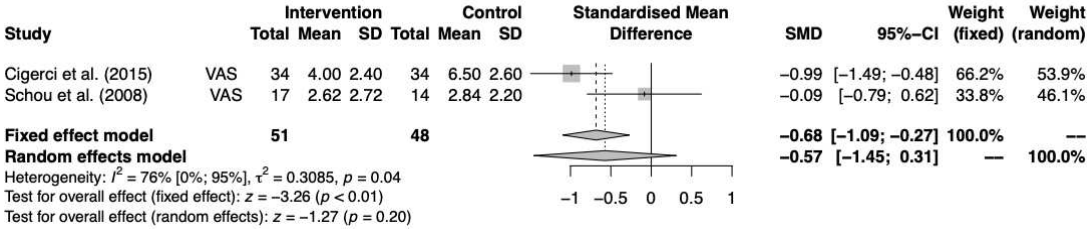


S6 Subgroup analysis

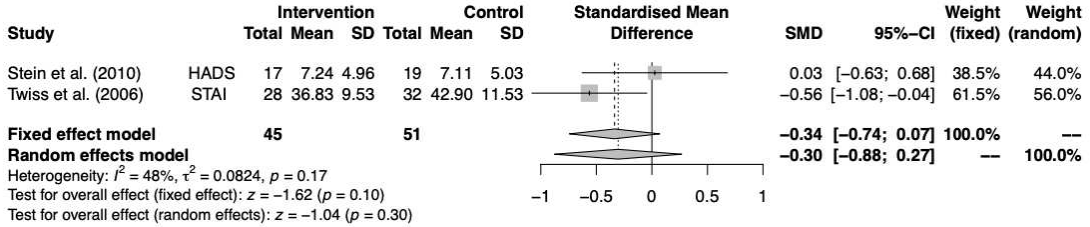
Forest plot of the effect of preoperative music in combination with postoperative music on postoperative anxiety.



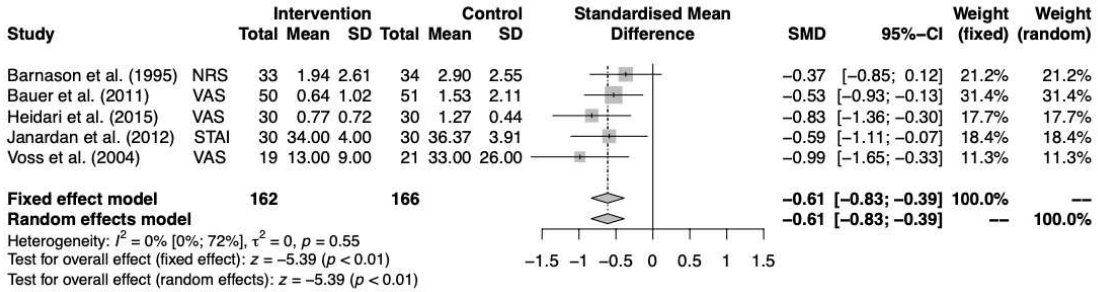
Forest plot of the effect of preoperative music in combination with postoperative music on postoperative pain.



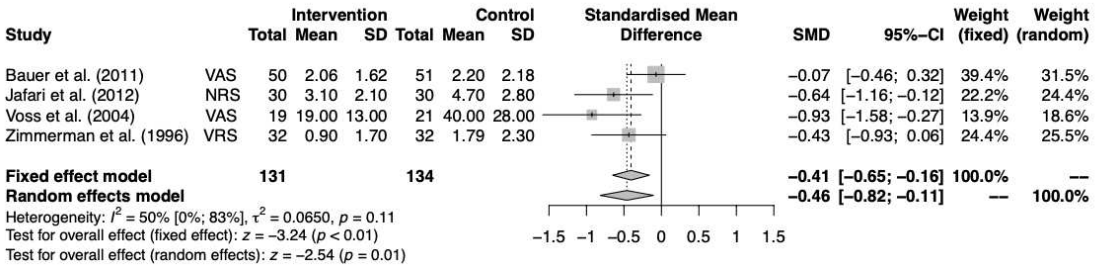
Forest plot of the effect of intraoperative music in combination with postoperative music on postoperative anxiety.



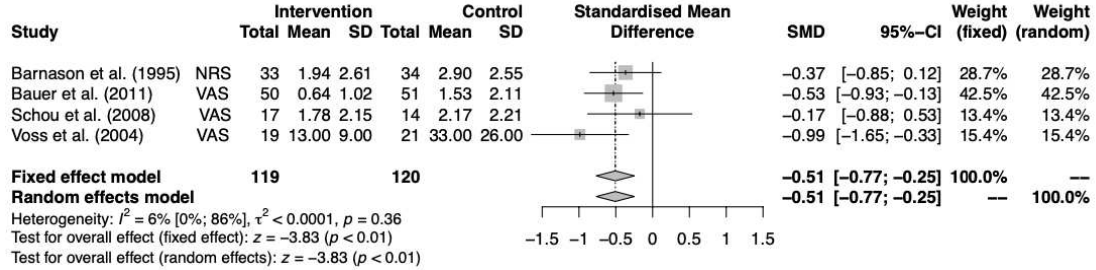
Forest plot of the effect of postoperative music on anxiety.



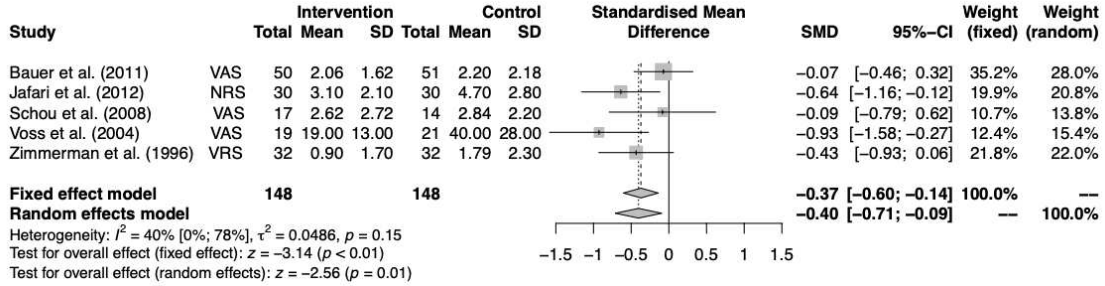
Forest plot of the effect of postoperative music on pain.



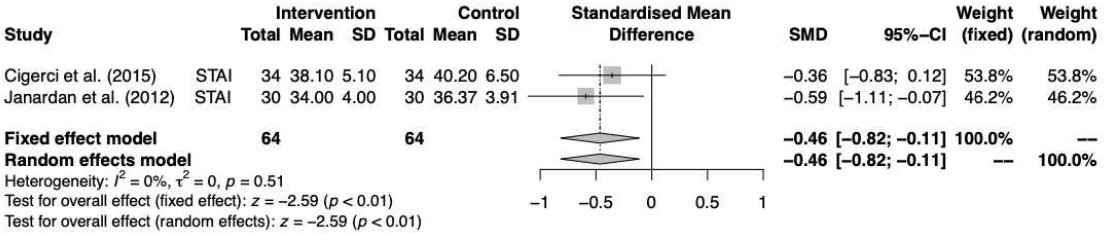
Forest plot of the effect of music on anxiety when patients choose from music lists.



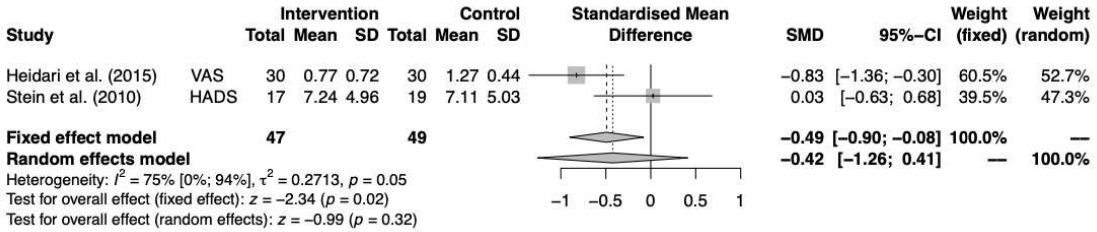
Forest plot of the effect of music on pain when patients choose from music lists.



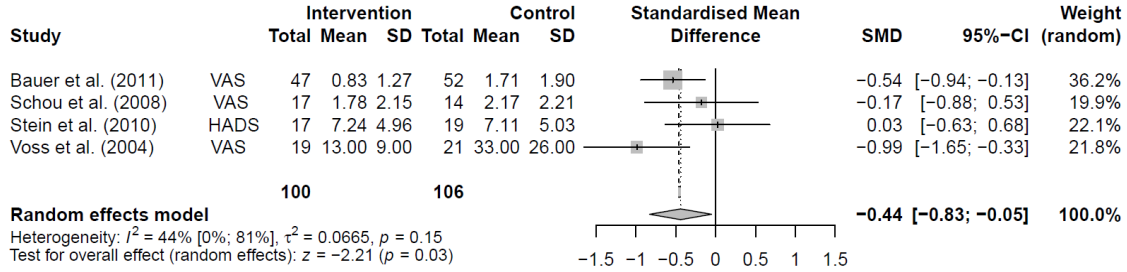
Forest plot of the effect of patient selected music on anxiety.



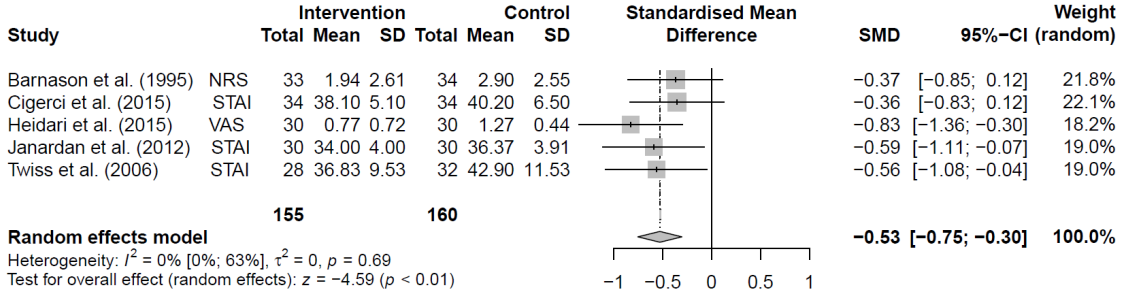
Forest plot of the effect of researcher selected music on anxiety.



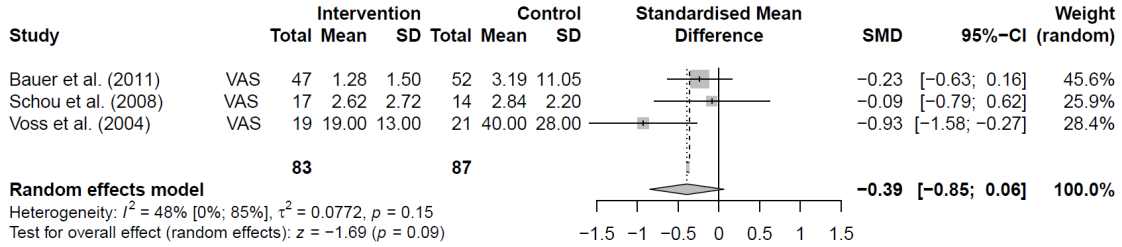
Forest plot of the effect of music on anxiety in studies with low risk of bias due to the randomization procedure.



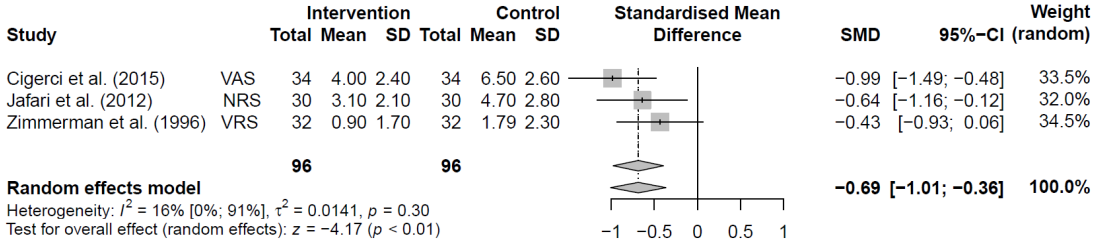
Forest plot of the effect of music on anxiety in studies with high risk of bias due to the randomization procedure.



Forest plot of the effect of music on pain in studies with low risk of bias due to the randomization procedure.

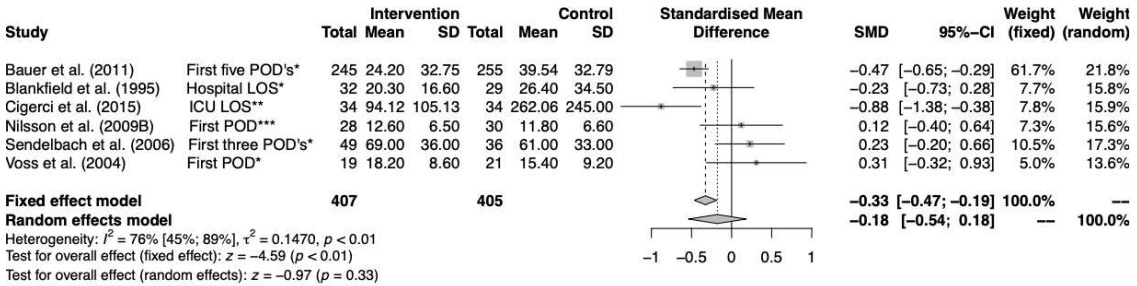


Forest plot of the effect of music on pain in studies with high risk of bias due to the randomization procedure.



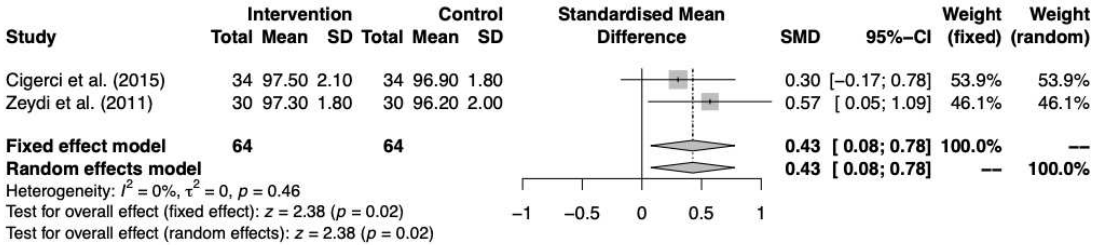
S7 Effect of music on other parameters

Forest plot of the effect of music on perioperative opioid use.

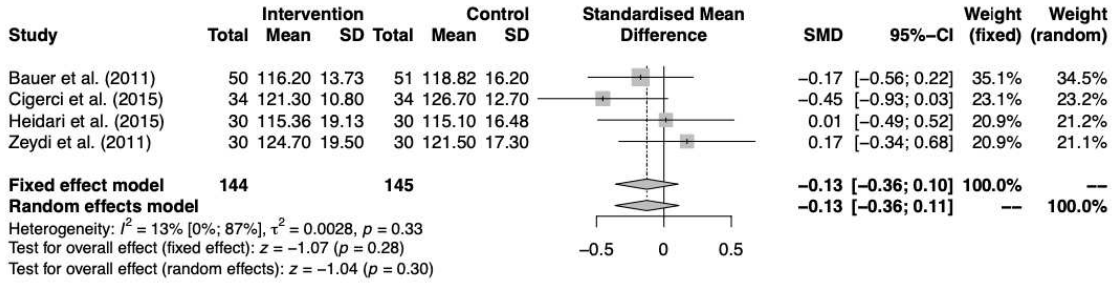


*Morphine equivalents; **Opioids; ***Ketobemidone

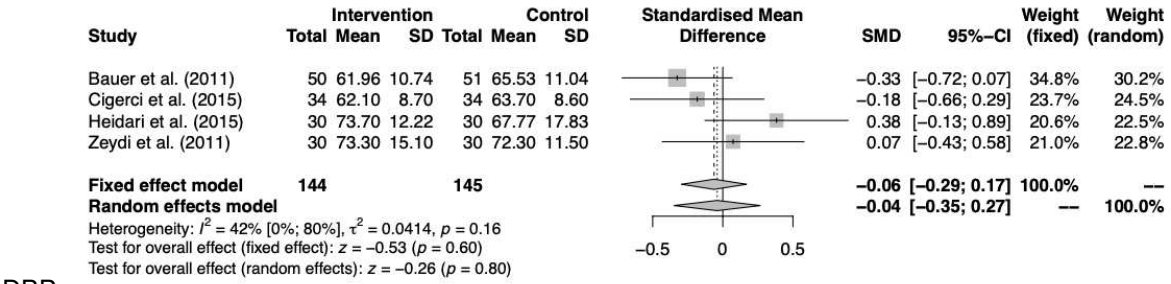
Forest plot of the effect of music on $Sp0_2$.



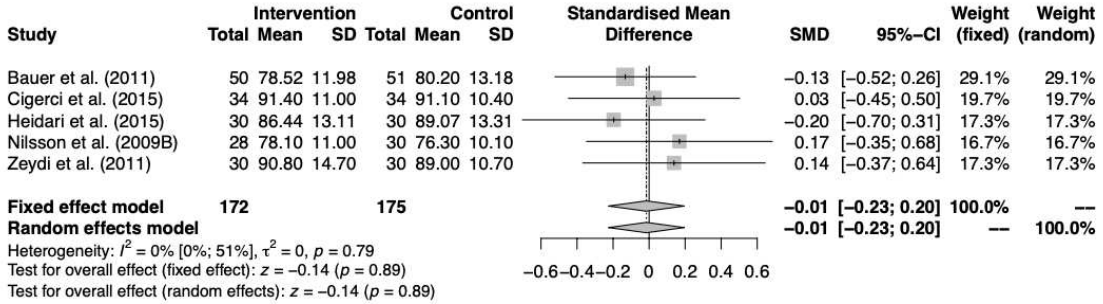
Forest plot of the effect of music on SBP.



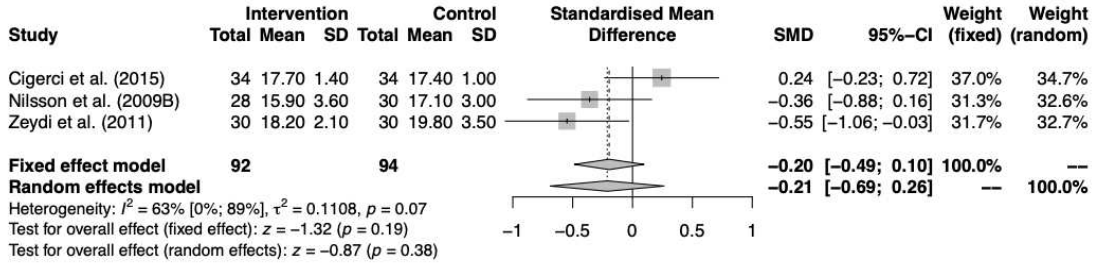
Forest plot of the effect of music on DBP.



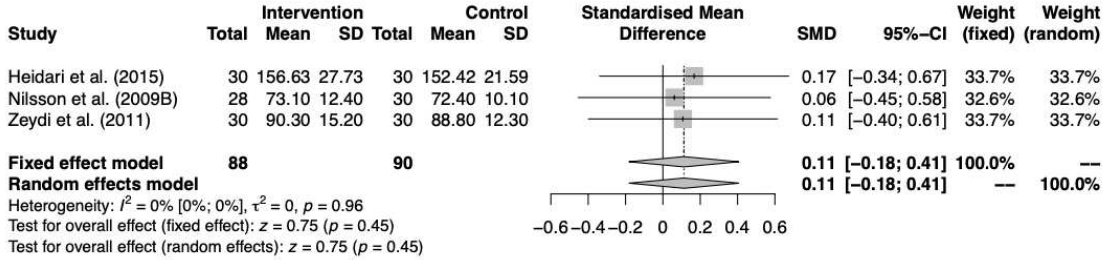
Forest plot of the effect of music on HR.



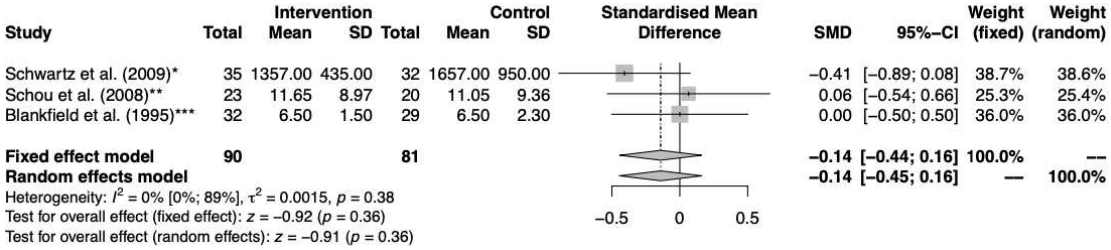
Forest plot of the effect of music on RR.



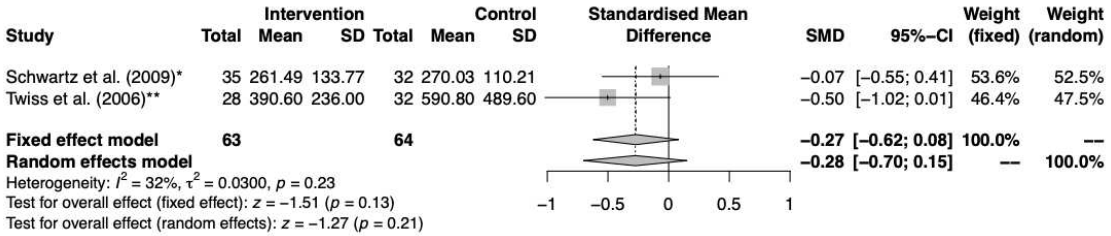
Forest plot of the effect of music on MAP.



Forest plot of the effect of music on LOS.



Forest plot of the effect of music on time on mechanical ventilation.


Intervention
Control
Standardised Mean Difference
Weight (fixed)
Weight (random)
Study
Total
Mean
SD
Total
Mean
SD
SMD
95%–CI
Schwartz et al. (2009)* 35 261.49 133.77 32 270.03 110.21 −0.07 [−0.55; 0.41] 53.6% 52.5%
Twiss et al. (2006)** 28 390.60 236.00 32 590.80 489.60 −0.50 [−1.02; 0.01] 46.4% 47.5%
Fixed effect model 63 64 −0.27 [−0.62; 0.08] 100.0% –
Random effects model −0.28 [−0.70; 0.15] – 100.0%
Heterogeneity: I^2 = 32%, τ^2 = 0.0300, p = 0.23
Test for overall effect (fixed effect): z = −1.51 (p = 0.13)
Test for overall effect (random effects): z = −1.27 (p = 0.21)
−1
−0.5
0
0.5
1