Chen *et al. BMC Psychology* (2025) 13:455
https://doi.org/10.1186/s40359-025-02643-x

BMC Psychology

SYSTEMATIC REVIEW

The effect of music therapy for patients with chronic pain: systematic review and meta-analysis

Siqing Chen[1,2,3,4], Qiao yuan[1,4], Chenchen Wang[1,4], Jing Ye[1,4] and Lili Yang[1,4*]

Abstract

Aims To assess the effect of music therapy in improving chronic pain (CP), anxiety, depression, and quality of life using randomized controlled trials, and to explore the role of various moderators in MT effectiveness.

Design Systematic review and Meta-analysis.

Methods We systematically searched four electronic databases for randomized controlled trials that investigated the effects of music therapy on chronic pain, anxiety, depression, and quality of life. We performed a Cochrane risk-of-bias assessment and calculated the pooled standard mean difference in the outcomes of the test and control groups after the intervention period.

Results Nine randomized controlled trials were retrieved that included a total of 787 patients. Music therapy significantly reduced CP in the test group compared with that in the control group post-intervention and depression, no evidence was observed for improvement in anxiety and quality of life. Subgroup analysis reveals that MT is most effective when interventions are conducted in developed countries, targeting CNMP or cancer pain patients in health centers. The therapy is most effective when patients select their own music, use instruments or earphones, and receive treatment from trained professionals, with an ideal duration of 20 min, except in studies involving postoperative CP or those conducted in developing countries.

Conclusions Music therapy effectively reduces CP and depression, but has limited effects on anxiety and quality of life. Its effectiveness varies depending on the specific conditions and CP categories of patients, with differences observed between developing and developed countries. Future research should focus on developing standardized guidelines for music therapy, exploring its long-term effects on pain, anxiety, and quality of life, and conducting high-quality, multicenter RCTs in developing countries to support its global adoption in CP management.

Keywords Chronic pain, Music therapy, Quality of life, Systematic review, Meta-analysis

*Correspondence:
Lili Yang
3200006@zju.edu.cn
Full list of author information is available at the end of the article

Introduction

Chronic pain (CP) has been defined by the International Association for the Study of Pain Research as persistent or recurrent pain that lasts for ≥ 3 months, which has been declared a disease in 2000 [1]. Approximately 25% of people worldwide will, at some point, suffer from chronic pain. In many countries, the incidence of CP in the general population is 20 ~ 45%. In the US alone, up to 12 million people have experience CP. The high prevalence and refractory nature of CP, in conjunction with the negative consequences of pain medication dependence, can lead to significant medical, social, and economic consequences, relationship issues, loss of productivity, and high healthcare costs [2–4]. The World Health Organization (WHO) estimates CP as one of the leading causes of Years Lost to Disability globally. However, the existing treatment has modest efficacy, limited tolerability, and important safety risks. CP is frequently accompanied by psychiatric disorders such as pain medication addiction and depression, which complicate the treatment [5]. In addition, pain can significantly diminish one's quality of life owing to its negative impact on every aspect of life [6, 7]. In 2016, the Centers for Disease Control and Prevention (CDC) issued recommendations to reduce the use of opioids and increase the use of non-pharmacological therapies for CP treatment [8, 9]. A recent study in the Lancet demonstrated that opioids currently are no longer considered to be a first-line treatment for any form of chronic pain, and many guidelines do not recommend them at all in some populations (e.g., young individuals with non-cancer pain), and it also have demonstrated that the rates of alternative treatments continue to increase [10]. Viable complementary therapy or alternatives to opioids are promising treatment options for patients with CP. The US Food and Drug Administration (USFDA) issued policy statements calling for the development of novel therapies with reduced potential for misuse [5].

The World Federation of Music Therapy (MT) defines MT as the use of music and musical elements (sound, rhythm, melodies, or harmonies) to ease and promote communication, relationships, learning, movement, expression, organization, and other relevant therapeutic objectives, thereby solving physical, emotional, mental, social, and cognitive needs [11]. Studies have shown that MT can benefit patients suffering from pain [11–13]. Currently, MT, as an important viable complementary and alternative treatments, has been widely used in the clinical management of diseases, but it is not widely used in patients with CP and the methodological quality of some trials is typically poor. In addition, the evidence regarding the effects of MT on CP and depression, anxiety, and quality of life has yet to be reported. Thus, we conducted a systematic review and Meta-analysis to evaluate the effectiveness of MT in patients with CP using published randomized clinical trials (RCTs) data and outcome indicators, improvement in CP was the primary outcome, and secondary outcomes included alleviation of depression and anxiety as well as improved quality of life. In addition, we sought to explore the role of various moderators in MT effectiveness, aiming to provide a basis for the development of therapeutic guidelines, clinical pain interventions, and the application of music therapy for CP patients.

Methods

Registration and protocol

We conducted this systematic review and meta-analysis following the Cochrane Handbook for Systematic Reviews of Interventions [14] and adhered to the PRISMA guidelines in preparing the manuscript. A PROSPERO protocol (CRD42022348688) was registered prior to starting the review.

Eligibility and exclusion criteria

The inclusion criteria were as follows: (1) Types of study participants: participants with all forms of CP, and the eligibility was not restricted by diagnostic status, medication usage, or any other characteristics (such as age or gender); (2) Types of interventions: the experimental group received MT; (3) Types of control: The comparison group accepted conventional control measures such as usual care, standard care and placebo intervention;(4) Outcome indicators: studies assessed CP as an outcome; (5) Study type: RCTs; and (6) Language: published in English. Exclusion criteria included: (1) duplicate publications, and (2) protocols, reviews, theoretical literature, case reports, dissertations, and conference papers.

Search strategy

We identified studies that evaluated the effectiveness of MT for CP patients using PubMed, Web of Science, Embase, and Cochrane Library. The search strategy was customized slightly for different databases. Search terms were as follows: "Music Therapy" OR "Music" OR "Musical" OR "Music Intervention" OR "sing" OR "Therapy, Music" And "Chronic Pains" OR "Pains, Chronic" OR "Pain, Chronic" OR "Widespread Chronic Pain" OR "Chronic Pain, Widespread" OR "Chronic Pains, Widespread" OR "Pain, Widespread Chronic" OR "Pains, Widespread Chronic" OR "Widespread Chronic Pains". After the electronic search, we searched potential papers from the reference lists of included relevant reviews, and previous meta-analyses. The PubMed search strategy was as follows:

#1 "Chronic pain" [Mesh]
#2 Chronic Pains [Title/Abstract] OR Pains, Chronic [Title/Abstract] OR Pain, Chronic [Title/Abstract] OR Widespread Chronic Pain [Title/Abstract] OR Chronic Pain, Widespread [Title/Abstract] OR Chronic Pains, Widespread [Title/Abstract] OR Pain, Widespread Chronic [Title/Abstract] OR Pains, Widespread Chronic [Title/Abstract] OR Widespread Chronic Pains [Title/Abstract]
#3 #1 OR #2
#4 "Music therapy" [Mesh]
#5 Music therapy [Title/Abstract] OR Music [Title/Abstract] OR Musical [Title/Abstract] OR Music Intervention [Title/Abstract] OR Sing [Title/Abstract] OR Therapy, Music [Title/Abstract]
#6 4 OR #5
#7 #3 AND #6

Study selection

Duplicate literature was identified using EndNote X9 and manually removed. Based on inclusion and exclusion criteria, titles and abstracts were screened to exclude documents that clearly did not meet the criteria. Full texts were then reviewed to further exclude any ineligible studies. Two reviewers independently extracted key information: first author, publication year, country, CP category, age, sex, sample size, intervention content and control treatments, music selection, tools, outcome measures, intervention equipment, form, frequency, timing, qualifications, and music genre. Disagreements were resolved by consulting a third reviewer for the final decision.

Quality assessment

Studies that met the inclusion criteria underwent a rigorous quality assessment to evaluate bias risk for each outcome. Two independent reviewers assessed the studies using the Cochrane Collaboration's risk of bias tool (Cochrane Handbook 5.3) [14], covering key domains like sequence generation, allocation concealment, blinding, incomplete outcome data, selective reporting, and other potential biases. Each study was assigned a risk level: low, unclear, or high. Quality grades were designated as A (low bias), B (moderate bias), or C (high bias). Studies rated A or B were included in the analysis, while those rated C were excluded due to high bias risk.

The two reviewers conducted evaluations independently, compared their results, and resolved disagreements through discussion or, if needed, by consulting a third party. The final evidence synthesis was performed using the John Hopkins Evidence Synthesis and Advice Tool, with meta-analysis findings interpreted in light of the identified bias risks.

Data synthesis and analysis

The meta-analysis was conducted using RevMan 5.4. Statistical effectiveness was analyzed using Cohen's standardized mean difference (SMD) with 95% confidence intervals (CI) for categorical and continuous data. Heterogeneity was assessed using Cochran's Q test and the I^2 statistic, with I^2 levels categorized as low (25%), moderate (50%), and high (75%). SMD was applied to combine results across different assessment tools, while mean difference (MD) was calculated for consistent tools, such as the Visual Analog Scale (VAS) and numeric rating scale (NRS). A funnel plot assessed publication bias.

To explore the impact of various moderators on MT effectiveness and investigate sources of heterogeneity across studies, we performed subgroup analyses. The subgroup variables included countries (developing countries, developed countries), sample sizes ($\geq 50- < 80; \geq 80- < 120; \geq 120$), mean ages ($< 50$, 50–55, > 55), settings (hospital and health/medical center), CP categories (CNMP, cancer, postoperative CP), intervention equipment (musical instrument, earphone, loudspeaker&Earphone, CD/Tape, Player&Headphone), intervention content (PMT (recorded music) and AMT (live music)), intervention durations (minutes) (20, 30, 60), music selection (patient, music therapists/nurses), qualifications (music therapists, trained therapists), pain assessment tools (NRS, VAS).

Results

Study selection and identification process

A total of 1,128 records were identified through database searches: Web of Science ($n=415$), Embase ($n=222$), PubMed ($n=214$), Cochrane Library ($n=$ 235), CNKI ($n=19$), Wanfang Database ($n=16$), and VIP ($n=7$). After removing duplicates, 538 records remained. Of these, 469 records were further assessed, and 232 were excluded due to incorrect study types, while 227 were deemed irrelevant. A total of 7 studies were included based on the reference lists of other publications. After full-text review, 69 publications were excluded for various reasons: 19 for acute pain, 24 for being combined with other therapies, 2 for being in other languages, 5 for being protocol articles, 7 for incomplete data, and 12 for unavailable full texts. Ultimately, Nine studies [15–23] were included in the meta-analysis, and two studies were conducted by the same researchers [20, 21]. Figure 1 presents the flow diagram of study selection and identification.

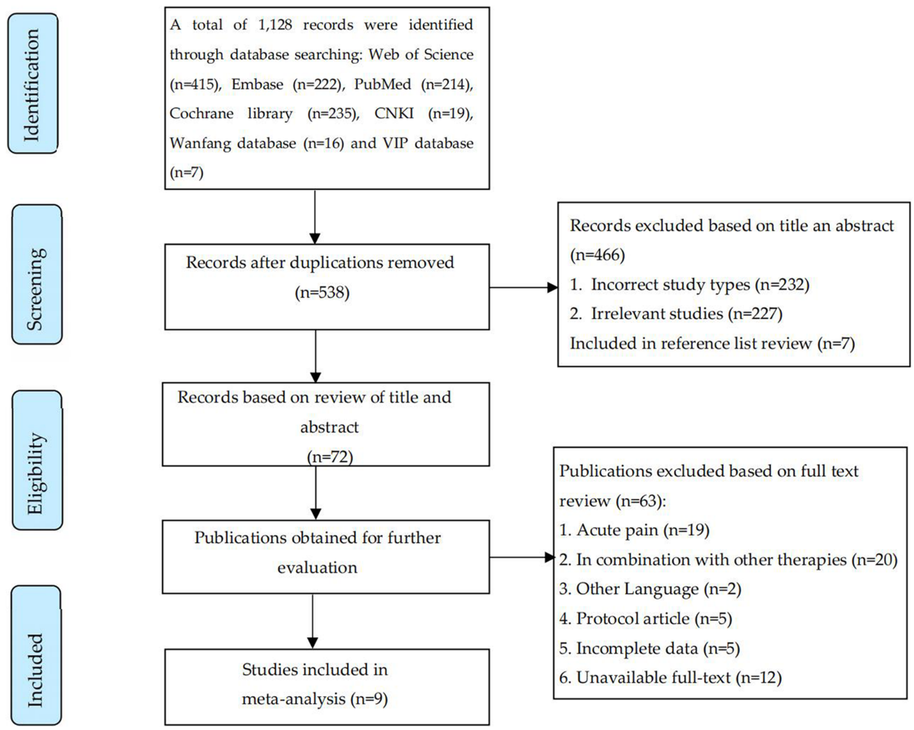

Fig. 1 Flow diagram of study selection and identification

Study characteristics

The included studies were published between 2006 and 2021, with sample sizes ranging from 42 to 198. These studies were from five different countries and regions: USA (*n* = 3) [15, 18, 23], China (*n* = 3) [19–21], France (*n* = 1) [17], Italy (*n* = 1) [16], Spain (*n* = 1) [22] and six (66.67%) studies were conducted in developed countries and three (33.33%) studies were conducted in developing countries. Regarding the sample size, five studies (55.56%) had sample sizes between ≥ 50 and < 80, 2 studies (22.22%) had sample sizes between ≥ 80, < 120, and two studies (22.22%) had sample sizes of ≥ 120.

Regarding the categories of CP, CNMP was reported in three studies (33.33%), chronic cancer pain and postoperative CP were reported in two studies (total *n* = 4, 44.44%); fibromyalgia was reported in one study (11.11%), and one study did not specify a medical condition or source of the CP (11.11%). In terms of the pain assessment tool, VAS was used as an assessment tool in seven studies (77.78%), while NRS (22.22%), and SF-MPQ (22.22%) were used in two studies. One study used NRS and FLACC together for pain assessment (11.11%). In terms of the quality of life, SF-36 was used in two studies (22.22%). In terms of depression and anxiety, HADS and BDI were used in two studies (22.22%) and one study (11.11%), respectively.

In terms of intervention durations, two studies (22.22%) used 60-min sessions, four studies (44.44%) applied 30-min sessions, and two studies (22.22%) used 60-min sessions. In terms of the measurement time, three studies (33.33%) measured before and after the intervention, two studies (22.22%) measured baseline, 4, 8, and 12 weeks (follow-up at 12 weeks); two studies (22.22%) measured six months after surgery, and one study (11.11%) measured baseline, 4, 8, and 12 weeks (follow-up at 12 weeks). One study (11.11%) measured 0, 5, 10, 60, and 90 days. Regarding the qualification, three studies were conducted by qualified music therapists (33.33%) and trained nurses(33.33%), and nurse-researcher teams; one study had no report (total *n* = 3, 33.3%). In terms of the music selection, it was selected by patients in seven studies (77.78%) and selected by music therapists and nurses were two studies (22.22%). In terms of the intervention setting, four studies (44.44%) were in a hospital, one study (11.11%) was at home, one study was at home, and one study was at a hospital, clinic, medical center, and nurse-managed health center, respectively (total n = 4, 44.44%). In terms of the music genre, six studies(66.67%) used three genres music (n = 22.22%), different genres (n = 22.22%) and instrumental music (n = 22.22%), followed by vocal improvisation (n = 1, 11.11%), mixed music (n = 1, 11.11%) and classical (n = 1, 11.11%). Among the three and mixed music genres: two studies (22.22%) used classical music, while three studies used jazz and world music (n = 1, 11.11%), folk songs, Buddhist music and instrumental music (n = 1, 11.11%) and salsa music (n = 1, 11.11%), respectively.

In terms of the music equipment, five studies (55.56%) used headphones, three studies (33.33%) used musical instruments, and one study used loudspeakers, tape players, and CDs (total n = 3, 33.33%). Regarding the music intervention type, eight studies (88.89%) used PMT, and one study (11.11%) used AMT. There were seven individual intervention studies (77.78%) and 2 group intervention studies (22.22%). Six studies (66.67%) had recorded music, one study (11.11%) had live music, and one study (11.11%) had vocal MT. All control groups were treated with standard care (n = 9,100%). In addition, in terms of the intervention duration, four studies (44.44%) were 30 min/time, three studies (33.33%) were 60 min/time, and two studies (22.22%) were 20 min/time. Regarding the frequency of intervention, seven studies (77.78%) were once a day, one study was two times/day, and eight times/a week (total n = 2, 22.22%). The characteristics of the included studies are summarized in Table 1.

Risk of bias

High-risk studies were excluded [24–28]. The risk assessment of bias in the included studies is shown in Figs. 2 and 3. Nine studies [15–23] had eight items mentioning the production of random order (88.9%), and one study did not describe the specific random method (11.1%). Six studies reports were hidden in allocation (66.7%), three studies did not mention the hidden plan (33.3%), and the experimental design of the object of the blindness of MT was difficult to apply. Six studies mentioned that the research objects and interviewees were blinded applied (66.7%). Three studies did not specify the blindness (33.3%) of the research objects and interviewees; five studies performed the results of the evaluation (55.6%), and the four studies did not describe whether the results were blind (44.4%). All nine studies are complete (100%) for the ending indicators, and the possibility of selective report results is low (100%); the risk of bias from other aspects is low (100%). The evidence synthesis of the included studies is summarized in Table 2.

The overall effects of MT

Nine studies (n = 787) [15–23] evaluated the effects of MT on CP using a random-effects model. Meta-analysis of the random effects model showed that the MT reduced CP [15–23] (9 RCTs, SMD = −0.51, 95% CI: −0.72, −0.30, $P < 0.00001$, $I^2 = 62\%$; Fig. 4), depression [15, 17, 22, 23] (4 RCTs, SMD = −0.83, 95% CI:−1.44 to −0.22, $P = 0.0001$, $I^2 = 83\%$; Fig. 5), while it did not show a positive effect on anxiety [15, 17] (2 RCTs, MD = −3.31, 95%CI (−8.21, 1.58, $P = 0.18$, $I^2 = 90\%$, Fig. 6) and quality of life [20, 21] (2 RCTs, MD = 2.59, 95%CI (−0.47, 5.65), $P = 0.1$, $I^2 = 77\%$, Fig. 7).

Sub-group analyses

Countries

9 RCTs (N = 747) [15–23] measured the effect of MT on CP in different countries. These countries were divided into two groups for subgroup analysis: developing countries (n = 3) [19–21], and developed countries (n = 6) [15–18, 22, 23]. The results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in developed countries group (SMD = −0.73, 95% CI: −0.16 to −0.04, $P < 0.0001$, $I^2 = 74\%$, but MT did not improve CP in developing countries group (SMD = −0.39, 95% CI: −0.89 to 0.11, $P < 0.13$, $I^2 = 64\%$), Table 3.

Sample sizes

9 RCTs (N = 747) [15–23] measured the effect of MT on CP in different sample sizes, which were divided into three groups for subgroup analysis: ≥ 50 and < 80 (n = 5), ≥ 80 and < 120 (n = 2), ≥ 120 (n = 2). The results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in all three groups (SMD = −0.68, 95% CI: −1.20 to −0.15, $P = 0.010$, $I^2 = 76\%$; SMD = −0.46, 95% CI: −0.72 to −0.20, $P = 0.0004$, $I^2 = 0\%$; SMD = −0.61, 95% CI: −0.96 to −0.26, $P = 0.0006$, $I^2 = 57\%$), Table 3.

Mean ages

9 RCTs (N = 747) [15–23] measured the effect of MT on CP in different ages, which were divided into three groups for subgroup analysis: < 50 (n = 3); 50 ~ 55 (n = 4) and ≥ 60 (n = 2) mean age group. The results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in all three groups (SMD = −0.54, 95% CI: −0.85 to −0.24, $P = 0.0004$, $I^2 = 0\%$; SMD = −0.71, 95% CI: −1.32 to −0.10, $P = 0.002$, $I^2 = 85\%$; SMD = −0.54, 95% CI: −0.84 to −0.24, $P = 0.0004$, $I^2 = 17\%$), Table 3.

Table 1 Characteristics of clinical trials included in this meta-analysis

Studies	Country	Setting	CP Categories	Mean Age (years)	Sex	Sample	Intervention Content	Control	Music Selection	Tools	Outcome indicators	Quality rating
Bradt et al. (2016) [15]	USA	Nurse-managed health center	CNMP	Adults (50–55)	F/M	28/27	AMT (vocal music)	Standard care	Patient	NRS (0–10), HADS	Pain, Depression, Anxiety	B
Burrai et al. (2014) [16]	Italy	Hospital (haemodialysis ward)	Cancer	Adults (> 55)	F/M	26/26	PMT (live music)	Standard care	Patient	VAS(0–10)	Pain	A
Guétin et al (2012) [17]	France	Hospital& home	CNMP: Mechanical (25%), Inflammatory (25%), Fibromyalgic (25%), Neurological pain (25%)	Adults (< 50)	F/M	44/43	PMT (recorded music)	Standard care	Patient	VAS(0–10), NRS (0–10) HADS,	Pain, Depression, Anxiety	A
Gutgsell et al. (2013) [18]	USA	Hospital	UCP:Cancer pain (87%) Non-cancer pain (13%)	Adults (> 55)	F/M	99/99	PMT (live music)	Standard care	Music therapist	NRS (0–10)	Pain	A
Huang et al. (2010) [19]	China (Taiwan)	Medical center	Cancer	Adults (50–55)	F/M	62/64	PMT (recorded music)	Standard care	Patient	VAS (0–100)	Pain	A
Lin et al (2020)[a] [20]	China (Fuzhou)	Hospital	Postoperative CP	Not Reported	F/M	43/43	PMT (recorded music)	Standard care	Patient	SF-MPQ, SF-36	Pain, Quality of life	B
Lin et al (2021)[b] [21]	China (Fuzhou)	Hospital	Postoperative CP	Adolescents (< 50)	F/M	43/43	PMT (recorded music)	Quiet rest time	Patient	SF-MPQ, SF-36	Pain, Quality of life	B
Onieva-Zafra et al. (2013) [22]	Spain	Home	Fibromyalgia	Adults (50–55)	F/M	28/27	PMT (recorded music)	Standard care	Nurse	VAS (0–10), BDI	Pain, Depression	B
Sandra et al. (2006) [23]	USA	Clinic	CNMP	Adults (< 50)	F/M	①SM22 ②PM18	PMT (recorded music)	Standard care	Patient	MPQ-SF (0–3), VAS (0–100)	Pain, Depression	B
Studies	Intervention Equipment		Intervention Form		Intervention Frequency		Intervention Durations	Measuring Time		Qualification	Music genre and descriptions	

Table 1 (continued)

Studies	Country	Setting	CP Categories	Mean Age (years)	Sex	Sample	Intervention Content	Control	Music Selection	Tools	Outcome indicators	Quality rating
Bradt et al. (2016) [15]	Musical instrument		Group intervention (6–8 participants per group)		8 times/week, 12 weeks		60 min	Baseline, 4, 8, and 12 weeks (12-week follow-up)		Music therapist	**Vocal improvisations**. Percussion instru-ments or body percussion were typically added, each session ended with singing an inspi-rational song selected by one of the group members	
Burrai et al. (2014) [16]	Musical instrument		Individual intervention		1 per day, 4 weeks		30 min	Before and after the 30-min		Trained nurse	**Instrumental music:** live saxophone perfor-mances	
Guétin et al. (2012) [17]	Earphone		Individual intervention		2 times/day, 15 weeks		20 min	D0, D10, D60, D90		Trained nurse	**Three genres**: **Classi-cal**: piano, violin, flute, etc.; **jazz**: trumpet, saxophone, trombone, etc.; **world music**: India, Andes, Africa, etc	
Gutgsell et al. (2013) [18]	Musical instrument		Individual intervention		1 per day		20 min	Before and after the 20-min		Music therapist	**Classical music:** Therapist briefly played the ocean drum and harp, then played four precomposed pieces in the key of C Major that can be described as **"light classical"** and are unfamiliar to most listeners: "Andante" by Waddington in duple meter, "Pass-ing By" and "Reverie" by Grandjany in duple meter, and "Barcarolle" by Grandjany in triple meter	

Table 1 (continued)

Studies	Country	Setting	CP Categories	Mean Age (years)	Sex	Sample	Intervention Content	Control	Music Selection	Tools	Outcome indicators	Quality rating
Huang et al. (2010) [19]	Earphone		Individual intervention		1 per day		30 min	Before and after the 30-min		Trained nurse	**Three genres**: Two of Taiwanese music(**folk songs** and **Buddhist** music) and two of American music(**instrumental music**: harp music and piano music)	
Lin et al (2020)[a] [20]	Loudspeaker&Earphone		Individual intervention		1 per day, 6 months		30 min	6 months after the operation (followed up at an outpatient clinic)		Music therapist	**Different genres**:Light music, folk songs, opera, and pop music, etc	
Lin et al (2021)[b] [21]			Individual intervention		1 per day, 6 months		30 min	6 months after the operation		Not reported		
Onieva-Zafra et al (2013) [22]	CD		Individual intervention		1 per day, 4 weeks		60 min	Baseline, 1, 2, 3 and 4 weeks (4-week follow-up)		Patient adminis-tered	**Mixed genres: Clas-sical music** mixed with salsa music	
Sandra et al (2006) [23]	Tape Player &Headphone		Individual intervention		1 per day, 1 week		60 min	Baseline, 4, 8, and 12 weeks (12-week follow-up)		Researchers	Relaxing **instrumental music** tape(piano, jazz, orchestra, harp and syn-thesizer)	

F Female, *M* Male, *CNMP* chronic non-malignant pain (mechanical pain, inflammatory pain, fibromyalgia, neurological pain, osteoarthritis, herniated disc, rheumatoid arthritis, degenerative joint disease), *UCP* universal CP, *SM* standard music group, *PM* patterning music group, *VAS* visual analog scale, *NRS* numeric rating scale, *FLACC* The Face, Legs, Activity, Cry, Consolability Behavioral Scale, *HADS* hospital anxiety and depression scale, *McGPQ* McGill Pain Questionnaire, *SF-MPQ* Simplified McGill Pain Questionnaire, *MPQ-SF* McGill Pain Questionnaire short-form, *SF-36* 36-Item Short Form Survey, *PROMIS-SF* Patient Reported Outcomes Measurement Information System 19 short forms, *BDI* Beck depression inventory, *D* day, *PMT* Passive music therapy, *AMT* Active music therapy

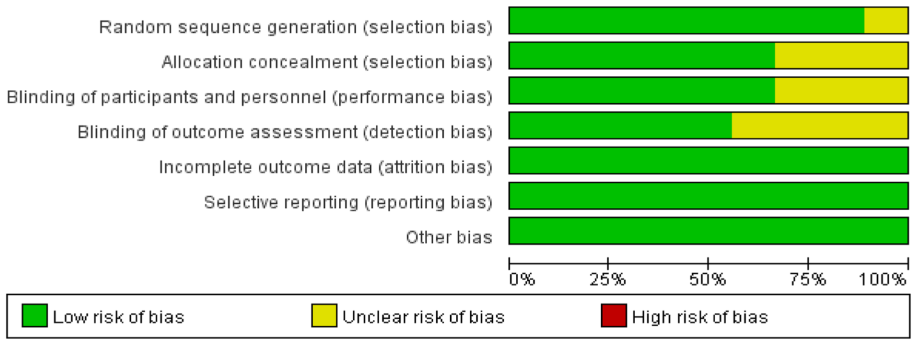

Fig. 2 Risk-of-bias graph and risk

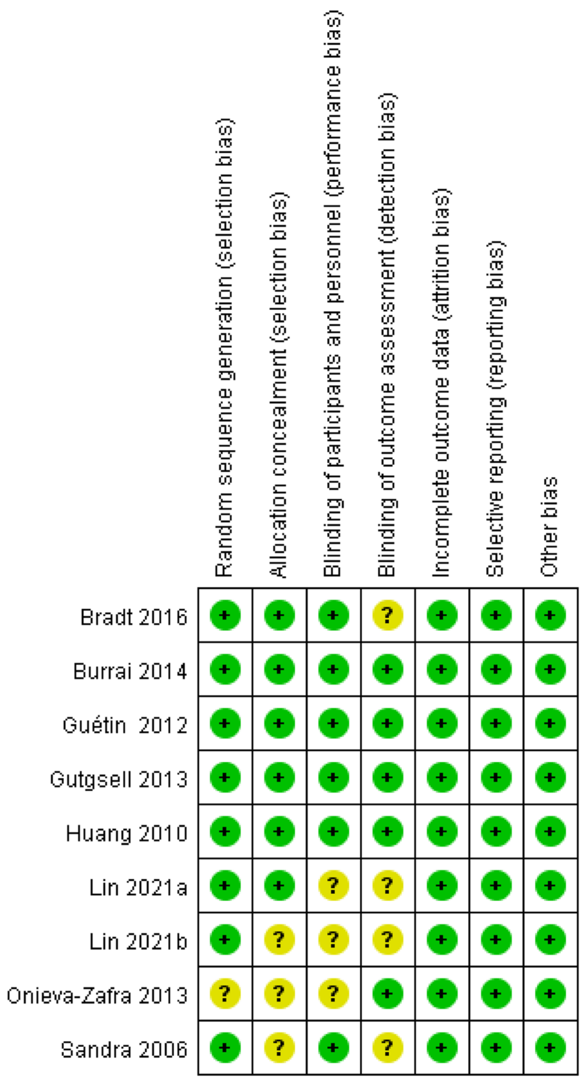

Fig. 3 Risk of bias in individual studies

Settings

6 RCTs ($N=456$) measured the effect of MT on CP in different settings, which were divided into two groups for subgroup analysis: hospital ($n=2$), health/medical center ($n=2$); the results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in two groups (SMD = −0.45, 95% CI: −0.83 to −0.07, $P=0.02$, $I^2=58\%$; SMD = −0.66, 95% CI: −1.04 to −0.27, $P<0.0009$, $I^2=35\%$), Table 3.

CP Categories

7 RCTs ($N=494$) [15–17, 19–21, 23] measured the effect of MT on CP in different categories, which were divided into three groups for subgroup analysis: CNMP ($n=3$) [15, 17, 23], Cancer ($n=2$) [16, 19], Postoperative ($n=2$) [20, 21]. The results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in CNMP and Cancer groups (SMD = −0.59, 95% CI: −0.88 to −0.28, $P=0.0001$, $I^2=0\%$; SMD = −0.81, 95% CI: −0.12 to −0.50, $P<0.00001$, $I^2=0\%$), but MT did not improve Postoperative CP (SMD = −0.12, 95% CI: −0.46 to 0.21, $P=0.470$, $I^2=0\%$), Table 3.

Intervention Equipment

9 RCTs (N = 747) [15–23] measured the effect of MT on CP in different equipment, which were divided into four groups for subgroup analysis: musical instrument ($n=3$), earphone ($n=2$), loudspeaker&earphone ($n=2$), CD/Tape player&Headphone ($n=2$). The results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in musical instrument and earphone groups (SMD = −0.66, 95% CI: −0.88 to −0.28, $P=0.0001$, $I^2=0\%$; SMD = −0.81, 95% CI: −0.12 to −0.50, $P=0.0006$, $I^2=57\%$), but MT did not improve Loudspeaker&Earphone (SMD = −0.12, 95% CI: −0.46 to 0.21, $P=0.47$, $I^2=0\%$) and CD/Tape player&Headphone groups (SMD = −1.09, 95% CI: −2.24 to −0.06, $P=0.06$, $I^2=85\%$), Table 3.

Table 2 Evidence synthesis

Classification (Level type)	Source/Overall level	Comprehensive findings of the EBP question
Level I	9/B	1. MT intervention can effectively reduce pain, improve anxiety (1, 2, 3, 4, 6, 8, 9) and quality of life (6, 7), regulate depression (1, 3, 4, 5, 6, 8, 9); 2. Settings: hospital (2, 4, 6, 7), family (8), homes and hospitals (3), clinics (9), medical center (5), nurse-managed health centers (1); 3. Music Selection: patients independently choose (1, 2, 3, 5, 6, 7, 9), music therapists provide (4), nurse provided (8); 4. Equipment: earphones (3, 5, 6, 7, 9), musical instruments (1, 2, 4), loudspeaker (6, 7), tape player (9), CD (8); 5. Intervention Content: AMT (1), PMT (2, 3, 4, 5, 6, 7, 8, 9); 6. Intervention Method: individual intervention (3, 4, 5, 6, 7, 8, 9), group intervention (1, 2); 7. Intervention frequency: 6 months (6, 7), 12 weeks (1), 15 weeks (3), 4 weeks (2, 8), 1 week (1), once a week (3, 4); 8. Intervention Durations: 20 min (3, 4), 30 min (2, 5, 6, 7), 60 min (1, 8, 9); 9. Measuring Time: measurement before and after intervention (2, 4, 5), baseline, 4, 8, 12 weeks (1, 9), 6 months after surgery (6, 7), baseline, Week 1-4 (8), day 0, 5, 10, 60, 90 (3); 10. Intervention Frequency: once a day (2, 4, 5, 6, 7, 8, 9), 2 times a day (3), 8 times a week (1); 11. Qualifications: Trained nurses (2, 3, 5), Music therapists (1, 4, 6), Nurses (8), Researcher (9), Unreported (7); 12. Music Genre: three genres of music (3, 5) different genres (6, 7), instrumental music (9), vocal improvisation (1), mixed music (8), classical (4); mixed music genres: classical music (3, 8), jazz and world music (3), folk songs, Buddhist music, instrumental and salsa music (5).

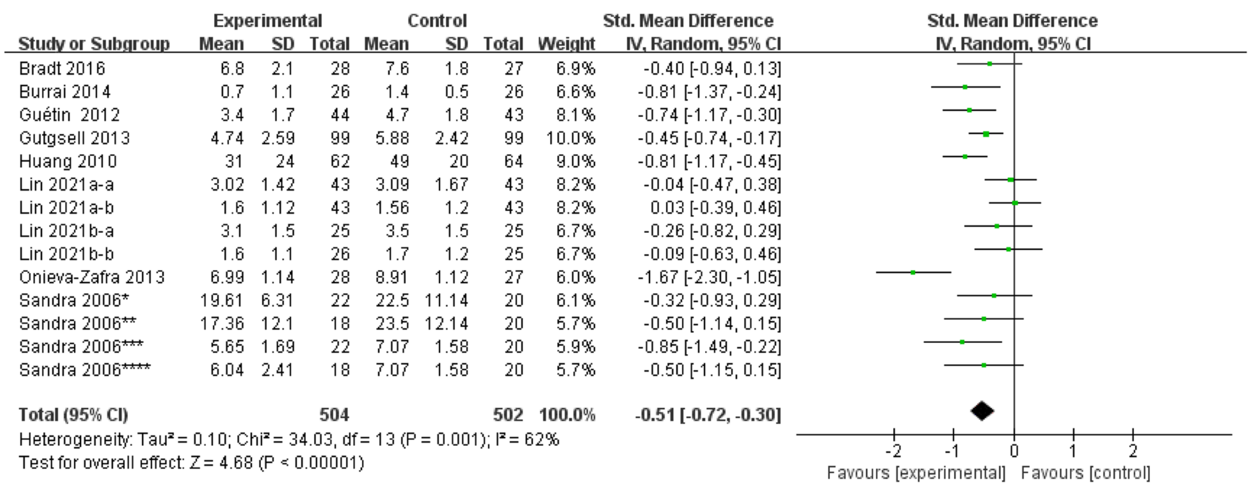

Fig. 4 Effects of MT to reduce CP [15–23]. SD = standard deviation, CI = confidence interval, IV = inverse variance, I^2 = inconsistency

(note: Lin et al. conducted two studies [20, 21]. Lin 2021a study focus on effect of MT on the Midterm Quality of Life of Patients after Mechanical Valve Replacement, while Lin 2021b study focus on the effect of MT on Quality of Life in Adolescents after Transthoracic Occlusion of Ventricular Septal Defects; Lin 2021a-a = The first study measured data using the VAS, Lin 2021a-b = The first study measured data using the SF-MPQ; Lin 2021b-a = The second study measured data using the VAS, Lin 2021b-b = The second study measured data using the SF-MPQ; Sandra 2006* = MPQ-S(Patterning Music, PM), Sandra 2006** = MPQ-S(Standard Music, SM), Sandra 2006*** = VAS(SM), Sandra 2006**** = VAS(PM))

Intervention Content

8 RCTs (N = 648) [16–23] measured the effect of MT on CP in different MT methods. These MT methods were divided into two groups for subgroup analysis: PMT (recorded music) (n = 6) [17, 19–23] and AMT (live music) (n = 2) [16, 18]. The results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in two groups (SMD = −0.45, 95% CI: −0.68 to −0.22, P = 0.0001,

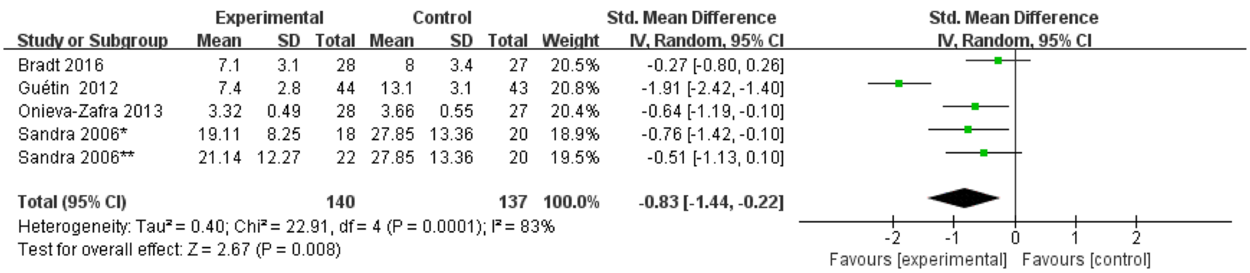

Fig. 5 Effects of MT to reduce depression. SD = standard deviation, CI = confidence interval, IV = inverse variance, I^2 = inconsistency

(note: Sandra 2006* = SM, Sandra 2006** = PM)

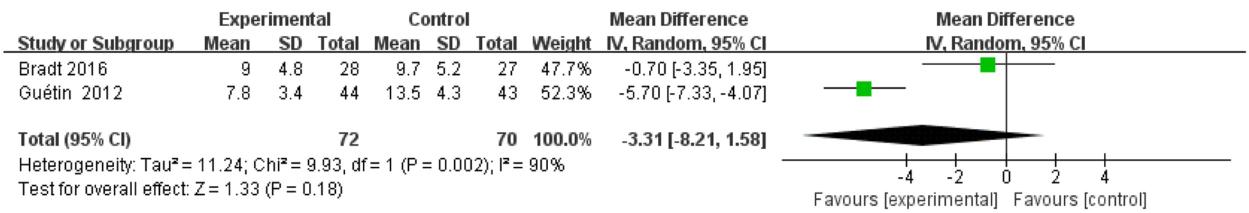

Fig. 6 Effects of MT to reduce anxiety. SD = standard deviation, CI = confidence interval, IV = inverse variance, I^2 = inconsistency

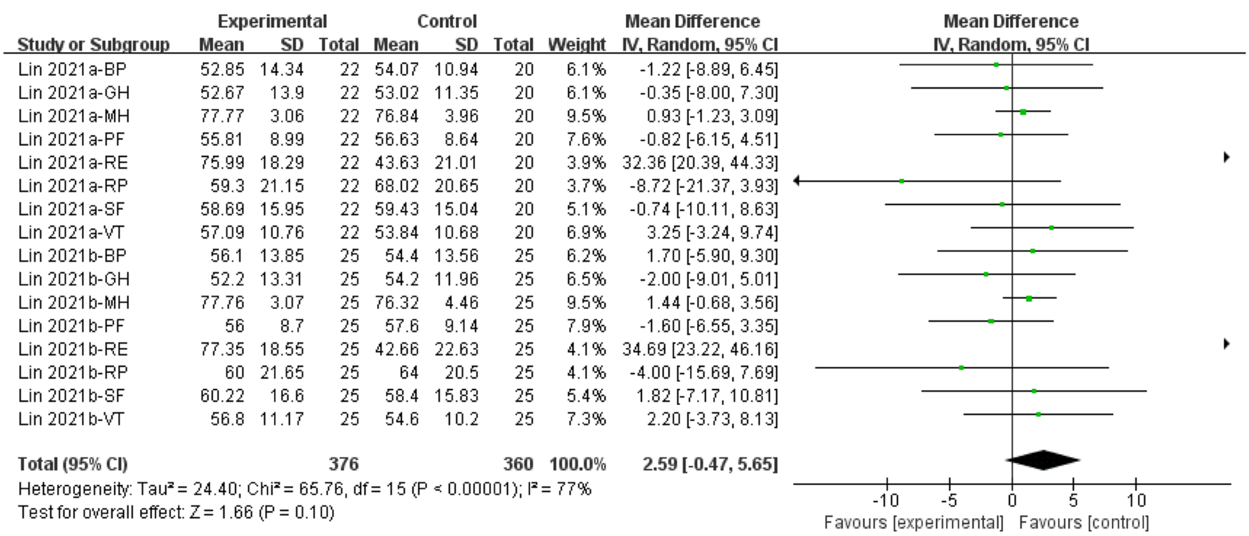

Fig. 7 Effects of MT on improving quality of life. SD = standard deviation, CI = confidence interval, IV = inverse variance, I^2 = inconsistency

(note: BP = bodily pain, GH = general health, MH = mental health, PF = physical functioning, RE = role-emotional, RP = role-physical, SF = social functioning, VT = vitality)

I^2 = 69%; SMD = −0.79, 95% CI: −1.04 to −0.54, $P < 0.00001$, I^2 = 17%), Table 3.

Intervention Durations

9 RCTs (N = 747) [15–23] measured the effect of MT on CP in different MT times, which were divided into three groups for subgroup analysis: 20 min (n = 2) and 30 min (n = 4) and 60 min (n = 3). The results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in three groups (SMD = −0.54, 95% CI: −0.80 to −0.28, $P < 0.0001$, I^2 = 13%; SMD = −0.48, 95% CI: −0.89 to −0.08, $P < 0.02$, I^2 = 67%; SMD = −0.85, 95% CI: −1.65 to −0.06), P = 0.04), Table 3.

Music Selection

9 RCTs (N = 747) [15–23] measured the effect of MT on CP in different music selections, which were divided into two groups for subgroup analysis: patient (n = 7) and music therapist/nurse (n = 2). The results of our

Table 3 Subgroup analyses of music-based intervention to reduce CP

Subgroup	Number of trials	Effects		Heterogeneity	
		SMD or MD (95%CI)	*P*	I^2(%)	*P*
Countries					
Developing countries	3	−0.39 (−0.89, 0.11)	0.13	74	0.02
Developed countries	6	−0.73 (−1.06, −0.40)	**< 0.0001**	64	0.02
Sample sizes					
≥ 50, < 80	5	−0.68 (−1.20, −0.15)	**0.01**	76	0.003
≥ 80, < 120	2	−0.46 (−0.72, −0.20)	**0.0004**	0	0.91
≥ 120	2	−0.61 (−0.96, −0.26)	**0.0006**	57	0.13
Mean ages (years)					
< 50	3	−0.54 (−0.85, −0.24)	**0.0004**	0	0.42
50–55	4	−0.71 (−1.32, −0.10)	**0.02**	85	0.0002
> 55	2	−0.54 (−0.84, −0.24)	**0.0004**	17	0.27
Settings					
Hospital	4	−0.45 (−0.83,−0.07)	**0.02**	58	0.07
Health/Medical Center	2	−0.66 (−1.04,−0.27)	**0.0009**	35	0.22
CP Categories					
CNMP	3	−0.59 (−0.88, −0.28)	**0.0001**	0	0.61
Cancer	2	−0.81 (−0.12, −0.50)	**< 0.00001**	0	0.99
Postoperative	2	−0.12 (−0.46, 0.21)	0.47	0	0.54
Intervention Equipments					
Musical instrument	3	−0.66 (−0.95, −0.37)	**< 0.00001**	0	0.53
Earphone	2	−0.61 (−0.96, −0.26)	**0.0006**	57	0.13
Loudspeaker&Earphone	2	−0.12 (−0.46, 0.21)	0.47	0	0.54
CD/Tape player&Headphone	2	−1.09 (−2.24, 0.06)	0.06	85	0.01
Intervention Content					
PMT (Recorded music)	6	−0.71 (−1.09, −0.33)	**0.0003**	69	0.007
AMT (Live music)	2	−0.54 (−0.84, −0.24)	**0.0004**	17	0.27
Intervention Durations (minutes)					
20	2	−0.54 (−0.80, −0.28)	**< 0.0001**	13	0.28
30	4	−0.48 (−0.89, −0.08)	**0.02**	67	0.03
60	3	−0.85 (−1.65, −0.06)	**0.04**	81	0.005
Music Selection					
Patient	7	−0.47 (−0.68, −0.26)	**< 0.0001**	35	0.16
Music Therapists/Nurses	2	−1.18 (−2.10, −0.26)	**0.01**	83	0.02
Qualification					
Music Therapist	3	−0.45 (−0.68, −0.22)	**0.0001**	0	0.98
Trained Nurse	3	−0.79 (−1.04, −0.54)	**< 0.00001**	0	0.96
Pain Assessment tools					
NRS	2	−1.03 (−1.61, −0.45)	**0.0005**	0	0.59
VAS	7	−1.09 (−1.77, −0.41)	**0.002**	83	< 0.00001

CNMP chronic non-malignant pain (mechanical pain, inflammatory pain, fibromyalgia, neurological pain, osteoarthritis, herniated disc, rheumatoid arthritis, degenerative joint disease), *NRS* numeric rating scale, *VAS* visual analog scale, *PMT* Passive music therapy, *AMT* Active music therapy

subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in two groups (SMD = −0.47, 95% CI: −0.68 to −0.22, $P < 0.0001$, $I^2 = 35\%$; SMD = −1.18, 95% CI: −2.10 to −0.26, $P = 0.01$, $I^2 = 83\%$, Table 3.

Qualifications

6 RCTs ($N = 560$) [15–20] measured the effect of MT on CP in different MT qualifications, which were divided into two groups for subgroup analysis: music therapist ($n = 3$) [15, 18, 20] and trained nurse ($n = 3$) [16, 17, 19]. The results of our subgroup meta-analysis showed

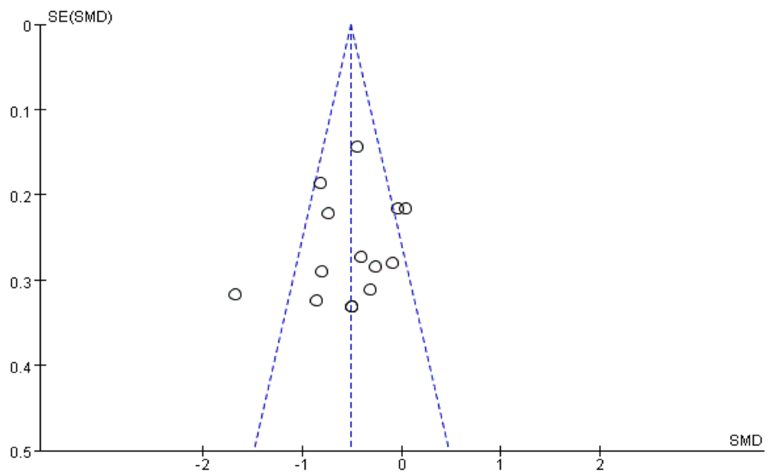

Fig. 8 Funnel plot of CP

that compared with the control group, MT significantly improved CP in two groups (SMD = −0.28, 95% CI: −0.51 to −0.06, $P < 0.05$, $I^2 = 0\%$; SMD = −0.49, 95% CI: −0.80 to −0.17, $P < 0.05$, $I^2 = 0\%$), Table 3.

Pain Assessment Tools

5 RCTs ($N = 447$) [15–18, 22] measured the effect of MT on CP in different pain assessment tools. These tools were divided into two groups for subgroup analysis: VAS (0–10) ($n = 3$) [16, 17, 22] and NRS ($n = 2$) [15, 18]. The results of our subgroup meta-analysis showed that compared with the control group, MT significantly improved CP in two groups (SMD = −1.55, 95% CI: −2.32 to −0.79, $P < 0.0001$, $I^2 = 64\%$; SMD = −1.29, 95% CI: −2.06 to 0.52, $P = 0.001$, $I^2 = 80\%$), Table 3.

Publication bias

We assessed the publication bias of CP by visual examination of funnel plots. The funnel plots show that all the research generally processes upside-down functions are left and right, and the publication bias is low, Fig. 8.

Discussion

Our meta-analysis demonstrated that MT was effective in alleviating CP and depression, but not anxiety or quality of life. Specifically, MT significantly reduced CP (9 RCTs, SMD = −0.51, 95% CI: −0.72, −0.30, $P < 0.00001$) and depression (4 RCTs, SMD = −0.83, 95% CI:−1.44 to −0.22, $P = 0.0001$), while no significant effects were observed for anxiety (2 RCTs, MD = −3.31, 95%CI: −8.21, 1.58, $P = 0.18$) or quality of life (2 RCTs, MD = 2.59, 95%CI: −0.47, 5.65, $P = 0.1$). Subgroup analysis further revealed that the effectiveness of MT varied significantly depending on different intervention conditions. Notably, the most pronounced therapeutic effects were observed in studies conducted in developed countries, targeting patients with CNMP or cancer pain, and implemented in health/medical centers. Additionally, interventions were more effective when patients selected their own music, used musical instruments or earphones, and received therapy from professionally trained nurses or music therapists. The optimal intervention duration was 20 min, and pain assessment tools such as VAS or NRS were commonly used. However, MT showed limited effect in developing countries, for postoperative CP, or when loudspeakers and CD/tape players were used. The high-quality RCTs included in our analysis, along with consistent reporting of blinding and allocation concealment, support the reliability of these results. These insights provide valuable evidence for developing future clinical guidelines and optimizing MT for specific CP populations and settings.

Opioids are an effective means of relieving CP in many patients; however, certain doses or long-term use can cause mental activity effects and drug addiction. Regarding drug abuse in developed countries. Cole et al. [29] reviewed 17 randomized controlled studies and provided support for the use of music as an adjuvant approach for pain treatment (acute pain, CP, and cancer pain control). This indicates that future studies can clinically apply MT as non-medication-assisted therapy or MT combined with drugs in CP groups to relieve CP and depressive symptoms, which will help in reducing the dose and intake of painkillers. However, ColeLc et al. [29] only conducted a systematic review without further meta-analysis. Our meta-analysis showed that MT was effective in alleviating CP and depression. This may be related to the following mechanisms: (1) It is hypothesized that MT stimulates the limbic system related to emotions, regulates the function of the cerebral cortex, and promotes the release of endorphins in the pituitary gland [30]. (2) MT activates areas of the brain associated with reward, emotion, and arousal, such as the nucleus accumbens, amygdala, anterior insula, cingulate cortex, orbitofrontal cortex, and dorsomedial thalamus, through which emotional and cognitive pain regulation can be achieved [31]. Previous studies [26–28] show that although patients with CP have different conditions, disease courses, social environments, and psychological states, most patients with CP have symptoms of anxiety and depression, which seriously affect their quality of life. The results of our meta-analysis suggest that MT can reduce depression in patients with CP, which is consistent with the results of Garza-Villarreal et al. [12]. Music can reduce the basal metabolic rate, oxygen consumption per minute, blood pressure, and heart rate, and the use of alcohol and painkillers to relax muscles and relieve anxiety. A meta-analysis [32] found that MT produced clinically beneficial outcomes for improving the quality of life of patients with pain. However, no evidence in this study suggested that MT can improve the anxiety and quality of life of patients with CP, which may be related to the small number of included studies and small sample size. Among the included studies ($n=9$), only two [15, 17] reported anxiety and quality of life scores, and the meta-analysis results should be interpreted with caution. As the evaluation of the quality of life includes many aspects, MT may improve patients' quality of life with CP, which needs to be confirmed by conducting further research.

Our study identified several key aspects in existing studies. Specifically, the number of such studies in developed countries was significantly higher than those conducted in developing countries. The MT settings were mostly present in the hospital. The sample size mostly included patients aged between 50 and 80 years. The CP category (CNMP) was the main category of CP. Patients choose recorded music over live or vocal MT, they choose music significantly more often than interveners who choose music for them. The individual intervention was significantly more common than the group intervention. Headphones were selected as the equipment. The intervention frequency was highest once a day. Thirty min/session was the most preferred intervention duration. Music therapists and nurses were qualified. Three genres or different genres and instrumental music were chosen the most. A total of three different scales were used to evaluate the CP of the participants, and NRS and VAS were the most frequently used scales. VAS applications were significantly higher than those of NRS, and most studies chose pre- and post-intervention measurements. MT is divided into three types according to the patient's involvement [13]. PMT is for the patients who are not required to participate actively in music performances or singing activities; only listening is expected. A professional music therapist usually plays music for patients and guides them to achieve a spiritual relaxation experience [33]. AMT refers to the treatment of patients with the method of cooperating with the patient to regulate their emotions in the form of lyrics, playing instruments, or singing and dancing to gradually improve the patient's ability to adapt to the outside world [34]. It is worth noting that our study varied greatly in terms of the number of active and passive music therapies, and more studies were used to improve CP using PMT ($n=8$). AMT was only conducted in one study. These findings provide valuable insights into the implementation of music therapy and research design, while also highlighting areas that future studies should focus on. Our subgroup analysis found that MT was more effective in reducing certain categories of CP, such as cancer and chronic non-malignant pain, without heterogeneity and had a significant positive effect in developed countries and across all age groups, sample sizes and types intervention methods, qualifications, and pain assessment tools. However, the effect of MT is not significant in developing countries, which may be due to the small number of music therapists in developing countries, shortage of medical personnel trained in MT, lack of norms in the implementation process, and a small amount of literature. Moreover, interventions conducted in health and medical centers, where patients select their own music and use instruments or earphones, and where the intervention is administered by trained nurses with a duration of 20 min, showed the most effective results. Additionally, due to the lack of relevant research, a few questions remain unresolved, including which is more effective: individual MT versus group MT, or the effect of home-based interventions. Moreover, the effectiveness of MT for CP types beyond the three studied in our research remains uncertain. Therefore, future high-quality RCTs are needed to explore the underlying mechanisms of the findings and address these unanswered questions.

The heterogeneity observed in the meta-analysis and subgroup analysis may be attributed to the following factors: (1) There is still a lack of corresponding guidelines for implementing standard intervention procedures for patients with CP. The specific intervention measures adopted by different studies vary and the types of interventions for patients with CP are relatively simple. This issue may be more serious in developing countries, and there are no high-quality RCTs on this topic which have been published in China. (2) The evaluation criteria are not uniform, and the lack of standardized measurement methods cannot be compared with the results obtained from different intervention types, and the results may be biased. In our subgroup analysis, we noticed that the heterogeneity of VAS is relatively high, which may be due to differences in the 0–10 and 0–100 ranges of VAS. This suggests that different studies used VAS scales with significantly varying score ranges, which could lead to differences in the assessment of pain intensity, thereby affecting the measurement of pain relief outcomes. Moreover, some studies may have employed different methods for score conversion or classification, further contributing to the heterogeneity of the results. Therefore, to reduce the heterogeneity introduced by VAS scores, it is recommended that future studies standardize the VAS score range and use standardized conversion methods for comparison. The range of NRS is consistent, which did not reveal heterogeneity. (3)The categories and severity of CP in the subjects were unclear. In this study, the subgroup analysis of various categories of CP did not reveal any heterogeneity. Therefore, the meta-analysis results of this study must be interpreted with caution, and an additional moderating variable analysis or meta-analysis is required to identify various sources of heterogeneity. To improve the quality of CP intervention, future studies should develop standardized intervention guidelines, unify evaluation criteria, and use consistent measurement tools (such as the VAS scale) to reduce heterogeneity. Additionally, it is important to clarify patient classifications and severity levels, and conduct subgroup analyses to better understand the effects of interventions.

We searched the related databases and found that there are fewer related meta-analyses at present, which may be related to the following two aspects. First, the WHO revised the International Disease Classification in 2018, which has divided CP into seven categories [1]. Previous to that, the classification and definition of CP was not clear, and it was difficult to evaluate and analyze it correctly. Second, because the effect of MT for treating patients with CP was not fully interpreted, there was no sufficient evidence to prove that music can relieve CP. Lee et al. [12] in their meta-analysis divided pain into acute pain, CP and programmed pain, their results showed that MT had a slightly stronger effect on acute/procedural pain (MD = −1.15) than on chronic/cancerous pain (MD = −0.97); however, the CP category included cancer pain alone, the categories of CP in this study are relatively singular (almost only cancer pain), which is not representative of the CP categories. A meta-analysis [2] only included RCTs involving adults aged 18–70 years and showed no significant difference in the results of MT used for the treatment of different categories of CP, their study did not include all categories of CP and the findings had significant heterogeneity, there is less evidence of the effectiveness of MT for the treatment of all categories of CP. Our study included all CP categories and excluded all research on acute pain. In contrast, our study included all categories of CP while excluding acute pain, and it conducted detailed subgroup analyses, providing a more comprehensive and representative assessment of MT's effectiveness for CP.

Based on our available findings, we suggest that MT be implemented in health/medical centers, specifically for patients with CNMP and cancer pain. The intervention should be conducted once per day, with a duration of 20 min. PMT using recorded music or AMT with live music can both be used. For PMT, patients should select their own music tracks and use earphones. In AMT, the therapist should use musical instruments during the therapy. The entire process should be guided by qualified music therapists and trained nurses. These findings provide a crucial foundation for the development of future clinical guidelines, aiming to optimize the application of music therapy in CP management. Future research should focus on developing operational guidelines for MT interventions in CP, outlining intervention processes and assessment standards, while expanding sample sizes and optimizing intervention designs. Additionally, the feasibility of home-based treatments should be explored. Comparative studies between individual and group MT should be conducted, along with an in-depth investigation into the mechanisms by which MT impacts CP and depression, as well as exploring its potential synergy with other therapies or medications. Developing countries should conduct more research, introducing innovative intervention models like AMT or diverse formats, including live music and vocal therapy, with long-term effectiveness evaluations to advance the widespread adoption of MT in CP treatment.

This study has the following advantages: First, we included only RCTs that used MT, excluding studies that combined MT with other therapies, and excluded high-risk studies [24–28] to ensure the quality of the included studies. Second, we included patients with all categories of CP and excluded studies that included patients with acute pain; thus, our results are relatively reliable. Third, through subgroup analyses, this study further investigated the effects of MT across Countries, Sample Sizes, Mean Ages, Settings, CP Categories, Intervention Equipment, Intervention Content, Intervention Durations, Music Selection, Qualifications, and Pain Assessment Tools, with no evidence of publication bias., and our results showed no publication bias. Fourth, our meta-analysis included quality of life as an outcome index for the first time to explore the relationship between MT and quality of life in patients with CP.

Limitations

This study has some limitations. First, although we used a comprehensive search strategy, only literature published in Chinese and English was retrieved, and studies published in other languages were not included. Second, although CP significantly reduced after MT intervention, only four studies reported follow-up. It is unclear whether MT has a long-term effect on pain in patients with CP. Third, Homogeneity cannot be guaranteed in the control group because the specific content of standard care was not reported and could not be compared. Furthermore, only certain categories of CP have been reported in the existing literature, and the effects on other specific CP categories are unclear, which may have led to bias in the results. Finally, only one study [19] reported changes in pain medication use, it showed that MT provided greater relief of cancer pain than analgesics alone, but it still should be more reliable evidence to analyze whether MT reduced pain medication use.

Conclusion

This study provides evidence that MT can reduce pain and depression in CP patients, though it has limited effects on anxiety and quality of life. Subgroup analysis reveals that MT is most effective when tailored to specific conditions, such as interventions in developed countries targeting CNMP or cancer pain, conducted in health centers, with patients selecting their own music, using instruments or earphones, and receiving therapy from trained professionals, ideally lasting 20 min. MT is a low-cost, non-invasive, and easily implemented therapy with significant clinical potential. Future research should develop standardized guidelines for MT implementation and evaluation to ensure consistency across studies. Additionally, studies should explore MT's long-term impact on pain, anxiety, quality of life, and its potential to reduce analgesic use, with a focus on its effects across different CP categories for reliable clinical evidence. High-quality, multicenter RCTs should be conducted in developing countries, explore cost-effective and culturally appropriate intervention models, ultimately advancing the global adoption of MT in CP management.

Acknowledgements

The authors thank all the other references members of the team for their contributions to this study.

Authors' contributions

SC and LY conceptualized the study. SC, QY, and CW developed the methodology, and SC implemented the software and validated the results. SC conducted the formal analysis, with SC and LY provided the resources. Data curation was performed by SC, QY, JY, and CW. SC prepared the original draft, and both SC and LY reviewed and edited the manuscript. SC also handled visualization, under the supervision of LY. All authors have read and agreed to the published version of the manuscript.

Funding

This study was supported by the "Double First-Class" Construction Specialized Discipline Project at Zhejiang University (HL202409), Jin- hua Science and Technology Bureau, China (grant number 2021-3-010) and the Zhejiang University Doctoral New Star Program (2023097).

Data availability

No datasets were generated or analyzed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Nursing Department, Sir Run Run Shaw Hospital, Zhejiang University School of Medicine, Hangzhou, China. [2]Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA, USA. [3]Department of Biobehavioral Sciences, Teachers College, Columbia University, New York, NY, USA. [4]School of Medicine, Zhejiang University, Hangzhou, Zhejiang, China.

Received: 17 October 2024 Accepted: 24 March 2025
Published online: 30 April 2025

References

1. Treede R-D, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). Pain. 2019;160(1):19–27.
2. Garza-Villarreal EA, Pando V, Vuust P, Parsons C. Music-induced analgesia in chronic pain conditions: a systematic review and meta-analysis. Pain Physician. 2017;20(7):597–610.
3. Chen S, Zhang X, Cao M, Zhao B, Fang J. Development and validation of the health literacy assessment instrument for patients with chronic pain. Evid Based Complement Alternat Med. 2021;2021:9342746. https://doi.org/10.1155/2021/9342746. PubMed PMID: 35096099; PubMed Central PMCID: PMCPMC8799325 publication of this paper. Epub 2022/02/01.
4. Chen S, Cao M, Zhang J, Yang L, Xu X, Zhang X. Development of the health literacy assessment instrument for chronic pain patients: a Delphi study. Nurs Open. 2022. https://doi.org/10.1002/nop2.1468. PubMed PMID: 36564937. Epub 2022/12/25.
5. Chronic pain: the need and hope for opioid alternatives. EBioMedicine. 2016;5:1. https://doi.org/10.1016/j.ebiom.2016.03.011. PubMed PMID: 27077094; PubMed Central PMCID: PMCPMC4816840. Epub 2016/04/15.
6. King NB, Fraser V. Untreated pain, narcotics regulation, and global health ideologies. PLoS Med. 2013;10(4):e1001411. https://doi.org/10.1371/journal.pmed.1001411. PubMed PMID: 23565063; PubMed Central PMCID: PMCPMC3614505. Epub 2013/04/09.
7. Reyes-Gibby CC, Aday L, Cleeland C. Impact of pain on self-rated health in the community-dwelling older adults. Pain. 2002;95(1–2):75–82. https://doi.org/10.1016/s0304-3959(01)00375-x. PubMed PMID: 11790469 Epub 2002/01/16.
8. Cohen SP, Vase L, Hooten WM. Chronic pain: an update on burden, best practices, and new advances. The Lancet. 2021;397(10289):2082–97. https://doi.org/10.1016/S0140-6736(21)00393-7.
9. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain - United States, 2016. MMWR Recomm Rep. 2016;65(1):1–49. https://doi.org/10.15585/mmwr.rr6501e1. PubMed PMID: 26987082. Epub 2016/03/18.
10. Cohen SP, Vase L, Hooten WM. Chronic pain: an update on burden, best practices, and new advances. Lancet. 2021;397(10289):2082–97.

11. Vink A, Hanser S. Music-based therapeutic interventions for people with dementia: a mini-review. Medicines (Basel). 2018;5(4). https://doi.org/10.3390/medicines5040109. PubMed PMID: 30297605; PubMed Central PMCID: PMCPMC6313334. Epub 2018/10/10.
12. Lee JH. The effects of music on pain: a meta-analysis. J Music Ther. 2016;53(4):430–77.
13. Facchini M, Ruini C. The role of music therapy in the treatment of children with cancer: a systematic review of literature. Complement Ther Clin Pract. 2021;42:101289. https://doi.org/10.1016/j.ctcp.2020.101289. PubMed PMID: 33316592. Epub 2020/12/15.
14. Cumpston M, Li T, Page MJ, Chandler J, Thomas J. Updated guidance for trusted systematic reviews: a new edition of the cochrane handbook for systematic reviews of interventions. Cochrane Database Syst Rev. 2019;10(10):ED000142.
15. Bradt J, Norris M, Shim M, Gracely EJ, Gerrity P. Vocal music therapy for chronic pain management in inner-city African Americans: a mixed methods feasibility study. J Music Ther. 2016;53(2):178–206. https://doi.org/10.1093/jmt/thw004.
16. Burrai F, Micheluzzi V, Zito MP, Pietro G, Sisti D. Effects of live saxophone music on physiological parameters, pain, mood and itching levels in patients undergoing haemodialysis. J Ren Care. 2014;40(4):249–56. https://doi.org/10.1111/jorc.12078. PubMedPMID:CN-01201107.
17. Guétin S, Giniès P, Siou DK, Picot MC, Pommié C, Guldner E, et al. The effects of music intervention in the management of chronic pain: a single-blind, randomized, controlled trial. Clin J Pain. 2012;28(4):329–37. https://doi.org/10.1097/AJP.0b013e31822be973. PubMedPMID:CN-00852320.
18. Gutsgell KJ, Schluchter M, Margevicius S, DeGolia PA, McLaughlin B, Harris M, et al. Music therapy reduces pain in palliative care patients: a randomized controlled trial. J Pain Symptom Manage. 2013;45(5):822–31. https://doi.org/10.1016/j.jpainsymman.2012.05.008. Epub 2012/09/29. PubMed PMID: 23017609.
19. Huang ST, Good M, Zauszniewski JA. The effectiveness of music in relieving pain in cancer patients: a randomized controlled trial. Int J Nurs Stud. 2010;47(11):1354–62. https://doi.org/10.1016/j.ijnurstu.2010.03.008. PubMed PMID: 20403600. Epub 2010/04/21.
20. Lin ZW, Huang ST, Xu N, Cao H, Chen LW, Chen Q. Effect of music therapy on the chronic pain and midterm quality of life of patients after mechanical valve replacement. Ann Thorac Cardiovasc Surg. 2020;26(4):196–201. https://doi.org/10.5761/atcs.oa.20-00022. PubMedPMID:CN-02177428.
21. Lin ZW, Liu JF, Xie WP, Chen Q, Cao H. The effect of music therapy on chronic pain, quality of life, and quality of sleep in adolescents after transthoracic occlusion of ventricular septal defects. Heart Surg Forum. 2021;24(2):E305–10. https://doi.org/10.1532/hsf.3513.
22. Onieva-Zafra MD, Castro-Sánchez AM, Matarán-Peñarrocha GA, Moreno-Lorenzo C. Effect of music as nursing intervention for people diagnosed with fibromyalgia. Pain Manag Nurs. 2013;14(2):e39–46. https://doi.org/10.1016/j.pmn.2010.09.004.
23. Siedliecki SL, Good M. Effect of music on power, pain, depression and disability. J Adv Nurs. 2006;54(5):553–62. https://doi.org/10.1111/j.1365-2648.2006.03860.x. PubMedPMID:CN-00565543.
24. Alparslan GB, Babadag B, Ozkaraman A, Yildiz P, Musmul A, Korkmaz C. Effects of music on pain in patients with fibromyalgia. Clin Rheumatol. 2016;35(5):1317–21. https://doi.org/10.1007/s10067-015-3046-3. PubMed PMID:WOS:000374970300023.
25. Clark M, Isaacks-Downton G, Wells N, Redlin-Frazier S, Eck C, Hepworth JT, et al. Use of preferred music to reduce emotional distress and symptom activity during radiation therapy. J Music Ther. 2006;43(3):247–65. https://doi.org/10.1093/jmt/43.3.247. PubMed PMID: 17037953 Epub 2006/10/14.
26. Li XM, Yan H, Zhou KN, Dang SN, Wang DL, Zhang YP. Effects of music therapy on pain among female breast cancer patients after radical mastectomy: results from a randomized controlled trial. Breast Cancer Res Tr. 2011;128(2):411–9. https://doi.org/10.1007/s10549-011-1533-z. PubMedPMID:WOS:000291866300011.
27. McCaffrey R, Freeman E. Effect of music on chronic osteoarthritis pain in older people. J Adv Nurs. 2003;44(5):517–24. https://doi.org/10.1046/j.0309-2402.2003.02835.x.
28. Seebacher B, Kuisma R, Glynn A, Berger T. The effect of rhythmic-cued motor imagery on walking, fatigue and quality of life in people with multiple sclerosis: a randomised controlled trial. Mult Scler. 2017;23(2):286–96. https://doi.org/10.1177/1352458516644058. PubMed PMID: 27055804.Epub 2016/04/09.
29. Cole LC, LoBiondo-Wood G. Music as an adjuvant therapy in control of pain and symptoms in hospitalized adults: a systematic review. Pain Manag Nurs. 2014;15(1):406–25. https://doi.org/10.1016/j.pmn.2012.08.010. PubMedPMID:WOS:000332398400043.
30. Stefano GB, Zhu W, Cadet P, Salamon E, Mantione KJ. Music alters constitutively expressed opiate and cytokine processes in listeners. Med Sci Monit. 2004;10(6):MS18-27 Epub 2004/06/03. PubMed PMID: 15173680.
31. Navratilova E, Porreca F. Reward and motivation in pain and pain relief. Nat Neurosci. 2014;17(10):1304–12. https://doi.org/10.1038/nn.3811. PubMed PMID: 25254980; PubMed Central PMCID: PMCPMC4301417. Epub 2014/09/26.
32. Gao Y, Wei Y, Yang W, Jiang L, Li X, Ding J, et al. The effectiveness of music therapy for terminally ill patients: a meta-analysis and systematic review. J Pain Symptom Manage. 2019;57(2):319–29. https://doi.org/10.1016/j.jpainsymman.2018.10.504. PubMed PMID: 30389608. Epub 2018/11/06.
33. Pacchetti C, Mancini F, Aglieri R, Fundaro C, Martignoni E, Nappi G. Active music therapy in Parkinson's disease: an integrative method for motor and emotional rehabilitation. Psychosom Med. 2000;62(3):386-93. Epub 2000/06/14. https://doi.org/10.1097/00006842-200005000-00012. PubMed PMID: 10845352.
34. Bruscia KE. Defining Music Therapy. 2nd ed. Gilsum: Barcelona Publishers; 1998. p. 300. ISBN: 189127807X, 9781891278075.

Publisher's Note