Systematic Review and Meta-Analysis

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Music-based interventions for pain relief in patients undergoing hemodialysis

A PRISMA-compliant systematic review and meta-analysis

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Abstract

Background: Music therapy and music-based interventions have been used widely in numerous medical procedures to reduce the physical and psychological disorders. However, the effect of music therapy on pain relief in hemodialysis patients still remains unclear.

Methods: Electronic databases were comprehensively searched through MEDLINE, Web of Science, EMBASE, Cochrane, and WANFANG. All studies met inclusion criteria were eligible for systematic review and meta-analysis. Clinical variables were extracted and pooled results were obtained using STATA software.

Results: A total of 10 studies with 722 participants were included for systematic review. Overall, music therapy showed a significantly favorable effect on reducing pain for patients undergoing hemodialysis (SMD: −0.90, 95%CIs: −1.25 to −0.55, $P < .001$). No publication bias was observed.

Conclusions: Music-based interventions could significantly relieve pain for patients undergoing hemodialysis, which should be promoted as an effective and safe complementary method.

Abbreviations: 95%CIs = 95% confidential intervals, BPI = Brief pain inventory, ESRD = End-stage renal disease, MPQ = McGill pain questionnaire, RCT = Randomized controlled studies, SMD = Standardized mean differences, VAS = Visual analogue scale.

Keywords: hemodialysis, meta-analysis, music therapy, pain, systematic review

1. Introduction

Hemodialysis is the most widely used treatment for patients with chronic kidney disease and end-stage renal disease (ESRD).[1] More than 500,000 patients are reported to receive the hemodialysis maintenance in the United States, the number of which is still increasing.[2] Compare to the general population, patients with ESRD experienced remarkably lower quality of life, as well as increasing physical and psychological disorders.[3] Numerous studies have focused on the physical complications during hemodialysis, such as hemodynamic changes, hypotension, nausea, vomiting, headache, hypertension; whereas the psychological changes mainly include mood disorders and sleep disorders.[4–6] Among these complications, pain is one of common complications for patients receiving hemodialysis, which could lead to psychological changes, such as incompatibility, loss of follow-up, allergy, and stress reactions in cardiovascular and immunology system, and therefore contribute to the worsening of quality of life.[7] On average, many patients often undergo the removal and transfusion of whole blood for at least 150 times in a year, which means patients have to suffer from more than 100 times of repeated pains during hemodialysis access cannulations, making the pain issue more problematic. Moreover, some patients suffering from the pain during the hemodialysis were reported to be closely associated with the withdrawals of fluid.[8] Thus, how to alleviate the pain from the hemodialysis procedures in a more cost-effective way remains to be further explored.

Despite several pharmacologic interventions available to alleviate pain, 19.5% of patients undergoing hemodialysis reported suffering from severe pain.[9] Moreover, certain inevitable adverse events, such as gastrointestinal symptoms, addiction, and abuse, raise more concern about the administration of oral or topical analgesic in hemodialysis patients.[10] Recently, substantial studies advocated the application of music therapy for psychological management, which was considered as

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JC and HZ contributed equally to this work.

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Data sharing not applicable to this article as no datasets were generated or analyzed during the present study.

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a cost-effective and safe method.[11] In psycho-oncological care, music therapy has been recommended as the treatment option for the relief of mood disorders, including anxiety and existential fears by national guideline in Germany.[12] Furthermore, music therapy could also be used to facilitate the communications in patients and promote relaxation to reduce stress, respiratory, and pain problems.[13] Additionally, a Cochrane systematic review about music in colposcopy suggested that music during colposcopy could significantly contribute to the promotion of relaxation and anxiety, as well as pain experienced during the procedure.[14] In contrast, a recent trial designed to investigate the effect of music or guided imagery during colposcopy reported no value of music intervention in increasing the satisfaction of patients during the procedure.[15] Similar controversial conclusions were also observed in the efficacy of music therapy on pain management in hemodialysis patients.[16–18]

In this study, we aimed to collect and review related clinical trials, and perform the systematic review and meta-analysis to quantitatively explore the effect of music therapy and music-based interventions in the hemodialysis patients suffering from pain.

2. Methods

2.1. Literature search

Comprehensive literature review was designed and conducted by two independent authors (JR Chen and HX Hong). The electronic databases for primary search included MEDLINE, Web of Science, EMBASE, Cochrane, and WANFANG (updated by May 1, 2020). The syntax used for review included: ("Renal Dialysis [Mesh]" OR "Hemodialysis, Home [Mesh]" OR "Hemodialysis Solutions [Mesh]" OR "Hemodialysis Units, Hospital [Mesh]" OR "Continuous Renal Replacement Therapy [Mesh]") AND ("music" OR "drumming" OR "choir" OR "melody" OR "sing" OR "singing" OR "rhythm"). Additionally, relevant reviews related to this study design and references of primary studies were included for search.

2.2. Inclusion and exclusion criteria

The inclusion criteria were presented as follows:

1. clinical trials designed to explore the effect of music therapy on reducing pain in patients receiving hemodialysis;
2. trials designed as the randomized controlled studies, case–control or pilot studies with at least one control group which receive standard care and treatment;
3. subjects included in trials suffered from pain induced by hemodialysis treatment;
4. studies written in English or Chinese.

In addition, there were several exclusion criteria:

1. reviews, case report, study protocol, or non-human studies;
2. studies written in other than English or Chinese;
3. duplicate of one clinical trial.

The study selection was performed by two independent authors (JR Chen and HX Hong), and disagreements during the study selection were solved by discussion.

2.3. Data extraction and quality assessment

Full-text eligible studies were reviewed and relevant data were extracted by two independent authors (JR Chen and HX Hong). Basic characteristics of patients and clinical trials were collected as follows: first author, publication year, mean age, gender distribution, case number, follow-up, interventions in control and music group, and conclusions. Furthermore, quantitative pain-related inventory information, such as visual analogue scale (VAS), McGill pain questionnaire (MPQ), and brief pain inventory (BPI), was also extracted. All disagreements were solved by discussion.

To evaluate the quality of eligible studies, Jadad scale including three dimensions (randomized, double-blind and description of withdrawal and dropout) was applied.[19] According to Jadad scale, each study will be score ranging from 0 to 5, with a higher score representing higher quality of study design. The threshold of high quality study is 3 points, whereas study with score <2 would be considered as low quality design. The quality assessment was performed by two independent authors (JR Chen and HX Hong).

2.4. Statistical analysis

Data synthesis was carried out in STATA (release 12.0, College Station, TX). Synthesized results were aimed to compare the efficacy of music therapy on the mitigation of pain among patients receiving hemodialysis. Standardized mean differences (SMD) with 95% confidential intervals (95%CIs) were calculated. The heterogeneity among selected studies was assessed using the I^2, which was described previously.[20] A I^2 value $<25\%$ was considered as low heterogeneity, and a fixed model would be applied; whereas, a random-effect model would be used. Egger's linear regression test and Begg's funnel plot were used to assess potential publication bias. $P<.05$ was recognized as statistically significant.

3. Results

3.1. Study selection and basic characteristics

The flow diagram of study selection was presented in Figure 1. A total of 87 studies were identified after the removal of duplicates in electronic databases, whereas 59 of which were selected for further screen after reviewing the title and abstract. Eleven studies were remained for full-text review and 48 were excluded. Finally, 10 studies[16–18,21–27] with 722 patients were eligible for this systematic review and one study was excluded due to the study protocol. Among these eligible studies, five studies[18,21,22,24,26] were further selected for quantitative meta-analysis.

The basic characteristics of eligible studies for systematic review and meta-analysis were shown in Table 1. Five studies were carried out in Chinese population, three studies were performed in Caucasians, and two were conducted in East Asians. For the study design, all included studies were designed with prospective and case–control trial, and three of which[17,18,22] were randomized controlled studies (RCTs). Three scales were used for the evaluation of pain, including VAS, MPQ, and BPI. However, due to the limited studies included, only studies using the VAS could be considered for the meta-analysis. The intervention in music group varies among studies: the type of music included pop music, classical music, folks, light music, soundtracks from movies, live or recorded instrumental music, and live singing; additionally, the patterns for the music therapy were mainly divided into live and prerecorded in the headphone. Last but not least, conclusions from eligible studies were favorable for the application of music

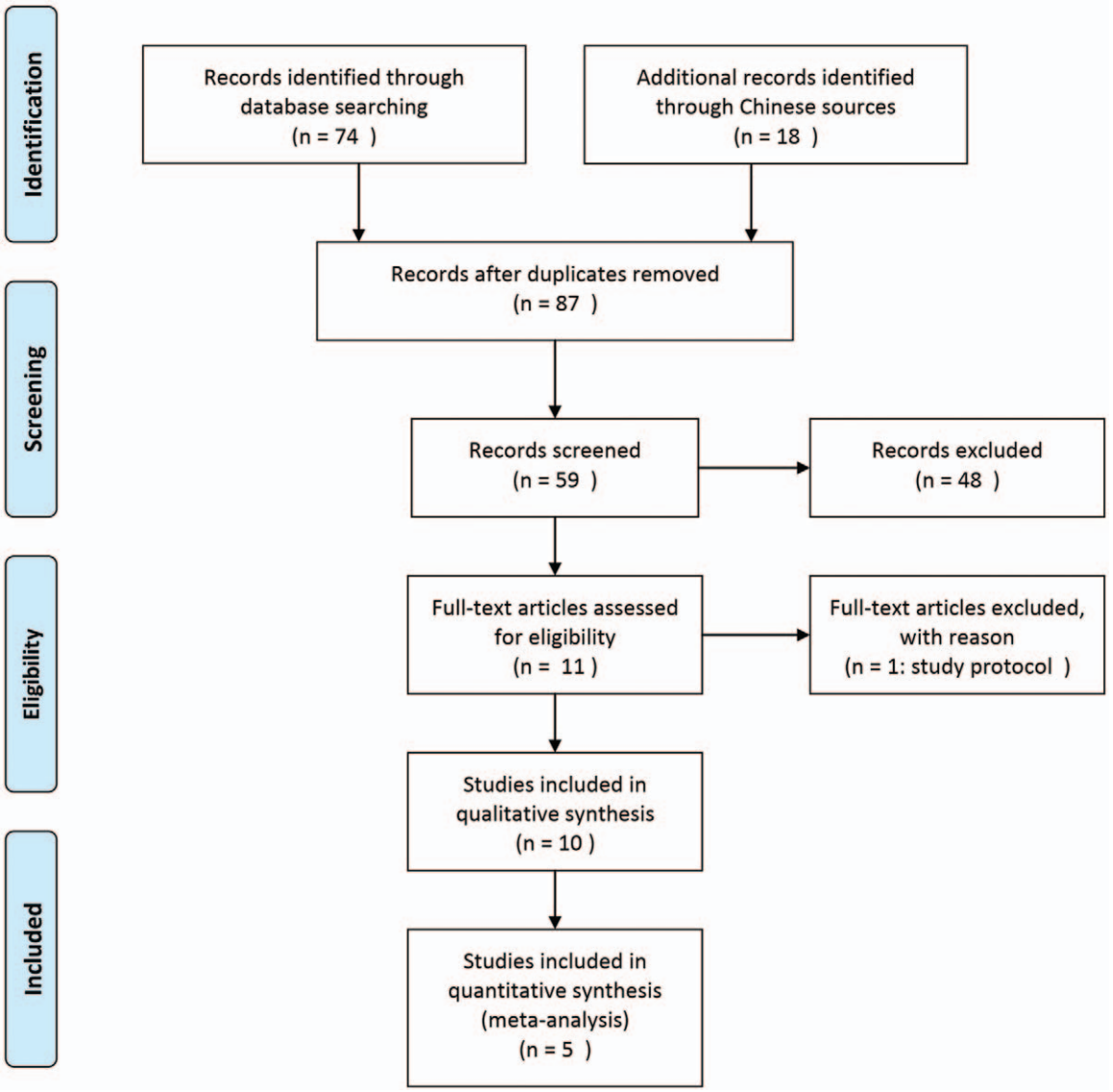

Figure 1. Flow diagram of literature search and eligible study selection.

therapy in the attenuation of pain during the hemodialysis, except for one study[16] which reported that there was no significant difference.

3.2. Risk of bias assessment

Results of risk of bias assessment can be seen in Supplemental Table 1, http://links.lww.com/MD/F551. Although total rating score overall show high bias in all eligible studies, differences varies among studies were still observed. Only one study was considered as high quality.[22]

3.3. Meta-analysis results

Then, we included five studies for further quantitative analysis, of which all these five studies applied the VAS scale to evaluate the pain relief, and pooled results were presented in Figure 2. Our meta-analysis showed that music-based interventions could significantly relieve the pain during the hemodialysis (SMD: −0.90, 95%CIs: −1.25 to −0.55, $P < .001$; Fig. 2). Moreover, we performed the Begg's and Egger's tests to explore the potential publication bias among studies, and no publication bias was observed (Begg's test: $z = -0.49$, $P = .62$; Egger's test: $t = -0.23$, $P = .83$; funnel plot was provided in Supplemental Figure 1, http://links.lww.com/MD/F550).

4. Discussion

In our study, we systematically reviewed published trials and identified a total of 10 studies, covering 722 patients undergoing hemodialysis. Our systematic review and meta-analysis suggested that music therapy and music-based interventions could significantly promote the satisfaction of patients suffering from pain during hemodialysis.

In our meta-analysis, the magnitude of the effect that music therapy had on the overall pain of patients receiving hemodialysis evaluated was consistent with previous review.[28] Music therapy has consistently shown favorable efficacy in terms of improving the anxiety status in hemodialysis patients in a systematic review and meta-analysis.[29] It is well established that music therapy can

Table 1

Basic characteristics of eligible studies in the systematic review and meta-analysis.

First author (publication year)	Nation	Case number	Mean age (years)	Gender (male/female)	Study design	Follow-up	Scale for pain	Intervention in music group	Intervention in control group	Conclusions
M. Pothoulaki (2008)	Greece	60	52.9	42/18	Prospective, case-control trial	NG	MPQ, VAS	Preferred music including popular music, Greek folk music, ethnic music, jazz, classical, soundtracks from films, and new age music	No music	Music listening can reduce anxiety and perceived pain during haemodialysis sessions.
Y Chen (2010)	China	20	50	12/8	Prospective, self-control trial	NG	MPQ	Light music	No music	Local anesthesia and light music therapy significantly reduces the pain during the puncture fistula, reduce stress.
H Pan (2012)	China	60	41.2	31/29	Prospective, case–control trial	3 months	VAS	Popular music, classical, modern music	No music	Auditory intervention can effectively reduce pain upon puncture fistula.
F. Burrai (2014)	Italy	114	68.2	49/65	Randomized controlled trial	4 weeks	VAS	Music played live with the saxophone in week 1–4	Music played live with saxophone in week 1	Live saxophone music could improve clinical symptoms and quality of life in HD patients.
A K. Kutlu (2014)	Turkey	60	53.0	37/23	Prospective, randomized control study	6 months	VAS	Instrumental (violin and piano) Turkish art music	No music	Pain, nausea, vomiting, and cramp scores were significantly reduced by music therapy.
Y Cai (2015)	China	60	50.3	38/22	Prospective, case–control trial	NG	VAS	Piano and Violin music	No music	Music can reduce the complications (pain, nausea and vomit) of HD.
H Zhang (2015)	China	150	59.9	81/69	Prospective, case–control trial	1 month	BPI	Instrumental music	No music	Psychological intervention combined with music therapy can effectively alleviate pain, depression and improve sleep quality of patients.
J Mo (2016)	China	60	42. 5	28/32	Prospective, case–control trial	NG	BPI	Popular music, folk music, classical, light music, and opera	No music	Music therapy is a convenient and safe therapy by reducing tension and fear of patients, improving the success rate of the life of fistula.
H S. Zarmi (2017)	Iran	114	58.9	60/54	Randomized clinical trial	NG	VAS	Familiar Persian folklore, traditional, soothing music	Headphone group: wore a headphone alone without listening to music; Control group: no music	Self-selected soothing music can alleviate pain following needle insertion into a fistula in the music group.
F. Burrai (2019)	Italy	24	62.3	15/9	Randomized controlled crossover parallel trial	5 weeks	VAS	Pop, movie soundtracks, classical, jazz, and folk music by live singing	No music	Listening to live music was associated with improvements in systolic and diastolic blood pressure, better quality of sleep, fewer cramps, and reduced anxiety/depression, pain, and itching.

BPI = brief pain inventory, MPQ = McGill pain questionnaire, NG = not given, SD = standard deviation, VAS = visual analogue scale.

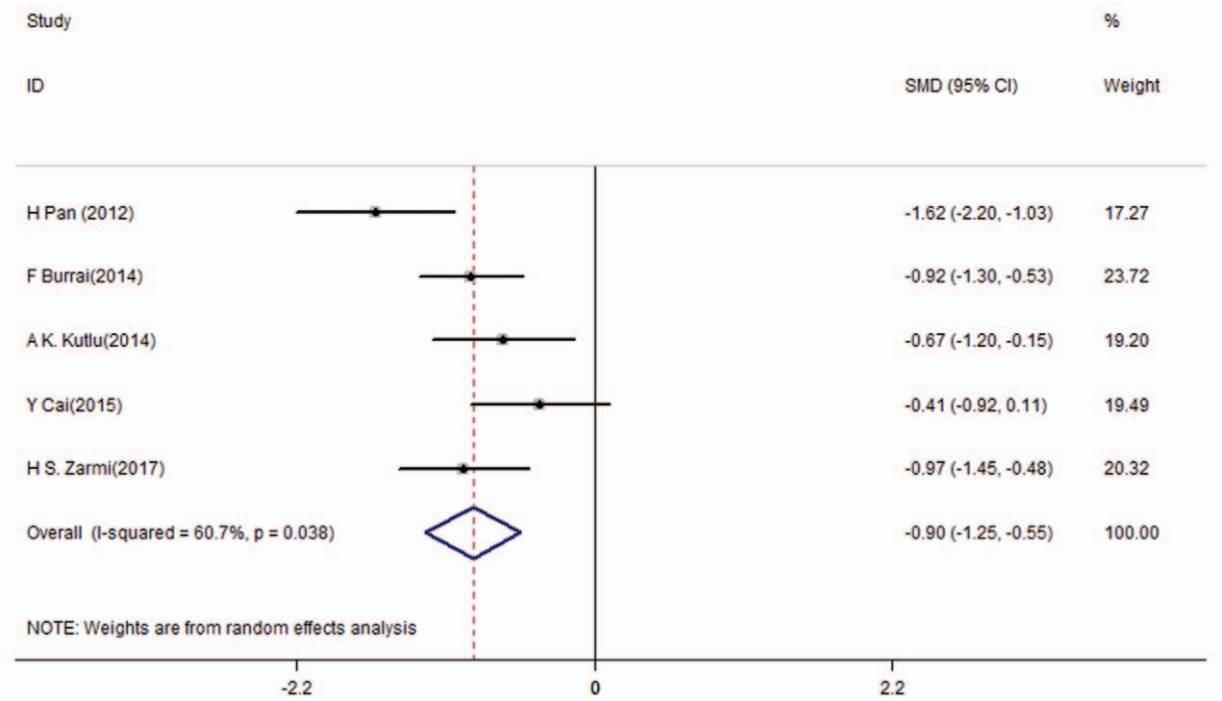

Figure 2. Forest plot of improvement efficacy of music therapy on pain management among eligible studies.

offer multifaceted support in coping with anxiety related to the disease or the medical procedures, in promoting the stressful physical and emotional conditions, and in alleviating symptom management, including pain and dyspnea.[30,31] For women, painful sensations, as well as relevant anxiety reactions, tended to be more severe when compared to male patients receiving hemodialysis, which can be alleviated significantly by music therapy.[32] Consistent with these studies, we concluded that pain scores can remarkably drop after the intervention of music therapy during the hemodialysis, which may improve the quality of life.

To be noted, the high heterogeneity among eligible studies was observed. First of all, considering only three RCTs were included, study design was identified as a crucial source of heterogeneity. Moreover, the quality assessment of eligible studies showed that most of studies were burdened with relatively low study design and quality. Given the nature of music therapy, it appears to be difficult to blind enrolled patients for intervention delivery. In the study conducted by Zarmi,[22] participants were randomly divided into three groups, including music group, headphone group, and control group, of which patients in headphone group would wear a headphone alone without any music. The comparison between music group and headphone group will minimize the confounding influence of intervention delivery, which was recommended for further study design. Then, pain scale varies among included studies. A total of three scales for the pain management, including VAS, BPI, and MPQ, were summarized, which also contribute to the potential heterogeneity. Due to the limited studies, we failed to quantitatively evaluate the pain management scored by BPI or MPQ. Given that positive conclusions derived from systematic review, it is with great possibility for the favorable pooled results from BPI and MPQ scales. To be noted, a recent systematic review and meta-analysis was designed to explore the effect of music therapy on reducing depression in people with dementia, and it is reported that no significant differences in depression levels in short-term interventions (3–4 weeks), whereas medium-term music therapy may contribute to the improvement of depression.[33] Similarly, a "1–2 month" session of music therapy was also recommended for ameliorating the quality of life in patients with cancer.[34] We have also noticed the follow-up of music therapy varies from short-term (3 weeks) to medium-term (6 months), and no statistics was obtained limited to the study number in our study. In our ongoing observations on music therapy, significant changes in mood disorders, such as anxiety and depression, were identified after at least 3–4 weeks intervention. Hence, medium-term session of music therapy was still recommended with regard to overall literature review.

There were a few limitations in the current systematic review and meta-analysis. First, only three RCTs with seven case–control studies were included, and there is a lack of high-quality studies with sufficient data and information. Then, due to insufficient data, we failed to perform the subgroup analysis based on follow-up, type of pain, and pain scale, which may hinder the application of music therapy in hemodialysis patients. Therefore, a large-scale, well-designed, validated study was still emerging for further research.

5. Conclusions

In conclusion, this systematic review confirmed that music therapy and music-based interventions could effectively reduce pain in patients during hemodialysis procedures. Further studies are recommended to explore the effects of long-term interventions and outcomes in hemodialysis patients. Also, validated studies are still in urgent for the confirmation of this conclusion.

Author contributions

Study design: XT Wang; Data collection and management: XT Wang, JX Gu and JW Liu; Data analysis: XT Wang and JW Liu; Manuscript preparation: XT Wang and HX Hong; All authors meet the criteria for authorship and have approved the final submitted manuscript.
Conceptualization: Jingru Cheng.
Data curation: Hong Bao.
Formal analysis: Hong Bao.
Funding acquisition: Hanxia Hong.
Investigation: Jingru Cheng, Hui Zhang, Hong Bao, Hanxia Hong.
Methodology: Jingru Cheng, Hui Zhang, Hong Bao.
Resources: Jingru Cheng, Hong Bao.
Supervision: Hui Zhang.
Validation: Hui Zhang.
Visualization: Hui Zhang.
Writing – review & editing: Hanxia Hong.

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