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Research Article

JOURNAL OF PSYCHIATRY AND PSYCHIATRIC DISORDERS

ISSN: 2572-519X

Effectiveness of Music Interventions on Chronic Pain: A Systematic Review

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Abstract

Background: Chronic pain, lasting over three months, significantly impacts quality of life. Music therapy and music medicine, are emerging as effective non-pharmacological treatments. These interventions engage brain regions involved in pain and emotion processing. The review investigates the research question of whether music has an impact on chronic pain.

Methods: This review aims to evaluate the effects of music interventions on individuals with chronic pain, focusing on randomized controlled trials. The review includes studies conducted on adults diagnosed with chronic pain. The intervention consists of music-based therapies, compared to control groups receiving either placebo or no therapy, while continuing standard treatments. Data were sourced from PubMed and Cochrane Central, with rigorous attention given to the study selection, data extraction, and bias assessment.

Results: A total of 14 studies were included, analyzing various music interventions for chronic pain across diverse diagnoses and age groups. Key findings included significant pain reduction in intervention groups, particularly when using tools such as the Visual Analog Scale (VAS) and the McGill Pain Questionnaire (MPQ). Risk of bias assessments revealed varying levels of bias across studies.

Discussion: This review of 14 studies found that music interventions can significantly reduce chronic pain, particularly using VAS and MPQ tools. However, varying methodologies and frequent biases suggest a need for more rigorous, standardized research to confirm these effects.

Keywords: Chronic Pain; Music Therapy, Music Intervention; Music Medicine, Non-pharmacological Treatment

Introduction

Pain is an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage. Chronic pain is pain that persists or recurs for longer than 3 months. Chronic pain is multifactorial: biological, psychological, and social factors contribute to the pain syndrome" [1].

This is how the International Classification of Diseases (ICD) 11 defines chronic pain. While International Classification of Diseases 10 did not provide a systematic categorization, leading to undefined treatment pathways due to the lack of classification codes, the International Association for the Study of Pain and the World Health Organization agreed to classify chronic pain into seven categories for the subsequent edition [2, 3].

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Citation: Tabea Frei, Thomas Szucs. Effectiveness of Music Interventions on Chronic Pain: A Systematic Review. Journal of Psychaity and Psychaitric Disorders. 9 (2025): 62-81.

Received: January 23, 2025
Accepted: February 03, 2025
Published: February 17, 2025

Frei T and Szucs T., J Psychiatry Psychiatric Disord 2025
DOI:10.26502/jppd.2572-519X0239

People with chronic pain often suffer from anxiety, depression, sleep problems, and fatigue, which lead to limitations in work and personal life, as well as a reduced quality of life [4]. Pain is often measured using standardized instruments such as the Visual Analog Scale (VAS), the Numeric Rating Scale (NRS), or the Verbal Rating Scale (VRS) [5]. The McGill Pain Questionnaire (MPQ) is also among these tools [6]. The VAS is a commonly used instrument for assessing pain intensity, where patients mark their pain sensation on a 100 mm line to evaluate therapies and changes in pain perception [7].

The NRS rates pain intensity from "no pain" to "worst imaginable pain" using numbers from 0 to 10 (sometimes also 0–20 or 0–100), where patients select the number that corresponds to their current pain level [8]. The VRS consists of a list of terms from which the patient selects or checks one [5]. The MPQ was the first to enable a multidimensional assessment of pain by considering intensity, emotional impact, and significance to the patient [9]. This led to the development of the Short Form, the MPQ-SF, which includes 15 descriptors (11 sensory, 4 affective), a VAS, and the Present Pain Intensity Index [10].

A study by Pain Alliance Europe from 2021 reported that 20 % of the population in Europe experiences chronic pain, with costs reaching into the hundreds of billions of euros [11]. Similar figures were reported in the United States in 2021, with 20.9 % of people suffering from chronic pain [12]. The costs are comparable to those in Europe [13].

Chronic pain can be treated with opioids as well as non-opioid pharmacologic treatments [14]. Another way to combat chronic pain is through the use of non-pharmacological treatments. This also includes the use of music interventions. A distinction is made between music therapy (MT) and music medicine. In MT, the patient works with a music therapist who designs a specific therapy. This can involve both actively creating or composing and listening to music [15]. There is also music medicine, where patients listen to music, usually through headphones, administered by medical staff without MT training. Depending on the situation, patients may have a say in what music is played [16]. Music interventions are cost-effective, have no side effects, and are non-discriminatory [17].

From a psychological perspective, music interventions are believed to increase motivation, improve mood, and alleviate pain by deliberately distracting from unpleasant sensations, thereby reducing the perception of pain or anxiety [17]. Pain processing in the brain involves multiple regions. Additionally, studies have shown that chronic pain is associated with altered brain function [18].

It was demonstrated, for instance, that various brain areas were active in people with osteoarthritis when experimentally induced acute pain was compared with clinical pain. Both pain states activated the pain matrix, but arthritic pain was associated with increased activity in the cingulate cortex, thalamus, and amygdala; these areas are involved in the processing of anxiety, emotions, and aversive conditioning [19]. Similarly, various brain areas are also activated during the processing of music [20]. The prefrontal cortex, which plays a key role in both pain and music processing, is involved in processes such as learning, memory, emotion regulation, and cognitive flexibility [17, 21, 22].

Systematic reviews on this topic have emerged in recent years. However, their methodology was limited, such as only searching for studies that involved vocal MT [23] or investigating the use of music interventions in older adults [24]. The aim of this review is to determine the effect of music on people with chronic pain. This review is the first to provide a comprehensive overview of this topic, thereby filling a research gap and generating new research opportunities.

Objectives

The aim of this systematic review was to determine and evaluate the effect of music interventions on individuals with chronic pain.

Methods

Criteria for considering studies for this review

The systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta- Analyses guidelines, as outlined in the PRISMA checklist [25].

Types of studies

Randomized controlled trials (RCTs) were included in the analysis, while quasi-randomized studies, cluster-randomized controlled trials, pilot studies, feasibility studies, and mixed methods studies were excluded. The studies could be either single- or double-blinded. Study designs with crossover or multi- arm trial approaches were also considered.

Types of participants

The review included studies conducted on adults diagnosed with chronic pain.

Types of intervention

The intervention included music-based interventions, while the control group received a placebo or no therapy.The existing standard therapy was continued.

Electronic searches

The databases Cochrane Central Register of Controlled Trials and PubMed were searched. There were no restrictions on the time period or language. The search query was: chronic pain AND music* (see Appendix 1 for detailed search information). The "RCT" filter was activated in PubMed. The initial literature search was carried out from February 21 to February 26, 2024.

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DOI:10.26502/jppd.2572-519X0239

Searching other resources

In addition to the electronic search, authors were also directly contacted for additional studies.

Data collection and analysis

Outcome

The primary outcome assessed in this review was the improvement of chronic pain without restrictions on the specific measurement methods used.

Selection of Studies

We conducted a thorough review of all titles and abstracts of studies identified through the search and those provided by the contacted authors. Studies that did not fulfill the inclusion criteria were excluded. Full-text analysis was carried out for the remaining studies, followed by a final decision on their suitability for inclusion in the review.

Data extraction and Management

Data collection and analysis were performed using Review Manager 5. Information from each study was systematically recorded using data extraction forms, which captured details such as the first author, year of publication, study design, participants, interventions, outcomes, and ethical approval (refer to study characteristics in Appendix 2). Study selection and bias assessments were carried out by a single author, with any uncertainties resolved collaboratively through discussions among all authors.

Synthesis of Findings

When the inclusion criteria were satisfied, not all studies necessarily assessed every outcome. All identified outcomes were systematically analyzed and compared qualitatively across the studies. Missing data were documented in the bias assessment, including cases where authors were contacted but did not respond. Variability between studies was addressed by underscoring differences and offering detailed descriptions of the measurement methodologies employed.

Assessment of risk of bias in studies included

Each study included was assessed for any risk of bias using the Risk of Bias 2 tool [26]. A table was used to distinguish between a low, high, and unclear risk of bias.

The following items were evaluated:

Random sequence generation

Allocation concealment

Blinding of participants and personnel

Blinding of outcome assessment

Incomplete outcome data

Selective reporting

Other bias

Results

PubMed and Cochrane Central were searched for this review, yielding 279 articles (Figure 1). An additional 54 articles were obtained by contacting authors. After excluding 49 duplicates, 284 articles remained, with their titles and abstracts screened. A total of 266 articles were excluded because they did not meet the criteria, the study was ongoing, or the article had been retracted. This left 18 articles, of which 4 more were excluded after full-text review for not meeting the criteria. A total of 14 studies were included in the review (see the study characteristics in Appendix 2). It should be noted that the study by Siedlecki (2009) is based on the work of Siedlecki and Good (2006). One study was exceptionally included because the intervention and control were reversed. Although the methodology would typically have required exclusion, it was considered because the control group only listened to music, while the intervention group additionally integrated tactile touch [27].

The age range of study participants ranged from 19 to 86, with some studies providing exact ages and others reporting the mean age with standard deviation. The studies were conducted in Turkey, China, France, Austria, Australia, the USA, Sweden, and Germany. The following chronic pain diagnoses were included in the studies: fibromyalgia, chronic pain, lumbalgia or common lumboradiculalgia, mechanical pain, inflammatory pain, fibromyalgic pain, neurological pain, chronic low back pain, postoperative chronic pain after valve replacement, osteoarthritis with chronic pain, one or more chronic nonmalignant pain disorders, Alzheimer's disease and chronic pain, Parkinson's disease with chronic Parkinson's disease-related pain, and cancer with chronic pain.

The shortest study lasted four days [28], and the longest 18 months [29]. Eleven studies received approval from an ethics committee to conduct the study. Two studies did not provide this information [28, 30]. One study did not require ethics committee approval, as per French bioethics law, no approval was needed if the physical and psychological integrity of the patients was not compromised, chronic pain was recognized as an indication for MT, and verbal consent was obtained [31].

The intervention in most studies involved listening to music in a quiet room with a comfortable seating or lying area, without engaging in any other activities while listening. Other interventions included uninterrupted MT, as well as MT following the Heidelberg model [28]. Additionally, there was group singing with a final concert [32]. Participants in two studies selected different types of music according to their current needs: cheerful and familiar music to relieve muscle tension, slow and melodic music for sleeping and relaxation, music to improve the mood during depression, and energetic music to boost energy during fatigue [33, 34].

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DOI:10.26502/jppd.2572-519X0239

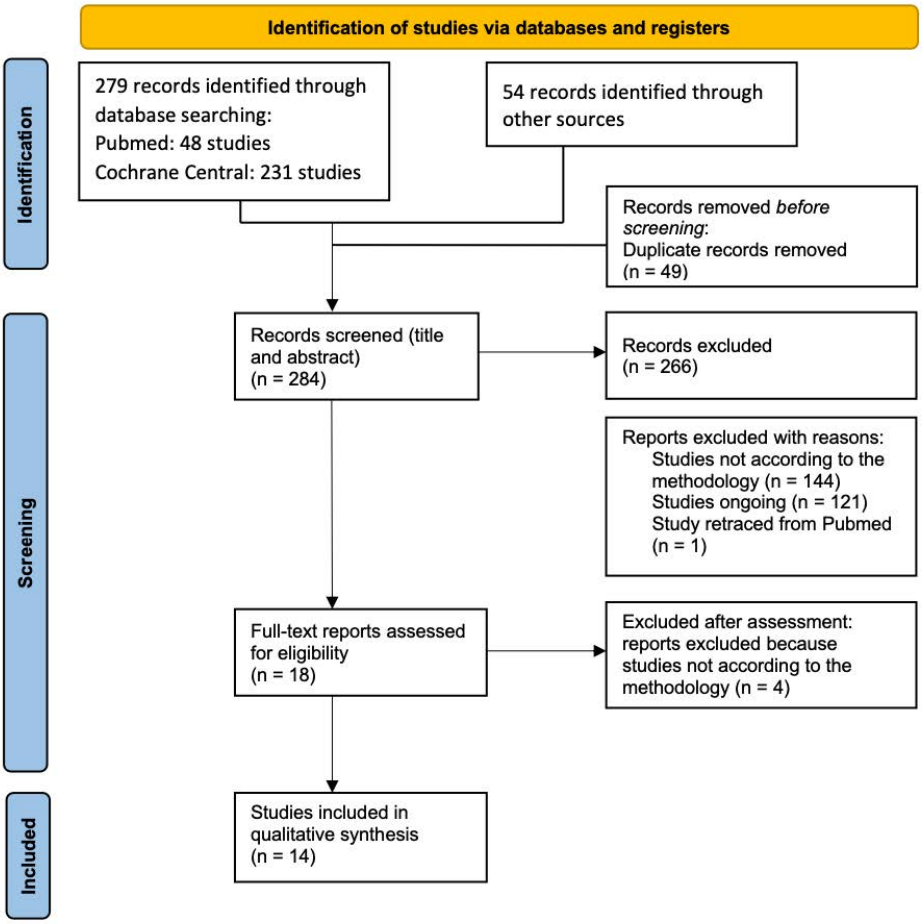

Figure 1: Study flow diagram.

Water and wave sounds were deliberately played in one study [35]. Another study selected only music that ranged between 8–150 Hz and 50–70 dB for the intervention group [17]. Simple, lively songs were sung after a vocal warm-up in one study [36]. In another study, only pieces by Mozart with a tempo of 60–80 bpm were played [37]. Two studies employed the U-Sequencing technique [29, 31].

The shortest intervention lasted 20 minutes, and the longest two hours. Some studies conducted one intervention per day, while others conducted two. In one study, only a single intervention was performed [38], and one study reported 12 interventions over three months [32]. The control groups were allowed to rest, read, or paint. The painting group held an exhibition at the end. Music was also provided for listening in two studies [33, 34], while in one study, music was combined with exercise [36] or tactile touch [27]. Ten studies mentioned that standard therapy was continued during the intervention. It can also be assumed for Siedlecki's (2009) study, as it is an extended analysis of the 2006 study, in which standard therapy was integrated. Risk of bias studies included The risk of bias for each study is visually represented in Figure 2.

Allocation

Participants in the 14 studies were divided into two or three groups through a randomization process. Six studies were classified as having a low risk of bias because they used computer-generated methods [27, 33, 34, 39], block randomization with stratified envelopes [37], or a centrally organized list in advance [29] for group assignment.

Six studies provided no information on how the randomization was conducted and were, therefore, classified as having an unclear risk of bias [17, 28, 30, 32, 36, 38]. Two studies were classified as having a high risk of bias because the participants were alternately assigned to the intervention and control groups [35]. In the second study, participants admitted in even-numbered months were assigned to the intervention group, while those admitted in odd- numbered months were assigned to the control group [31]. Regarding allocation concealment, one study was classified as having a low risk of bias because an external member of the research team handled the communication of the randomization process [27]. Ten studies did not report specific details on allocation concealment [17, 28-30, 32-34, 36, 38, 39]. These were rated as having an unclear risk of bias. In one study, after giving

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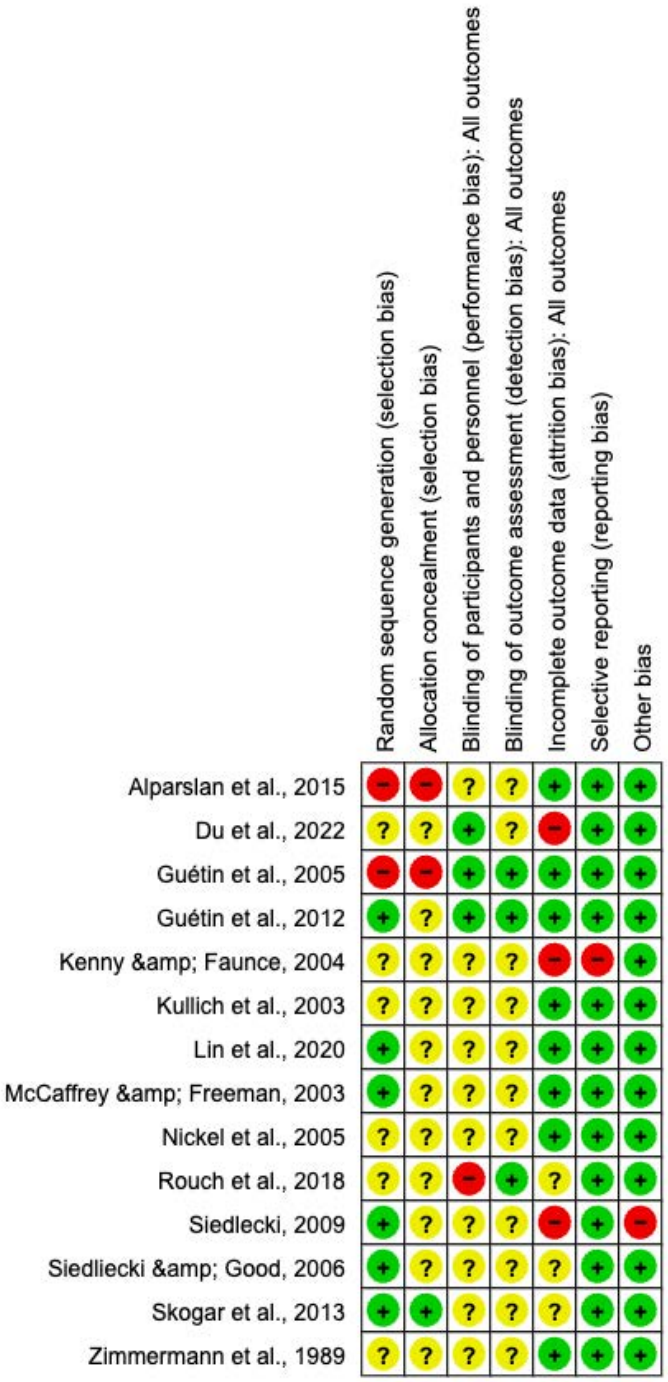

Figure 2: Summary of risk of bias: authors' assessments for each risk of bias item across all studies included.

consent, participants opened an envelope containing their group assignment (C for control group, E for intervention group). This study was rated as having an "unclear risk of bias" because it was unsure whether participants were aware of their group assignment [37]. Due to the alternating randomization process, two studies were also rated as having a high risk of bias for allocation concealment [31, 35].

Blinding

Eight studies did not provide information about blinding. One study reported that the participants were informed about the study, but it was later mentioned that the control group did not know the intervention group was receiving music, suggesting possible blinding, though this is not entirely clear [38]. In another study, participants knew whether they were in Group E or C after opening their envelopes, which allowed them to infer their group assignment [37]. These ten studies were, therefore, rated as having an "unclear risk of bias." One study reported that randomization was done by an independent statistician, so that the participants and clinicians did not know to which group they were assigned [17]. Another study reported that the results were collected by an independent evaluator, but it was not stated whether the participants were blinded or not [31]. A further study reported blinding of the staff and the immediate removal of equipment after the intervention so that the assessor could not infer any information [29].

These three studies were rated as having a low risk of bias. One study was rated as having a high risk of bias because it was stated that participants knew in which group they were placed [32].

Regarding the blinding of outcome assessment, 11 studies were rated as having an unclear risk of bias because no information was provided. Three studies were rated as having a low risk of bias because they explicitly stated that the assessors were blinded [29, 31, 32].

Incomplete outcome data

One study reported five dropouts but still had enough participants to maintain statistical power [31]. Another study recorded four dropouts out of 64 participants, which was considered acceptable [34]. Seven studies showed no missing outcomes, resulting in nine studies being rated as having a "low risk of bias." Three studies were rated as having a "high risk of bias." One study initially reported 37 participants but later only 35, without mentioning the dropout rate [17]. The second study identified significant differences at baseline and included them as covariates in the analysis, but spontaneously formed a third group when some participants did not show up [36]. The third study recorded four dropouts and reported an initial, significant difference in the VAS measurement, which was not statistically verified later [33]. One study was rated as having an "unclear risk of bias" because it was based on an earlier study with 59 participants, but only 50 completed both the baseline and the 12-week assessment. The absence of nine participants was not explained [32]. Another study also received an "unclear risk of bias" rating because one outcome reported two p-values without explanation, which were not related to the outcomes of this review [27].

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Selective Reporting

No selective reporting was found in 13 studies, which were rated as having a low risk of bias. One study mentioned conducting a follow-up, but some results were missing. Additionally, it did not specify how many men and women participated in the study, even though it was stated that there was no significant difference between them [36]. This study was rated as having a high risk of bias.

Other Bias

One study was rated as having a high risk of bias because there were three significant differences already present at baseline, and it was noted that these differences were not statistically controlled for in the subsequent analysis [33]. Another study had significant group differences at baseline, but this was addressed by using covariates in the main analysis [35]. This study and 12 others were rated as having a low risk of bias.

Effects of Intervention

Although each study examined different outcomes, this review focused solely on pain reduction. The measurement methods VAS, MPQ, and NRS have already been explained in the Introduction. This section directly addresses the results.

Pain

All studies assessed pain progression using various testing methods.

VAS

Six studies used the VAS [17, 28-31, 35]. All studies showed significant improvements in the intervention groups. Guétin et al. (2005) noted that the intervention group only showed significant improvements immediately after the session, and no significant difference was measured between the groups. Similarly, Nickel et al. (2005) found no significant differences in the current pain measurement between the groups, but there was a significant improvement in the last four days in the intervention group.

MPQ

Five studies used the MPQ, four of which used the short form [33, 34, 37, 38]. All studies showed significant differences between the groups. McCaffrey and Freeman (2003) found consistent significant differences, while Zimmerman et al. (1989) observed differences in all but one subcategory. Lin et al. (2020) observed significant differences only in the pain rating index emotional item. Siedliecki and Good (2006) examined two intervention groups and a control group. The combined music groups showed a significant pain reduction compared to the control group ($p = 0.002$), with other results reported as percentages. Siedlecki (2009), an extension of the 2006 study, investigated racial differences and found significant differences between races. Significant differences were observed between the intervention and control groups for Caucasians but not for African Americans.

Pain-O-Meter (POM)

The POM combines the VAS and the MPQ into a single tool for comprehensive pain assessment. The POM includes a 10 cm VAS to measure pain intensity and a list of sensory and affective words (POM-WDS) to evaluate the sensory and affective components of pain. The results can be aggregated into a total score for pain intensity [40]. POMemo categorizes emotional pain terms on a scale ranging from worrying (=1) to terrifying (=5), whereas POMphys evaluates physical pain descriptions from soaring (=1) to tearing (=5) [27]. The POM was used to evaluate pain outcomes in the study by Skogar et al. (2013). No significant differences were measured between the groups. However, within the groups, the POM-VAS showed a significant reduction in pain intensity in both groups. Regarding the POM-emo and POM-phys, only the Tactile Touch group showed a significant improvement, while the Rest-To-Music group did not.

Pain Self-efficacy Questionnaire

The Pain Self-efficacy Questionnaire is a self-assessment tool consisting of ten items. Each item is rated on a 7-point Likert scale from 0 (“not at all confident”) to 6 (“completely confident”). Respondents indicate how confident they are in their ability to perform certain tasks despite their pain. The total score is calculated by summing the individual ratings and can reach a maximum of 60. Higher scores indicate greater confidence in the ability to achieve the desired outcomes despite pain [41]. The study by Kenny and Faunce (2004), which spontaneously formed a third group, showed no significant improvement between the singing group and the control group or between the singing group and the nonparticipating group. However, a significant time effect was observed for both the singing and control groups after six months. No information was provided on the comparison between the singing group and the nonparticipating group.

Pain-related Self Statements Scale

The Pain-related Self Statements Scale assesses situation-specific aspects of cognitive pain coping and includes the subscales “Catastrophizing” and “Coping.” These subscales are validated, sensitive to changes, and closely related to pain intensity and impairment due to pain experiences [42]. The study by Kenny and Faunce (2004) reported the following results for the Pain-related Self Statements Scale: There were no significant differences in active coping between the singing group and the control group, or between the singing group and the nonparticipating group. There was even a decrease in active coping in the singing group and an increase in the control group at the six-month follow-up. No significant results were found for catastrophizing either.

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Oswestry Low Back Pain Disability Questionnaire

The Oswestry Low Back Pain Disability Questionnaire is a self-report instrument used to measure the quality of life and pain tolerance in cases of low back pain. It consists of ten sections, each with five statements representing increasing degrees of disability, along with a separate section for pain intensity. Each section can score a maximum of 5 points, leading to a total score of 50 points. This score is then converted into a percentage, with higher percentages indicating a greater disability [36]. The study by Kenny and Faunce (2004) again showed no significant improvement in pain disability between the singing group and the control group or between the singing group and the nonparticipating group. The singing group even showed an increase in pain disability, while the control group showed a decrease at the six-month follow-up. No information was provided on the comparison between the singing group and the nonparticipating group.

Roland-Morris Disability Questionnaire and 4-Point Scale The Roland-Morris Disability Questionnaire is a self-administered questionnaire consisting of 24 items that reflect daily activities. Each item is scored as 1 (applicable) or 0 (not applicable), resulting in a total score ranging from 0 (no disability) to 24 (severe disability) [43]. The study by Kullich et al. (2003) assessed the effects of MT on patients with chronic low back pain, including the use of the Roland-Morris Disability Questionnaire, and showed significant results in the intervention group on days 10 and 21. However, the control group also showed a significant improvement on day 21. Additionally, Kullich et al. (2003) used the 4-point scale to measure spinal tenderness. The scale was divided into no, mild, moderate, and severe pain. The results showed a significant reduction in spinal tenderness in the MT group.

Pain Sensation Scale

One study used the Pain Sensation Scale by Geissner, which employs 24 adjectives to assess acute and chronic pain, based on the adjective list from the MPQ. Two models were developed: a 5-factor model with affective and sensory factors, and a 2-factor model that combines affective and sensory pain [44, 45]. The study by Nickel et al. (2005) did not find any significant differences between the groups using the Pain Sensation Scale.

NRS, Simple Visual Scale (SVS), Brief Pain Inventory (BPI)

The study by Rouch et al. (2018) used the NRS to examine the usual pain intensity over the past week (NRS-U) and the worst perceived pain over the last eight days (NRS-I). An SVS is used to assess the pain intensity. In the SVS, patients are asked to use a scale from 0 to 4, where 0 represents “no pain” and 4 represents “very severe pain” [32]. The study by Rouch et al. (2018) investigated the usual pain intensity (SVS-U) and the worst perceived pain of the last eight days (SVS-I). The BPI quickly and easily measures pain intensity and its impact on the lives of pain patients. Respondents rate their worst, least, average, and current pain intensity on a scale from 0 to 10, as well as the extent to which pain interferes with seven functional areas: general activity, mood, walking ability, normal work, relationships, sleep, and enjoyment of life [46] The study by Rouch et al. (2018) divided the BPI into BPI-I and BPI-R. The BPI-I measured pain intensity (sensory dimension, three items) and assessed the usual and worst pain over the last eight days. The BPI-R captured the interference caused by pain (reactive dimension, ten items) and examined its impact on daily life. The study by Rouch et al. (2018) did not focus on the pain measurement alone but combined it with the Big Five Inventory. As a result, the groups were combined regarding pain measurement, and the results were reported as percentages. Therefore, this review could not provide an answer regarding significant differences between the groups.

Discussion

14 studies were identified for this review. Almost all of them examined multiple outcomes, but this review focuses exclusively on the improvement of chronic pain. The use of various tests for measuring pain intensity is central in pain research. Notably, studies that employed the VAS and MPQ showed significant differences between the intervention and control groups, providing consistent results that highlight their clinical relevance. Additionally, the 4-Point Scale also delivered clear results [30].

Studies on pain assessment demonstrated that the VAS is considered a particularly reliable instrument, especially when compared to the NRS and VRS [47]. Another study also found a high correlation ($r = 0.86$) between the MPQ-SF and the VAS, further confirming the VAS as the preferred method for pain assessment [48]. Only the NRS was used in one study [32] in the those included besides the VAS and MPQ. Otherwise, eight other complex measurement instruments were employed. It is noteworthy that these studies produced less consistent results, raising questions about their precision and user-friendliness.

All participants were diagnosed with chronic pain, but some studies provided more detailed differentiation between various types of chronic pain. This led to differences in the comparability of the results, making it often possible to draw only general conclusions. This could be due to the fact that many of the studies were conducted before the precise classifications of ICD-11 were introduced when there was less emphasis on a clear definition of chronic pain. It would, therefore, be desirable to conduct further studies focused on specific diagnoses of chronic pain to enable more targeted comparisons.

The study by Kenny and Faunce (2004) reported significant differences between the groups from the outset. However,

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these were used as covariates in the main analysis. Notably, the study measured numerous outcomes, yet, no significant differences between the intervention and control groups were found, and, in some cases, results were not reported at all. Particularly peculiar is the fact that the singing group showed a deterioration in Active Coping and Pain Disability during the follow-up. This might be due to a change in the study design, where a third group was spontaneously introduced because some participants were missing. This adjustment raises questions about the statistical power and, consequently, the validity of the results, as the original design only included two groups, and ethical approval was granted on that basis. This could have compromised the overall validity of the study.

Further uncertainties arose in the study by Siedlecki (2009), which reported three significant differences at baseline that were not accounted for later. This may lead to biases in the results and could have been easily avoided if, similar to the study by Kenny and Faunce (2004), these data had been used as covariates. One study conducted only a single intervention [38]. It is questionable whether the results obtained are even comparable with other studies, or if it would have been better to treat it as a pilot study to explore whether a larger-scale study would be feasible.

The study by Skogar et al. (2013) was included despite methodological concerns, as the intervention and control groups were reversed. In this case, the intervention group received tactile touch therapy in addition to music, while the control group only listened to music. The inclusion of the study is justified because the control group essentially received the music intervention that was assigned to intervention groups in other studies. Notably, despite the lack of significant differences between the groups, pain relief still occurred, suggesting that the use of music alone can be very effective.

It was noticeable in the risk-of-bias assessment that an "unclear risk of bias" was frequently identified in the "allocation" and "blinding" categories. In fact, one study showed that results are deliberately not published. The reasons varied, ranging from uninteresting to unexpected results, but also the question of securing funding [49]. One possible reason for this could be that the participants were informed at the beginning of the study and presumably recognized themselves in the course of the study to which group they were assigned. The study staff may also have known whether they were working with participants from the experimental or control group. These circumstances may have led to a decision not to document these

aspects precisely, which explains the frequent lack of justification. However, blinding would be necessary to prevent performance bias and avoid any potential bias [50]. The studies demonstrated a variety of interventions used. Nevertheless, listening to music was a central aspect. Participants were allowed to choose from a pool of different music in some studies.

Research in psychology has shown that people prefer to make their own decisions rather than having decisions made for them. The freedom to choose enhances the sense of autonomy and promotes intrinsic motivation, leading to higher satisfaction and more positive emotions [51]. Positive affect, in turn, leads to pain reduction [52]. The ability to choose their own music might have been more enjoyable for the participants, leading to better emotions and, consequently, a reduction in pain.

Another study used group singing in a choir as an intervention [32]. Previous research has also found that group singing leads to positive emotions [53]. Three studies specifically used music and its properties for relaxation through the "U" sequence (tempo, volume, frequency, orchestral size) and music by Mozart with a tempo between 60 and 80 beats per minute [29, 31, 37]. Relaxation helps to reduce chronic pain, as demonstrated by a systematic review in 2021 [54]. This may explain why significant differences were measured between the groups in these studies.

In summary, it can be concluded that music, whether individually selected, experienced collectively, or specifically used for relaxation, plays a valuable role in pain management. The promotion of positive affect through musical interventions is a key mechanism contributing to pain relief. The strengths of this review lie in the fact that many studies show significant differences in the use of music for treating chronic pain. Additionally, the frequent use of the VAS and MPQ allowed for a good comparability of results. Nevertheless, the review has limitations, including many "unclear risk of bias" ratings in blinding and allocation, heterogeneous pain diagnoses, and inconsistent study durations and interventions. Additionally, the varying formats of result reporting, such as p-values and percentages, made direct comparisons between studies challenging. One aspect to consider is that study selection and bias assessments were primarily conducted by a single author. However, uncertainties were resolved collaboratively within the group, and standardized assessment tools were applied to support consistency and reliability.

Recommendations for Future Research

Future studies should aim for larger sample sizes and longer study durations to increase the robustness and generalizability of the findings. Additionally, procedures for blinding and the allocation of participants should be explicitly documented to allow for a precise assessment of bias risk. A stronger focus should also be placed on standardizing intervention protocols to ensure consistency and comparability across studies. It would also be important for all studies to report results not only in percentages but also as p-values to clarify the effects.

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An interesting avenue for future research could involve combining this approach with neuroscience, where the use of music in individuals with chronic pain is examined from the perspective of the neural mechanisms involved in pain relief, such as the activation of the prefrontal cortex or the modulation of stress and reward systems in the brain.

Acknowledgement

ChatGPT 4.0 was used in the preparation of this work for assistance with translation, text correction, and condensation. The authors subsequently reviewed and edited all content.

Conflict of Interest Statement

The authors declare no conflicts of interest.

Funding Sources

No funding or sponsorship was provided for this study.

Références

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Citation: Tabea Frei, Thomas Szucs. Effectiveness of Music Interventions on Chronic Pain: A Systematic Review. Journal of Psychaity and Psychaitric Disorders. 9 (2025): 62-81.

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Appendix 1

Detailed search information

PubMed

Search carried out from February 21 to February 26, 2024
Filter: RCT

Search: **chronic pain AND music***
("chronic pain"[MeSH Terms] OR ("chronic"[All Fields] AND "pain"[All Fields]) OR "chronic pain"[All Fields]) AND "music*"[All Fields]

Translations

chronic pain: "chronic pain"[MeSH Terms] OR ("chronic"[All Fields] AND "pain"[All Fields]) OR "chronic pain"[All Fields]

Cochrane Central Register of Controlled Trials

Search carried out from February 21 to February 26, 2024
#1 (chronic pain AND music*):ti,ab,kw

Appendix 2

Study characteristics: Music* and Chronic pain

Alparslan et al., 2015

Methods	**Allocation:** A criteria sampling method for randomization was employed creating intervention and control groups by allocating the first patient to the intervention group and the second patient to the control group. **Blindness:** no information **Duration:** 14 days (D), no follow-up mention **Design:** RCT
Participants	**Diagnosis:** Diagnosis of primary fibromyalgia **N:** 37 **Age range:** between 35 and 53 years **Male:** 2 **Female:** 35 **Location:** Turkey
Intervention	**1. Intervention (n = 21):** Music CD (with water and wave sound) for intervention group, listen 25 min, twice daily, quiet environment, comfortable seating, no other activities during listening, **2. Control (n = 16):** No music CD for control group
Outcomes	**Pain:** Measured with VAS: D1, D7, D14 Between D1 and D14: intervention group with a significant decrease of pain (P = 0.026). Between D1 and D14: control group without a significant decrease of pain (P = 0.853).
Notes	**Approval from the Ethics Committee:** yes

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Du et al., 2022

Methods	**Allocation:** Participants were randomly assigned to the following two groups in a 1:1 allocation ratio. **Blindness:** An independent statistician randomized blocks of random sizes, hiding the task from clinicians and patients. But no further information about blinding of participants and personnel. **Duration:** 7 D, no follow-up mention **Design:** RCT
Participants	**Diagnosis:** chronic pain **N:** 37 **Age range:** around 40 and 64 years **Male:** 15 **Female:** 22 **Location:** China
Intervention	**1. Intervention (n = 19):** 30 minutes for 7 D, listening to music before going to bed (8–150 Hz, 50–70 dB), plus usual care **2. Control (n = 18):** no intervention, 7 D usual care
Outcomes	**Pain:** Measured with VAS MT: Pre- and posttest: ($F = 31.50$, $P < 0.001$, $\eta2 = 0.71$) significant decrease of pain Control: Pre- and posttest: ($F = 1.00$, $P = 0.34$, $\eta2 = 0.07$) no significant decrease of pain
Notes	**Approval from the Ethics Committee:** Yes

Guétin et al., 2005

Methods	**Allocation:** alternating month technique, random group allocation, hospital admission date, even months to intervention group, odd months to control group. **Blindness:** The results for D0, D5, D12 were collected by an independent rater (nurse). No information about blinding of participants. **Duration:** 12 D, Intervention: D0-D5, final measurement: D12, unclear if follow-up or part of evaluation. Design: RCT
Participants	**Diagnosis:** lumbalgia or common lumboradiculalgia with duration of minimum six months **N:** 65 **Age range:** between 30 and 70 years **Male:** 32 **Female:** 33 **Location:** France
Intervention	**1. Intervention (n = 33, 3 patients left during study):** recommended rehabilitation therapies (physiotherapy, balneotherapy, physical exercises) plus four music therapy intervention during D0 and D5. Individual MT, daily afternoon sessions, first four hospital D, patient-preferred music, headphones, quiet room, lying down, 20 minute sequence, gradual relaxation, reactivating phase, U-Montage technique. **2. Control (n = 32, 2 patients left during study):** recommended rehabilitation therapies (physiotherapy, balneotherapy, physical exercises)
Outcomes	**Pain:** measured with VAS No significant difference between the two groups at the end of the study (no p-value). Significant improvement in pain immediately after the session in the intervention group ($P < 0.0001$) -> The expose contains the same statement, but with a P-value of < 0.001 **Measuring the immediate effectiveness of each music therapy session:** Measured with VAS, pre/post music therapy sessions Significant improvements, all sessions ($p < 0.0001$). First session: 1.6 point improvement (35 %), average pain 4.5. Pain level increases between sessions.
Notes	**Approval from the Ethics Committee:** According to French bioethics legislation, approval from an advisory committee for the protection of individuals in biomedical research (CCPPRB) is not required for studies such as this one where there is no risk to the physical and psychological integrity of hospitalized individuals. Chronic pain is a recognized indication for music therapy, and simple verbal consent was obtained before participants were included in the study.

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Guétin et al., 2012

Methods	Single-blind RCT **Allocation:** centralized randomization, randomization list **Blindness:** assessors and nurses were blinded **Duration:** 18 months including a 3-month follow-up period **Design:** RCT
Participants	**Diagnosis:** either mechanical pain, inflammatory pain, fibromyalgic pain, neurological pain for at least 6 months **N:** 87 **Age range:** between 19 and 84 years **Male:** 19 **Female:** 68 **Location:** France
Intervention	**1. Intervention (n = 44):** Listening to music in addition to standard care (medication and, if necessary, nonmedical treatments) The study used a receptive relaxation music intervention called the "U" sequence, lasting 20 minutes, which was designed to relax patients by altering the tempo, volume, and orchestration of the music. Custom music was provided by Music Care, with sessions tailored to individual musical preferences gathered from a pre-therapy questionnaire. Patients listened through earphones in a relaxed environment and later had access to a music database for 10 D in the hospital and 50 D at home, with adherence monitored through a form. The goal was to assess the lasting effects of the intervention 30 D after the sessions, requiring at least two sessions daily. **2. Control (n = 43):** standard therapy (drugs and if needed nonmedical treatments)
Outcomes	**Pain:** measured with VAS D60 compared with D0: significant reduction of pain in the intervention group -3.4 (±2.3) and control group -1.6 (±2.2) with P < 0.001, relative improvement of 54 %. Control group with a relative improvement of 25.8 %. D90: mean score for intervention group 3.4 (±1.7) and for control group 4.7 (±1.8), P < 0.001 D0–D90: Significant difference favoring the music intervention group, with changes of -3.1 (±1.9) versus -1.5 (±2.4), P = 0.001.
Notes	**Approval from the Ethics Committee:** yes

Kenny & Faunce, 2004

Methods	RCT, randomization between intervention and control group. The third group was formed after from the participants who did not show up for the study. **Allocation:** no information **Blindness:** no information **Duration:** 3 weeks intervention, follow-up after 6 months **Design:** RCT
Participants	**Diagnosis:** chronic pain **N:** 77 **Age range:** around 26 and 55 years **Male:** no information **Female:** no information **Location:** Australia
Intervention	**1. Intervention: (n = unclear)** group singing, vocal warm-ups, lively songs, simple lyrics, posture guidance, clavinova accompaniment, 30 minute sessions. Same pain management as the other groups. Standard therapy **2. Control (n = unclear)** Listening to music and doing sport. Same pain management as the other groups. standard therapy **3. Did not participate in singing sessions (n = unclear)** Same pain management as the other groups. Standard therapy

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Outcomes	**Pain management (Pain Self-efficacy Questionnaire):** Comparison of singing group vs. control group: no significant improvement Comparison of singing group vs. participants who did not take part: no significant improvement Follow-up after 6 months: significant effect of time for both groups (singing and control group) (P = 0.044) Follow-up after 6 months: no information about singing group vs. group which did not take part **Pain-related cognitions (Pain Responses Self-statements):** Active coping: comparison of singing group vs. control group: No significant difference. Comparison of singing group vs. participants who did not take part: The difference in active coping approached conventional significance (P = 0.061). Follow-up after 6 months: No significant effect between singing and control group (p = 0.08). (The singing group exhibited a decrease in active coping from post-intervention to follow-up [though the mean score at follow-up was still higher than the pre-intervention score], while the comparison group showed an increase in active coping over the same period.) Follow-up after 6 months: significant effect of time for both groups (singing and control group) (P = 0.024) Follow-up after 6 months: no information about singing group vs. group which did not take part Catastrophizing: comparison of singing group vs. control group: no significant improvement Comparison of singing group vs. participants who did not take part: no significant improvement Follow-up after 6 months: group effect (P = 0.074). No information which groups are meant. **Pain disability (Oswestry Low Back Pain Disability Questionnaire):** Comparison of singing group vs. control group: no significant improvement Comparison of singing group vs. participants who did not take part: no significant improvement Follow-up after 6 months: comparison of singing group vs. control group: significant increase in pain disability (P = 0.033). But, singing group with an increase in pain disability and control group with a decrease at follow-up. Follow-up after 6 months: No information about singing group vs. group which did not take part.
Notes	**Approval from the Ethics Committee:** yes **Significant differences between groups at the start of the study were accounted for by using pre-intervention scores as covariates in the analysis.**

Kullich et al., 2003

Methods	**Allocation:** no information about how randomization was done. **Blindness:** no information about how the blinding was done. **Duration:** 3 weeks, no follow-up mention **Design:** RCT
Participants	**Diagnosis:** chronic low back pain **Pain duration before study:** between 30 and 261 D **N:** 65 **Age range:** between 21 and 68 years **Male:** 41 **Female:** 24 **Location:** Austria
Intervention	**1. Intervention (n = 32):** MT with standardized music and physiotherapy program, listening to music once a day for a minimum of 25 minutes, during three weeks in an undisturbed environment Plus standardized inpatient physiotherapy program (spinal exercises, mechanotherapy, massage, parafango, electrotherapy) **2. Control (n = 33):** Standardized inpatient physiotherapy program (spinal exercises, mechanotherapy, massage, parafango, electrotherapy)

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Outcomes	**Global pain perception:** VAS D10: significant improvement for intervention group (P < 0.001) D21: significant improvement for intervention group (P < 0.00001) **Chronic low back pain:** measured with Roland-Morris Disability Questionnaire D10: significant improvement for intervention group (P < 0.005) D21: significant improvement for both groups; intervention group (P < 0.00002), control group (P < 0.002) **Pressure pain in the spine:** measured with a 4-Point Scale (no, slight, moderate, severe pain) Significant reduction in music group Intervention Group - Start: 1.8 ± 1.1 - After 10 days: 1.4 ± 1.0 - After 21 days: 0.9 ± 1.1 Frequency distribution of pain relief: - Reduction in moderate pain: from 10 to 5 patients - Reduction in severe pain: from 11 to 4 patients - Improvement: more than 50 % Control Group Frequency distribution of pain relief: - Improvement: 1 patient each with moderate and severe pain (3 %)
Notes	**Approval from the Ethics Committee:** no information

Lin et al., 2020

Methods	**Allocation:** A computer randomly generated two numbers, 0 or 1. Patients who received a 0 were assigned to the music group, while those who received a 1 were assigned to the control group. **Blindness:** no information **Duration:** The 6-month intervention phase concluded with a direct follow-up for data collection. **Design:** RCT
Participants	**Diagnosis:** postoperative chronic pain after valve replacement **N:** 86 **Age range:** around 48.5 and 56 years **Male:** 42 **Female:** 44 **Location:** China
Intervention	**1. Intervention (n = 43):** quiet room environment, nightly rest 8–10 pm, patient music preferences, music types including light, folk, opera, pop, music group using speakers or headphones, 30 minute sessions, every day during 6 months, soft and soothing music with controlled volume, researcher guidance before discharge, family involvement post-discharge, WeChat support for issues. (Standard treatment is not mentioned, but it can be assumed that this was the control group.) **2. Control (n = 43):** quiet room, nightly 30 minute rest, 8–10 pm, every day during 6 months, researcher instructions, family support, WeChat communication. Plus standard treatment
Outcomes	**Chronic pain:** measured with a SF-MPQ with four subscales: PRI sensory item: no significant difference between groups (P = 0.492) PRI emotional item: intervention group significantly lower than control group (P = 0.021) VAS: no significant difference between groups (P = 0.752) PPI: no significant difference between groups (P = 0.841)
Notes	**Approval from the Ethics Committee:** yes

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McCaffrey & Freeman, 2003

Methods	**Allocation:** Randomization was accomplished by placing slips labeled “C” for control and “E” for experimental into envelopes – 22 each for women and 11 each for men. The envelopes were mixed in a box, and the unopened ones were stacked. After providing consent and confirming eligibility, participants picked and opened the top envelope. Those who received a “C” slip were assigned to the control group, while those with an “E” slip were assigned to the experimental group. **Blindness:** no blinding for participants, unclear about personal **Duration:** 14 D, no follow-up mention **Design:** RCT
Participants	**Diagnosis:** osteoarthritis with chronic pain, at least 15 days per month, pain rating 3 or higher an 1–10 scale **N:** 66 **Age range:** around 69 and 82 years **Male:** 22 **Female:** 44 **Location:** USA
Intervention	**Intervention (n = 33):** cassette tape player, relaxation music of Mozart for daily 20 minutes for 14 D, (Andantino, Concerto for Flute, Harp, Orchestra in C, K.299, Overture Le nozze di Figaro, K.492, Symphony No. 40, first movement), music tempo (60–80 bpm), consistent seating, no distractions, SF-MPQ, before and after music listening on D1, D7 and D14. Plus standard therapy **Control (n = 33):** same setting without listening to music. Permission to read newspaper, books or magazines. Plus standard therapy
Outcomes	**Pain:** measured with the SF-MPQ on D1, D7 and D14 Pain Rating Index: Less pain in the intervention group, with significant differences observed between the intervention and control groups in pre- to posttest pain levels on each of the three days (P = 0.001). VAS: Less pain in the intervention group, with significant differences observed between the intervention and control groups in pre- to posttest pain levels on each of the three days (P = 0.001).
Notes	**Approval from the Ethics Committee:** yes

Nickel et al., 2005

Methods	**Allocation:** No information **Blindness:** No information **Duration:** Minimum 4 D but no further information, no follow-up mention **Design:** RCT
Participants	**Diagnosis:** one or more chronic nonmalignant pain disorders **N:** 40 **Age range:** around 40 and 62 years **Male:** 12 **Female:** 28 **Location:** Germany
Intervention	**Intervention (n = 21):** Heidelberger model of MT plus standard pharmacological pain management **Control (n = 19):** standard pharmacological pain management
Outcomes	**Pain intensity score,** measured with VAS Momentary pain: non-significant difference between intervention and control group (P = 0.092) Pain in the last four days: significant between intervention and control group (P = 0.014), with improvement in the intervention group. **Pain sensation scale,** (*Schmerzempfindungskala*) Affective pain: no significant difference between intervention and control group (P = 0.355) Sensory pain : no significant difference between intervention and control group (P = 0.832)
Notes	**Approval from the Ethics Committee:** no information

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Rouch et al., 2018

Methods	**Allocation:** randomization but no information about how it was done. **Blindness:** Participants and personnel knew about groups but the outcome assessment was blinded. **Duration:** The 3-month intervention phase concluded with a direct follow-up for data collection. **Design:** RCT
Participants	**Diagnosis:** Alzheimer's disease and chronic pain **N:** 50 **Age range:** around 73 and 86 years **Male:** 18 **Female:** 32 **Location:** France
Intervention	**Intervention (n = 24):** Group singing with a concert at the end of the study, weekly two hours intervention, 12 times during three months **Control (n = 26):** Painting with an exhibition at the end of the study, weekly two hours intervention, 12 times during three months
Outcomes	**Chronic pain:** NRS-U: decrease of 9.7 % NRS-I: decrease of 17 % SVS-U: decrease of 20.2 % SVS-I: decrease of 11.4 % BPI-I: decrease of 6.1 % BPI-R: decrease of 22.5 % In the study by Rouch et al. (2018), art interventions, which included both music therapy and painting activities, were analyzed in patients with mild Alzheimer's disease regarding their influence on chronic pain. Although the study found a reduction in pain after the intervention, the data from both art therapy groups were combined for the analysis.
Notes	**Approval from the Ethics Committee:** yes

Siedliecki, 2009

Methods	**Allocation:** randomization with the Min-8 program **Blindness:** no information **Duration:** 7 D, no follow-up mention **Design:** RCT
Participants	**Diagnosis:** chronic nonmalignant pain (osteoarthritis, herniated disc, rheumatoid arthritis, degenerative join disease, fibromyalgia) **Duration of chronic pain:** 6–30 years **N:** 64, dropout of 4 participants (3 of the control group and 1 of the patterning music group) **Age range:** between 26 and 64 years **Male:** 14 **Female:** 46 **Caucasian:** 24 **African-American:** 36 **Location:** USA
Intervention	**Intervention 1: patterning music group (n = 18):** 1 hour a day for seven consecutive days, selecting their own music. They chose from different types of music according to their current needs: upbeat and familiar music to relieve muscle tension, slow and melodious music for sleep and relaxation, music to improve mood when feeling depressed, and energetic music to boost energy when fatigued. Keeping a diary and standard care **Intervention 2: standard music group (n = 22):** 1 hour a day for seven consecutive days. Participants were offered a choice of one 60 minute tape of relaxing instrumental music from a collection of five types: piano, jazz, orchestra, harp, or synthesizer. Keeping a diary standard care **Control (n = 20):** standard care, keeping a diary

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Outcomes	**Pain:** measured with MPQ-SF and VAS Significant differences in pain reduction from pretest to posttest between music and no-music groups (P = 0.004). Racial Differences in Music Effect: Significant posttest differences between Caucasian and African American groups (P = 0.032). Caucasian Group: Significant differences between music and no-music group in pain reduction (P = 0.013). Follow-up: MPQ-SF with P = 0.007 and VAS with P = 0.006 African American Group: No significant differences between music and no-music in pain reduction (P = 0.319). Follow-up: MPQ-SF with P = 0.154 and VAS with P = 0.242
Notes	**Approval from the Ethics Committee:** yes

Siedliecki & Good, 2006

Methods	**Allocation:** randomization with the Min-8 program **Blindness:** no information **Duration:** 7 D, no follow-up mention **Design:** RCT
Participants	**Diagnosis:** Chronic nonmalignant pain (osteoarthritis, herniated disc, rheumatoid arthritis, degenerative join disease, fibromyalgia) **Duration of chronic pain:** 6–30 years **N:** 64, dropout of 4 participants (3 of the control group and 1 of the patterning music group) **Age range:** between 26 and 64 years (see **Siedliecki, 2009)** **Male:** 14 **Female:** 46 **Location:** USA
Intervention	**Intervention 1: patterning music group (n = 18):** 1 hour a day for seven consecutive days, selecting their own music. They chose from different types of music according to their current needs: upbeat and familiar music to relieve muscle tension, slow and melodious music for sleep and relaxation, music to improve mood when feeling depressed, and energetic music to boost energy when fatigued. Keeping a diary and standard care **Intervention 2: standard music group (n = 22):** 1 hour a day for seven consecutive days. Participants were offered a choice of one 60 minute tape of relaxing instrumental music from a collection of five types: piano, jazz, orchestra, harp, and synthesizer. Keeping a diary and standard care **Control (n = 20):** standard care, keeping a diary
Outcomes	**Pain:** measured with MPQ-SF and VAS Both music groups reported 20 % less pain from pretest to posttest; control group saw a 2 % increase. Adjusted means: 19 % less pain in PM group and 21 % less pain in SM group compared to control. VAS scores: 12 % decrease in PM group, 16 % decrease in SM group, 1 % increase in control. Significant reduction in pain for combined music groups vs. control group (Follow-up: $F(1, 55) = 10.766$, $P = 0.002$, $\eta^2 = 0.90$).
Notes	**Approval from the Ethics Committee:** yes

Skogar et al., 2013

Methods	**Allocation:** random number generator lottery-based computerized randomization process **Blindness:** Personnel not blinded to treatment assignment, involved in delivering specific massage interventions **Duration:** 8 weeks intervention, follow-up after week 34 **Design:** RCT
Participants	**Diagnosis:** Parkinson's disease, longer than two years and chronic Parkinson's disease-related pain **Duration of chronic pain: c**hronic pain incidence of PD, minimum 3 days per week, minimum 3 months prior to study **N:** 45 (dropout 1) **Age range:** between 50 and 79 years **Male:** 28 **Female:** 16 **Location:** Sweden
Intervention	**Tactile Touch – Intervention (n = 29):** Involved whole-body tactile stimulation performed by the same therapist at a consistent time, mostly in the mornings, around 1 hour, 10 x during 8 weeks, room with comfortable temperature between 22 °C/72 °F and 24 °C/75 °F, using a specific "Fibro oil®! mixed with virgin oil, room scented with lavender aroma, background music played was "Music for well-being II – Letting go of stress" by Fönix Music®. Plus standard care **RTM Intervention (n = 16, dropout 1):** same intervention as Tactile Touch – Intervention but without Tactile Touch Plus standard care

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Outcomes	**Pain:** measured with, VAS (before intervention), Pain-O-Meter POMvas: no significant difference between groups at week 3 measured before/after (P = 0.174) Within the Tactile Touch group (TT) (P = 0.007) and the Rest To Music group (RTM) (P = 0.016): significant reductions in pain intensity from before to after the intervention POMemo: no significant difference between groups at week 3 measured before/after (P = 0.178) Within the TT (P = 0.03) and RTM (P = 0.178) POMphys: no significant difference between groups at week 3 measured before/after (0.086) Within the TT (P = 0.027) and RMT (P = 0.414)
Notes	**Approval from the Ethics Committee:** yes

Zimmermann et al., 1989

Methods	**Allocation:** The only information provided is that participants were randomly assigned to groups. **Blindness:** Study's purpose explained but control group was unaware of music treatment in experimental group. No information about the blinding of personnel or the assessment of outcomes. **Duration:** 9 months (but only 1 intervention), no follow-up mention **Design:** RCT
Participants	**Diagnosis:** cancer and chronic pain **Duration of chronic pain:** more than 6 months **N:** 40 **Age range:** between 34 and 79 years **Male:** 16 **Female:** 24 **Location:** USA
Intervention	**Intervention (n = 20):** dimmed lights, listening to preferred music for 30 minute duration on headphones. Choice of 10 relaxation tapes, Halpern anti-frantic default in the absence of a preference, MPQ and VAS pre/post music session. Plus standard care **Control (n = 20):** Same setting without listening to music Plus standard care
Outcomes	**Pain:** measured with SF-MPQ and VAS: Present Pain Intensity : no significant difference between groups (P = 0.056) Pain Rating Index with sub-scores: Sensory: significant difference between groups (P < 0.05) Affective: significant difference between groups (P < 0.001), simple main effect-control P > 0.05, simple main effect-intervention P < 0.001 Evaluative: significant difference between groups (P < 0.05) Miscellaneous: significant difference between groups (P < 0.05) VAS: significant difference between groups (P > 0.02), simple main effect-control (P > 0.05), simple main effect-intervention (P < 0.01)
Notes	**Approval from the Ethics Committee:** yes