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Music therapy for the treatment of anxiety: a systematic review with multilevel meta-analyses

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Summary

Background A considerable number of published clinical trials have examined the anxiety-reducing effects of music therapy interventions across several settings, including mental health care, medical environments, and work- and study-related contexts. Music therapy involves personally tailored music interventions that are designed and implemented by qualified music therapists to meet the specific health needs of individual patients.

Methods To summarise this evidence base, we conducted a linear restricted maximum likelihood multilevel meta-analysis searching multiple electronic databases (CINAHL, Cochran Central Register of Controlled Trials, PubMed, Embase, PsycInfo, Web of Science core collection), from inception to 12th February 2025. The primary measure was the effects of music therapy on 7 psychological anxiety outcomes and physiological outcomes. The secondary measures were outcome, study, sample, or intervention design factors that moderate the effects of music therapy interventions. Meta-analyses were performed on 93 effect sizes (ES) from 51 studies to assess the magnitude of effects of music therapy targeting anxiety outcomes, and to compare effects across key intervention and study design factors. PROSPERO registration (CRD42024495801).

Findings Of the 10,210 identified records, 6147 records were screened and 51 articles meeting the research criteria were included. Results showed an overall medium effect of music therapy across all anxiety outcomes ($g = 0.357$, [0.201, 0.514]; 51 trials, 93 ES), of which a medium effect was found in participants' self-reported anxiety ($g = 0.410$, [0.236, 0.585]; 50 trials, 61 ES) and a small non-significant effect in physiological outcomes ($g = 0.153$ [−0.153, 0.400]; 13 trials, 32 ES). Subgroup analyses showed significant larger effects for receptive and combination of active and receptive interventions when compared with active interventions.

Interpretation The findings suggest that music therapy, particularly receptive methods or combinations of receptive and active approaches, offer effective, flexible, and scalable interventions for reducing anxiety symptoms, offering psychological benefits that enhance patient autonomy and quality of life, though its impact on physiological outcomes and long-term effects requires further research.

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Keywords: Music therapy; Music interventions; Non-pharmacological; State-anxiety; Trait-anxiety; Anxiety disorders; Multilevel meta-analysis

Research in context

Evidence before this study

Numerous studies have demonstrated that music therapy significantly reduces anxiety across a wide range of clinical settings. These include patients with cancer, cardiac conditions, undergoing medical or dental procedures, on hemodialysis, pregnant women, and those who are mechanically ventilated, as well as individuals with psychiatric diagnoses. However, a comprehensive analysis exploring the consistency of effects across different intervention formats, clinical contexts, and study designs has been lacking.

Added value of this study

This study addresses that gap by applying a broad inclusion strategy and conducting subgroup analyses to explore the influence of intervention type, study design, and clinical context on outcomes. While not aiming to compare music therapy directly with other non-pharmacological interventions, our findings demonstrate consistent effects across settings, positioning music therapy as a valuable complementary approach within integrated care. Receptive and combined receptive-active formats showed greater effectiveness than active-only interventions, contributing to a more nuanced understanding of what may work best in clinical practice.

Implications of all the available evidence

These findings support the use of music therapy as an effective intervention for reducing anxiety, with inclusive but promising effects on physiological outcomes. Although no significant differences were found between mental health, medical, or work-related contexts, the type of intervention appeared to be an important factor. These findings are relevant for clinicians, researchers, and policymakers seeking context-sensitive, evidence-based tools to enhance anxiety care.

Introduction

Anxiety, fear, and emotional distress are hallmark features of the most common mental disorders, affecting approximately 4% of the global population at any time and impacting one in three people over their lifetime.[1–3] Similarly, reviews of anxiety in medical settings found prevalence ranged from 7% to 90% dependent on the diagnosis and severity.[4] As anxiety contributes significantly to healthcare burden, addressing its prevalence and health implications of anxiety is therefore essential to reduce healthcare costs and societal strain.[5]

Research demonstrates that music modulates brain activity in regions associated with emotion and mood regulation, reducing state anxiety, restlessness, and subjective distress,[6–12] noting that when the music is not matched to the aim, it may worsen symptoms. Music triggers neurotransmitter release, including endorphins, oxytocin, and dopamine, which contribute to well-being and anxiety reduction.[13–17] Physiological effects, such as decreased heart rate, blood pressure, and cortisol levels, further support music's anxiolytic potential.[18–21] Music provides a distraction from anxiety-inducing thoughts, enhancing its therapeutic impact.[22,23] Despite growing evidence from neuroscience and clinical studies, the mechanisms underlying music's anxiety-reducing effects remain complex and multifaceted.

Studies have drawn on these therapeutic benefits of music to address anxiety, including those implemented by music therapists, and those by other health professionals.[24] Music therapy interventions provided by a credentialed music therapist, uses indigenous (active and receptive) music therapy approaches. Receptive music therapy involves clients listening to live or recorded music, facilitated by a trained therapist, and includes techniques like music-assisted relaxation, guided imagery, and lyric analysis to reduce stress, anxiety, and pain while enhancing relaxation. In contrast, active music therapy engages clients in creating music through singing, playing instruments, improvisation, or songwriting, fostering self-expression, communication, and physical movement, and promoting cognitive and motor rehabilitation. Conversely, music interventions implemented by other professionals tend to use music listening (receptive methods). In many prior studies, the term *music therapy* has been broadly applied to encompass various music-based interventions, including self-administered music listening or music-related activities facilitated by healthcare professionals who are not trained music therapists.[25,26] To provide clarity and precision in this review, we have focused exclusively on studies where music therapy interventions were delivered by trained music therapists.

Numerous reviews have documented the positive effects of music therapy on anxiety in specific clinical contexts. For instance, studies have shown significant reductions in anxiety among cancer patients,[27–31] individuals undergoing cardiac catheterization,[32] and those with coronary heart disease.[14] Positive outcomes were also observed in dental care settings,[33] gastrointestinal endoscopic procedures,[34] and during maintenance hemodialysis treatments.[35] Pregnant women[36] and mechanically ventilated patients[37] have similarly benefited from music therapy interventions, with reported decreases in anxiety. Additionally, studies focusing on preprocedural state anxiety,[38] surgical patients,[39] and individuals who are terminally ill[40] have demonstrated the efficacy of music therapy in mitigating anxiety in these populations. In breast cancer patients, a systematic review and meta-analysis found significant positive impacts of music therapy on anxiety levels.[41]

Three meta-analyses have also explored the effects of music therapy on anxiety as a *secondary* outcome in people with psychiatric diagnoses. For individuals diagnosed with depression, a study reported that music therapy effectively reduced anxiety symptoms.[42] In patients with serious mental disorders, a review found a large effect size (ES) for the reduction of anxiety when music therapy was added to treatment as usual, based on data from two randomized controlled trials (RCTs).[43] The third meta-analysis examined the effects of music therapy on state anxiety in adults primarily experiencing stress, and found large overall ES, derived from 26 RCTs and controlled clinical trials (CCTs).[25]

This study aims to address gaps and opportunities in the existing meta-analytic literature on music therapy and anxiety. While previous meta-analyses, have demonstrated the efficacy of music therapy in reducing anxiety across various clinical populations (14, 26, 28–443), these studies often focus on specific contexts, populations, or intervention types and do not consistently account for the broader applicability of anxiety as an outcome measure. Anxiety symptoms are not exclusive to anxiety disorders but are pervasive across nearly all mental health conditions and are frequently experienced in medical and procedural contexts.[3,4,44] This review addresses these limitations by conducting a comprehensive systematic review and multilevel meta-analysis that includes both randomized controlled trials (RCTs) and controlled clinical trials (CCTs). By incorporating non-randomized studies, which are often conducted under clinically representative conditions, this study enhances the external validity of findings,[45,46] offering a more nuanced understanding of the effects of music therapy on anxiety. Furthermore, by separately examining state- and trait-anxiety outcomes and their relationship with key study, sample, outcome, and intervention characteristics, this study aims to provide deeper insights into the conditions under which music therapy is most effective. This comprehensive approach builds on the foundations of previous research[25,47] but significantly expands the scope and applicability of findings, addressing the need for a more holistic understanding of music therapy's impact on anxiety across diverse settings and populations. The primary research question was: What are the effects of music therapy on psychological anxiety outcomes and physiological outcomes? The secondary question was: What outcome, study, sample, or intervention design factors may moderate the effects of music therapy interventions?

Methods

Eligibility criteria

Eligible studies were RCTs or CCTs that examined the effect of *music therapy* on anxiety outcomes in adults with elevated anxiety symptoms in clinical, occupational or educational settings.

Populations

Adults aged >18 years with anxiety symptoms at baseline, with or without a formal diagnosis of anxiety disorder. Studies targeting people younger than 18 or those with dementia were excluded.

Interventions

Eligible studies provided music therapy, defined as the clinical and evidence-informed use of music interventions by a qualified music therapist, to accomplish individualized goals within a therapeutic relationship in order to achieve physical, emotional, mental, social and cognitive needs. Interventions that were not delivered by a music therapist or did not follow the principles of music therapy, namely did not facilitate a therapeutic process or did not use tailored personal music experiences were excluded.

Comparisons

Eligible studies compared music therapy to one or more control condition, including care/treatment as usual, passive/waitlist control or alternative interventions, including music interventions not considered as music therapy. If studies included multiple control conditions, all eligible control groups were included.

Outcomes

Eligible studies reported at least one direct psychological or physiological measure of anxiety. For psychological outcomes, this included validated self-report measures of state or trait anxiety (e.g., State-Trait Anxiety Inventory). For physiological outcomes, objective measures such as heart rate, blood pressure, respiratory rate, or cortisol assessed using standardized clinical procedures. This clarification was made post hoc and was not explicitly stated in the original PROSPERO registration (CRD42024495801) but aligns with Preferred Reporting Items for Systematic reviews and

Meta-Analyses (PRISMA) guidelines.[48] Outcome measures indirectly related to anxiety, such as to quality of life (QoL), distress or pain were excluded.

Information sources and study selection

This review included all RCTs and CCTs available up to the 12th of February 2025 that met the predefined inclusion criteria. The initial search was conducted on the 23rd of February 2023 across six electronic literature databases, including Cinahl, Cochrane Central Register of Controlled Trials (CENTRAL), Embase, PsycInfo, PubMed, and Web of Science Core Collection. A search update was performed on the 12th of February 2025 to ensure inclusion of the most recent studies. For each database, search results were exported individually, merged and deduplicated using EndNote. To supplement the systematic search, citation tracking (backward and forward) was used to identify additional relevant studies. Tools such as Google Scholar, ResearchRabbit[49] and InCiteful[50] were specifically used for this purpose. Screening of records was conducted using Rayyan QCRI (https://rayyan.qcri.org/). The review protocol is registered at the international prospective register of systematic reviews (CRD42024495801). The search strings are available in Appendix A.1.

Data extraction and coding

Effect size (ES) data as well as outcome-, study-, sample-, and intervention characteristics were extracted and coded in duplicate by three reviewers (MdW, SA, AK) using a coding sheet according to established guidelines.[51]

For self-reported anxiety outcomes, coding included whether outcome assessments were conducted using self-report questionnaires for *state* or *trait* anxiety. Common tools for measuring perceived state anxiety included the State-Trait Anxiety Inventory (STAI),[52] Visual Analog Scales for Anxiety (VAS), Self-Rating Anxiety Scales (SAS),[53] and the anxiety version of the Hospital Anxiety and Depression Scale (HADS-A).[54] Trait anxiety is often measured using the trait version of the State-Trait Anxiety Inventory (STAI-T),[17] the Beck Anxiety Inventory (BAI),[55] the Quick Mood Scale (QMS),[56] and the Profile of Mood States (POMS).[57]

Study characteristics coded included study design, intervention, quality of the design, setting, control condition and whether the study was conducted in Western- (Europe, North America) or non-Western countries (Asia, Latin America). Study quality was coded as *strong, moderate* or *weak* based on Quality Assessment Tool for Quantitative Studies,[58] which offers a comprehensive and structured assessment of study quality.[59] The Effective Public Health Practice Project (EPHPP) tool, used for this assessment, has demonstrated to have high content and construct validity.[60,61]

Settings were categorized into *mental healthcare setting, medical settings* (e.g., during polyclinic treatments, before or after surgery, palliative care), or *study or work-related setting* (universities or in companies). Control conditions were also coded, recognizing their potential impact on ES.[62,63] These were categorized as *care as usual* (CAU), where patients received standard care without anxiety-specific interventions; *waiting list* where no care or intervention was offered; or *alternative interventions* such as counseling or mindfulness-based therapy. Further, studies were classified by location as either *Western* countries or *non-Western* countries, recognizing that cultural environments influence stress and anxiety responses.[64,65] In a previous meta-analysis, music therapy for stress reduction[25] indicated that studies conducted in non-Western contexts yielded larger effects ($p < 0.01$).

Sample characteristics coded included the percentage of male participants, given differences in psychological and physiological responses to anxiety between genders.[66–68] The average age of the participants was also coded, as occupational stress research revealed variability in stress levels between different age groups.[66]

Music therapy characteristics coded included the delivery format (individually or group therapy), and whether active, receptive, or combined methods were used. Specific activities such as vocalization, instrument playing, or music listening, or their combination were noted, reflecting categories identified in recent music therapy studies.[67] The therapist's specific approach was categorized as improvisational or structured. Further the duration, total number of sessions, and the frequency per week were recorded, as previous research shows a positive correlation between these design factors and stress/anxiety regulation.[43,68,69]

Statistics

Outcome data were converted to Hedge's g and standard errors. Positive g values indicate better clinical change in the music therapy group from baseline to follow-up compared to the control condition. Most outcome data was derived from mean at each time point or mean change and standard deviations, or estimated from test statistics. All eligible outcome measures and study arms were included.

All analyses were conducted using the metafor package in R.[70] To address interdependence of multiple ES or subgroups within the same study, all analyses were based on linear three-level restricted maximum likelihood (REML) meta-analysis model. This model accounted for three sources: sampling variance (i.e., random error) within studies (level 1), variance between ES within studies (level 2, σ^2_{level2}), and variance between studies (level 3, σ^2_{level3}).[71] The proportion of variance at each level out of total observed variance was estimated using the I^2 statistic.[72] Results of individual studies were plotted using a modified forest plot for multilevel meta-analyses, which plots the pooled ES and

CI alongside the CI of individual outcomes within each study.[73] By convention, Hedges' g values of 0.2, 0.5 and 0.8 were considered small, medium and large, respectively.

Analysis was first performed across all outcomes, followed by separate analyses of self-reported anxiety outcomes and physiological outcomes. Subgroup analyses and meta-regressions of continuous outcomes were performed using three-level models and tested for between-subgroup difference using the Q statistic. Small-study effect ('publication bias') across was assessed by visually inspecting funnel plots of ES vs standard error for asymmetry[74] and formally tested using a multilevel version of the Egger's intercept test.[75]

Ethics

Not relevant to this study.

Role of funding source

The study was undertaken independently of any input from funding bodies. Funders have had no role in the study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

Results

Study selection

The initial search of 23 of February 2023, conducted by a medical librarian in collaboration with the first author, identified 10,210 records, of which 4155 duplicates were removed, resulting in 6147 records screened. A search update was performed on 12 February 2025, identifying 12,688 records. After removing 5052 duplicates and overlap with the initial search, 1681 additional unique records were screened. In total, 7828 unique records were screened across both search phases. All eligible studies from both rounds were included in the review. In the first screening round (February 2023), screening of title and abstract resulted in 229 studies, which underwent full text screening based on the inclusion criteria, of which 44 studies met all inclusion criteria and were included in the review. In the second screening round (February 2025), 25 additional studies were assessed in full text following title and abstract screening (see Fig. 1). Of these, 6 met all inclusion criteria and were included in the review. In total, 51 studies were included in the final synthesis (full reference list of included studies are detailed in Appendix A.2). The selection of studies was conducted independently by two authors. In cases of disagreement, a third author was consulted to resolve the selection conflicts and make the final decision. Table 1 provides an overview of the included studies and their main characteristics. A list of studies excluded during the full text screening, along with reasons for exclusion, can be found in Appendix A.3 with full references listed in Appendix A.4.

Characteristics of included studies

Of the 51 eligible studies, 43 were RCTs and 8 were CCTs (Table 1). In total, 9 studies were conducted in mental healthcare settings, 38 in medical settings, and 4 in work/study-related settings. In total, 11 studies had a small sample size of $\leq$25 participants, and 40 studies had larger sample sizes (26–200 participants). A total of 35 studies examined the effects of music therapy compared with CAU controls, 10 studies used controls receiving another intervention, and 6 studies used wait list controls or controls receiving nothing (no CAU or other intervention). The overall quality of the studies was assessed with the Quality Assessment Tool for Quantitative Studies'[76] and 23.5% of the studies were rated as strong, 37.3% as moderate, and 39.2% as weak. Appendix A.5 shows an overview of the most important characteristics of the included studies and provides more details on study quality.

Overall effects of music therapy on anxiety outcomes

The present meta-analytic review on the effects of music therapy on anxiety outcomes, included 51 independent studies (s), reporting on 93 ES (k), and a total sample of n = 3276 participants, of which n = 1664 participants in the music therapy groups, and n = 1363 participants in the comparison groups. Table 2 shows the overall effect of music therapy on anxiety outcomes. The forest plot for use in multilevel meta-analyses can be found in Supplementary Figure B.1. Overall, we found a statistically significant medium ES (g = 0.357, [0.201, 0.514]) of music therapy across all measures of anxiety. There was no evidence of funnel plot asymmetry (Egger's intercept –0.033, p = 0.886, Supplementary Figure B.2). Fifty studies included measures of self-reported anxiety, and showed a statistically significant medium ES (g = 0.410, [0.236, 0.585]). The effects of music therapy on (psycho) physiological anxiety-related outcomes were examined in 13 studies including 32 ES, with an overall small and non-significant ES. A subgroup analysis suggests that the type of measure (self-reported or physiological) may moderate observed heterogeneity across studies (Q-between = 2.967, p = 0.085, Table 3).

Results of subgroup analyses of music therapy on overall anxiety outcomes

Study design

Table 3 provides details of all subgroup analyses aiming to investigate heterogeneity across the 93 anxiety outcomes included in the main analysis. The pooled effect estimate across RCTs (s = 43, k = 83, g = 0.413, 95% CI 0.241–0.587) was significantly greater than CCTs (s = 8, k = 10, g = –0.003, 95% CI –0.308 to 0.303), a statistically significant difference (Q-between = 6.744, p = 0.009) which strengthens confidence in the results. Furthermore, study quality (i.e., risk of bias within

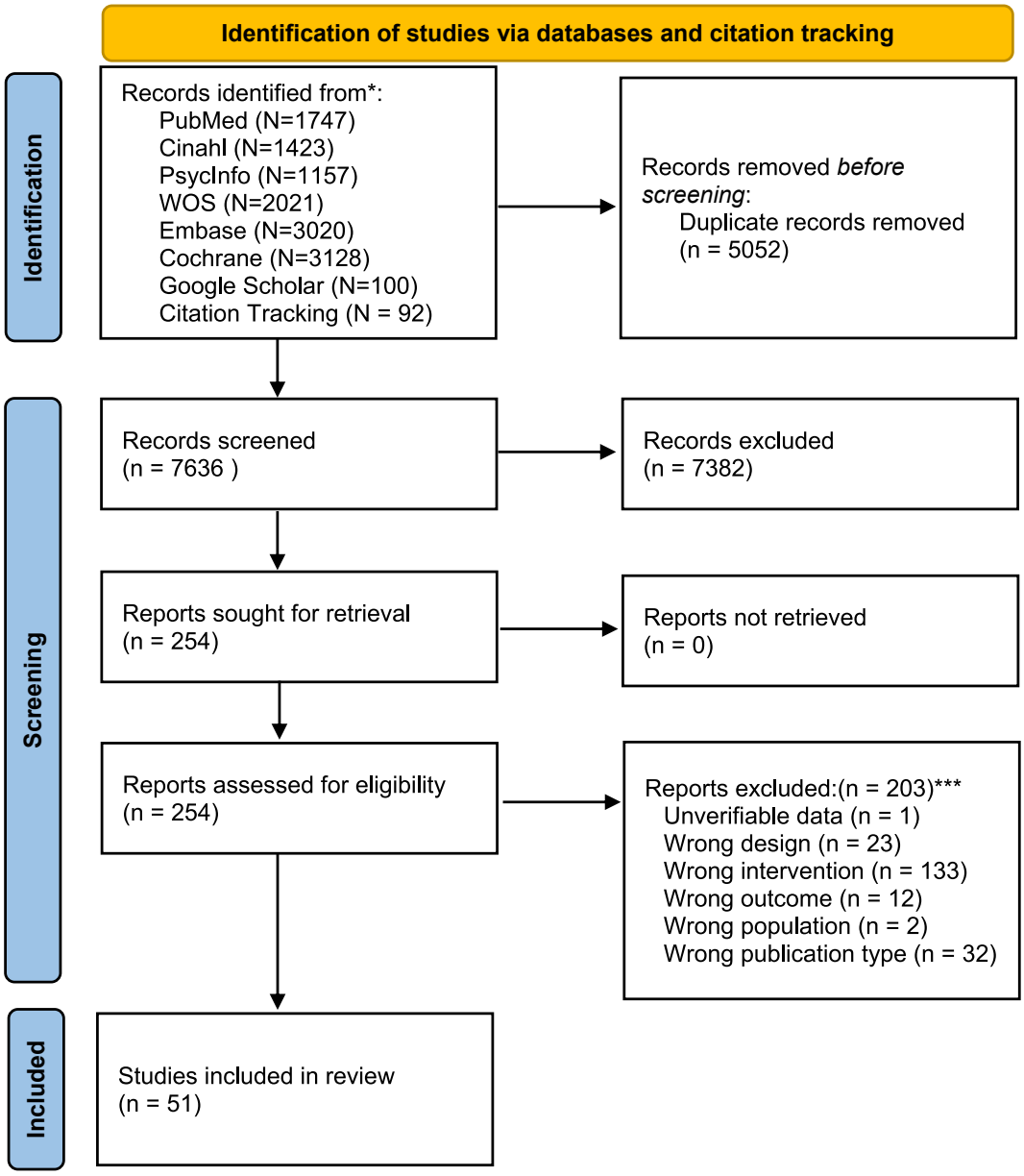

Fig. 1: PRISMA flow diagram of study selection process. * Number of records per database are shown separately. *** Only the first reason for exclusion is reported.

studies) did not seem to moderate the effect estimates. Conversely, whereas music therapy was more efficacious than all types of controls, the effect estimate across studies that used waitlist or passive control ($s = 4$, $k = 7$, $g = 0.688$, 95% CI 0.344–1.031) was significantly larger compared to those that used care as usual ($s = 35$, $k = 68$, $g = 0.350$, 95% CI 0.147–0.552) or an active intervention ($s = 12$, $k = 18$, $g = 0.257$, 95% CI 0.008–0.507, Q-between = 5.909, $p = 0.052$). Neither the percentage of males ($\beta = 0.279$, $p = 0.279$) nor the average age of the sample ($\beta = 0.004$, $p = 0.466$) moderate the efficacy of music therapy. There were no differences in the effects across different settings (mental health, medical, and study/workplace; Q = 0.758 $p = 0.685$).

Intervention characteristics

Studies using receptive ($s = 22$, $k = 54$, $g = 0.417$, 95% CI 0.148–0.687) or combined methods ($s = 15$, $k = 17$, $g = 0.474$, 95% CI 0.133–0.815) reported significantly

No.	First author	Year	Total n	Study design	Setting	Anxiety outcome	Type of measure	MT method	Intervention type	Group/ individual	Number of sessions	Controls	Study quality
1	Beck	2015	20	RCT	Study/Work	State	Self-report/Phys	Receptive	Music listening	Group	10	CAU	Moderate
2	Bradt	2015	62	RCT	Medical	State	Self-report	Active	Combined	Individual	2	Music medicine	Moderate
3	Cassileth	2003	60	RCT	Medical	State	Self-report	Combined	Combined	Individual	5	CAU	Weak
4	Chen	2016	200	RCT	Mental	State/ Trait	Self-report	Combined	Combined	Group	20	CAU	Strong
5	Chen	2024	90	RCT	Mental	State/ Trait	Self-report	Receptive	Music listening	Group	12	Mental health classes	Moderate
6	Dóro	2017	100	RCT	Medical	State	Self-report	Active	Combined	Individual	2	CAU	Moderate
7	Du	2024	62	RCT	Medical	State	Self-report/Phys	Receptive	Music listening	Individual	2	CAU	Strong
8	Erkkila	2011	79	RCT	Mental	Trait	Self-report	Active	Instrument playing	Individual	20	CAU	Strong
9	Eroglu	2022	61	RCT	Medical	State	Self-report	Receptive	Music listening	Group	16	CAU	Moderate
10	Ettenberger	2024	23	RCT	Medical	State	Self-report/Phys	Receptive	Music listening	Individual	4	CAU	Strong
11	Eyuboglu	2021	125	RCT	Study/Work	State	Self-report/Phys	Active	Combined	Group	5	No CAU/Intervention	Strong
12	Ferrer	2007	50	RCT	Medical	State	Self-report/Phys	Receptive	Music listening	Individual	1	CAU	Weak
13	Gallagher	2018	163	RCT	Medical	State	Self-report	Combined	Combined	Individual	2	CAU	Weak
14	Giordano, Losurdo	2022	40	RCT	Medical	State	Self-report/Phys	Receptive	Music listening	Individual	1	CAU	Moderate
15	Giordano, Giglio	2023	60	RCT	Medical	State	Self-report/Phys	Receptive	Music listening	Individual	1	CAU	Strong
16	Gold	2013	79	RCT	Mental	State/ Trait	Self-report	Active	Combined	Group	5	CAU	Weak
17	Hanser, Thompson	1994	20	RCT	Mental	State	Self-report	Receptive	Music listening	Combined	8	CAU	Weak
18	Hanser, Bauer-Wu	2006	42	RCT	Medical	Trait	Self-report	Combined	Combined	Individual	3	CAU	Weak
19	Horne-Thompson	2008	25	RCT	Medical	State	Phys	Combined	Combined	Group	1	Emotional support	Weak
20	Huang	2021	36	RCT	Mental	State	Self-report	Receptive	Music listening	Group	10	CAU	Strong
21	Kim	2011	18	CCT	Medical	State	Self-report	Active	Combined	Group	8	CAU	Moderate
22	Mandel, Davis	2013	92	RCT	Medical	State/ Trait	Self-report/Phys	Receptive	Music listening	Group	8	CAU	Weak
23	Mandel, Hanser	2007	68	RCT	Medical	State/ Trait	Self-report/Phys	Combined	Combined	Group	4	CAU	Weak
24	March-Lujan	2021	43	RCT	Medical	State	Self-report/Phys	Receptive	Music listening	Group	9	Waiting list	Moderate
25	Mondanaro, Homel	2017	60	CCT	Medical	State	Self-report	Combined	Combined	Individual	1	CAU	Moderate
26	Mondanaro, Sara	2021	87	RCT	Medical	State	Self-report	Active	Combined	Group	3	CAU	Weak
27	Morgan	2011	49	CCT	Mental	Trait	Self-report	Active	Combined	Group	4	Nature sounds	Weak
28	Palmer	2015	135	RCT	Medical	State	Self-report	Receptive	Music listening	Individual	1	CAU	Moderate
29	Pérez-Nuñez	2024	113	CCT	Mental	State/ Trait	Self-report	Active	Combined	Group	10	CAU	Strong
30	Rabinowitch	2023	30	RCT	Medical	State	Self-report	Receptive	Music listening	Group	1	Guided meditation	Weak
31	Raglio, Giovanazzi	2016	30	RCT	Medical	Trait	Self-report	Active	Instrument playing	Individual	12	CAU	Moderate
32	Raglio, Zaliani	2017	38	RCT	Medical	Trait	Self-report	Active	Instrument playing	Group	20	CAU	Moderate
33	Ramirez	2018	40	RCT	Medical	State	Self-report	Combined	Combined	Individual	1	Conversation about music	Moderate
34	Ribeiro	2018	21	RCT	Medical	State	Self-report/Phys	Receptive	Music listening	Individual	7	Waiting list	Weak
35	Romito	2013	62	RCT	Medical	State	Self-report	Combined	Combined	Group	1	Emotional support	Weak
36	Rossetti	2017	78	RCT	Medical	State	Self-report	Receptive	Music listening	Individual	1	CAU	Moderate
37	Rossetti	2023	160	RCT	Medical	State	Self-report	Receptive	Music listening	Group	1	CAU	Strong
38	Schmid	2004	20	CCT	Medical	Trait	Self-report	Active	Combined	Group	30	CAU	Moderate
39	Schwantes	2014	47	RCT	Study/Work	State	Self-report	Active	Combined	Group	10	Emotional support	Moderate
40	Tang	2021	100	RCT	Medical	State	Self-report	Combined	Combined	Group	1	CAU	Strong
41	Teckenberg-Jansson	2019	101	RCT	Medical	State	Self-report/Phys	Receptive	Music listening	Individual	3	CAU	Strong

(Table 1 continues on next page)

No.	First author	Year	Total n	Study design	Setting	Anxiety outcome	Type of measure	MT method	Intervention type	Group/ individual	Number of sessions	Controls	Study quality
(Continued from previous page)													
42	Thaut	2009	54	CCT	Medical	Trait	Self-report	Active	Instrument playing	Group	4	Rest in quiet room	Weak
43	Torres	2018	56	RCT	Medical	State/ Trait	Self-report	Receptive	Music listening	Group	12	CAU	Weak
44	Tuinmann	2016	66	RCT	Medical	Trait	Self-report	Combined	Combined	Individual	8	CAU	Weak
45	Verstegen	2018	13	RCT	Medical	State	Self-report	Receptive	Music listening	Individual	1	Waiting list	Moderate
46	Volpe	2018	106	RCT	Mental	Trait	Self-report	Combined	Combined	Group	3	CAU	Strong
47	Walworth	2008	27	RCT	Medical	State	Self-report	Combined	Combined	Individual	N/A	CAU	Weak
48	Wang	2024	147	CCT	Medical	State	Self-report	Combined	Combined	Group	N/A	CAU	Moderate
49	West	2020	24	CCT	Medical	State	Self-report	Combined	Combined	Individual	1	Guided relaxation	Weak
50	Wu	2002	24	RCT	Study/Work	Trait	Self-report	Combined	Combined	Group	10	No CAU/Intervention	Weak
51	Yates	2015	22	RCT	Medical	State	Self-report	Receptive	Music listening	Individual	1	Waiting list	Weak

Table 1: **Characteristics of included studies.**

larger effect estimates that those of studies that used active music therapy alone ($s = 15$, $k = 22$, $g = 0.070$, 95% CI –0.056 to 0.815, Q-between = 9.641, $p = 0.008$). No other categorical covariates appeared to explain heterogeneity across studies. Similarly, there was no statistically significant relationship between ES and session length ($\beta = 0.004$, $p = 0.161$), frequency ($\beta = -0.041$, $p = 0.471$) or total number of sessions ($\beta = 0.009$, $p = 0.496$).

Discussion

Based on a substantial evidence base of 51 studies encompassing over 3000 participants, the results of this systematic review and meta-analysis indicate that music therapy can be an efficacious strategy for reducing anxiety symptoms in a variety of clinical settings. Overall, our results demonstrate a clinically medium ES, which was not confounded by methodological quality or small-study effect ('publication bias'). The estimated ES were even more robust when the analysis was limited to RCTs, which further strengthens confidence in the results. However, benefits were more pronounced when music therapy was compared to passive control conditions, and there was insufficient evidence to determine whether music therapy could have a concurrent effect on physiological outcomes associated with anxiety.

State anxiety outcomes showed a stronger response than trait anxiety outcomes, which aligns with prior reviews,[25,42,43] highlighting the growing number of trials validating non-pharmaceutical interventions like music therapy. The increasing demand for such approaches reflects concerns over tranquilizer side effects, such as dependence, and limited evidence for pharmacological treatments alone.[77] Since ~50% of people with anxiety disorders prefer not to engage in various psychological treatments or use medication, including music therapy in treatment options could improve patient autonomy and reduce dropout rates.[78] Music therapy's direct impact on state anxiety may help prevent more severe psychopathology.

Studies using a CCT design did not demonstrate significantly higher effects compared to RCTs, even though selection bias in non-randomized studies often inflates treatment effects.[79,80] While including only RCTs can enhance reliability, their rigorously controlled conditions often limit external validity and generalizability.[81] Reviews that incorporate CCTs may provide a more realistic understanding of effects in everyday music therapy practice, balancing internal validity with practical applicability.

The findings highlight the influence of certain intervention characteristics on the effectiveness of music therapy. Studies utilizing receptive methods (music listening) or a combination of receptive and active methods (music listening combined with singing, playing instruments, improvising) demonstrated significantly larger ES compared to those using active music therapy alone. This suggests that music therapy interventions focusing on listening to music, either exclusively or in combination with active methods, may offer greater therapeutic benefits. Receptive methods, offered or designed by music therapists, demonstrated the strongest effects, making them an ideal choice for integration into resource-constrained environments or in situations where active participation is not feasible. Clinicians might consider prioritizing music therapeutic based listening interventions as a cost-effective and scalable option, which can be deployed in group settings, individual sessions, or even remotely via digital platforms. However, active methods or combinations of receptive and active approaches may offer additional therapeutic benefits beyond what is reflected in effect sizes alone, such as supporting emotional expression, social interaction, and patient engagement.

Outcome	s	k	Mean g	95% CI	p	σ^2_{level2}	σ^2_{level3}	% Var. level 1	% Var. level 2	% Var. level 3
Anxiety overall	51	93	0.357	0.201–0.514	<0.001	0.25	0.233	19.62	7.80	72.59
Self-reported anxiety	50	61	0.410	0.236–0.585	<0.001	0	0.302	17.11	0	82.89
Physiological outcomes	13	32	0.153	−0.094–0.400	0.216	0	0.145	31.06	0	68.94

s = number of studies; *k* = number of effect sizes; CI = confidence interval; Mean *d* = mean effect size (*d*); CI = confidence interval; % Var = percentage of variance explained; σ^2_{level2} = variance between effect sizes within the same study; σ^2_{level3} = variance between studies.

Table 2: **Overall effects of music therapy on anxiety outcomes.**

Subgroup	s	k	Mean g	95% CI	Between-subgroup Q	Between-subgroup p-value
Outcome characteristics						
Type of anxiety measures					2.967	0.085
Self-Report	50	61	0.410	0.236, 0.585		
Physiological	13	32	0.153	−0.094, 0.400		
Type of anxiety outcome					0.247	0.619
State-anxiety	41	75	0.376	0.188, 0.563		
Trait-anxiety	17	18	0.310	0.116, 0.505		
Study characteristics						
Design					6.744	0.009
RCT	43	83	0.414	0.241, 0.587		
CCT	8	10	−0.003	−0.308, 0.303		
Clinical setting					0.758	0.685
Mental health care	9	15	0.456	0.165, 0.748		
Medical health care	38	69	0.335	0.138, 0.532		
Work/study related	4	9	0.263	−0.238, 0.765		
Sample size					0.569	0.451
>25 participants (large)	41	70	0.331	0.156, 0.505		
<25 participants (small)	10	23	0.489	0.094, 0.883		
Study location					0.520	0.471
Non-Western countries	13	31	0.468	0.079, 0.857		
Western countries	38	62	0.318	0.152, 0.485		
Study quality					1.366	0.505
Strong	12	34	0.543	0.099, 0.987		
Moderate	18	25	0.252	−0.003, 0.507		
Weak	21	34	0.305	0.142, 0.469		
Type of control condition					5.909	0.052
Care as usual	35	68	0.350	0.147, 0.552		
Waiting list/nothing	4	7	0.688	0.344, 1.031		
Other intervention	12	18	0.257	0.008, 0.507		
Group/individual					1.063	0.303
Individual	24	46	0.279	0.062, 0.497		
Group	28	47	0.442	0.211, 0.672		
Music therapy approach					0.135	0.714
Structured	32	64	0.375	0.165, 0.586		
Improvisational	15	22	0.310	0.013, 0.607		
Music therapy method					9.641	0.008
Active	15	22	0.070	−0.056, 0.197		
Receptive	22	54	0.417	0.148, 0.687		
Combination of both	15	17	0.474	0.133, 0.815		
Type of intervention					1.043	0.594
Music listening	22	54	0.417	0.148, 0.687		
Instrument playing	5	5	0.217	−0.181, 0.615		
Combined interventions	25	34	0.330	0.114, 0.546		

s = number of studies; *k* = number of effect sizes; CI = confidence interval; Mean *d* = mean effect size (*d*); CI = confidence interval; p = significance; Q = between subgroup difference.

Table 3: **Subgroup analyses of music therapy on anxiety outcomes.**

The smaller and non-significant ES for physiological outcomes suggests that music therapy might not directly influence physiological markers of anxiety or that these effects are less pronounced. However, the robust effects on self-reported anxiety indicate a meaningful psychological impact. This could mean that the primary value of music therapy lies in its ability to improve subjective experiences of anxiety, which can still translate to overall well-being and quality of life. Future research should investigate whether these psychological benefits indirectly influence long-term physiological outcomes.

Our findings suggest that session length, frequency, and total number of sessions do not significantly impact effectiveness, which is crucial for designing flexible intervention models. Clinicians might focus on session quality and content rather than rigidly adhering to specific time frames or frequencies. This flexibility can optimize the potential of music therapy to support individualized care plans tailored to the needs and preferences of clients, making music therapy more adaptable across diverse populations and care settings. This potential for wide applicability is further strengthened by the finding that music therapy had similar effects across the mental health, medical health and work/study settings.

The current study has several limitations. Firstly, although the evidence for benefit on clinical measures of self-reported anxiety is clinically meaningful and robust to study quality or size, there was insufficient evidence to detect what cohorts might benefit and what 'dose' of music therapy is required. That is, heterogeneity across studies indicates that music therapy could be ineffectual in some settings, but could only be partially explained by study design factors. Similarly, benefits were limited to interventions that included receptive music therapy (by itself or combined with active methods), and there was insufficient evidence to determine the extent to the therapeutic components of music therapy augmented the effects of music listening alone. This question warrants direct comparisons of music interventions delivered by music therapists to those delivered by other professionals. Given capacity limitations and an increased demand for music interventions, such studies could guide clinical implementation, including the settings in which music therapists are most critical to ensure effective delivery. While such research is important, music therapists are essential not only in delivering interventions, but also in guiding how music can be responsibly applied by others in healthcare.

Second, efficacy on self-reported measures was not corroborated by positive effects on physiological measures. Since this meta-analysis was based on aggregate data, it was not possible to determine whether the weak evidence for efficacy on physiological outcomes was due to confounding (e.g., studies that used less efficacious methods were also more likely to report physiological outcomes), or to a weak correlation between anxiety and physiological change. Other methods, most notably an individual participant data meta-analysis, could shed light on this question, and potentially detect what prognostic factors could predict response to music therapy.

Finally, most included studies lacked masking procedures, meaning that results could have been influenced by expectancy bias ('placebo effect'),[82] as indicated by a significantly larger ES when music therapy was compared to passive control conditions. Masking participants to intervention assignment is difficult and arguably impractical in music therapy[25] as well as nearly any other intervention where participants are asked to perform or participate in an activity. Future research should aim to account for these effects, for example by measuring expectation and/or adopting alternative experimental designs.[83] Improving study quality through the use of larger samples and masking procedures are essential for progressing the field, but can be practically and ethically challenging in anxiety and stress studies. Nonetheless, elements such as ensuring studies are well-powered, masking assessors to the intervention, conducting analyses on an intention-to-treat basis, and increasing transparent reporting and preregistration would be practical measures to improve the quality and reliability of research in this area.

In conclusion, music therapy interventions targeting anxiety demonstrate significant medium effects, establishing them as a viable alternative to other non-pharmacological approaches, such as CBT, and pharmacological treatments. Notably, receptive methods, like music listening, and a combination of receptive and active methods have a greater impact compared to active methods only, such as playing instruments or singing. Consequently, receptive and combined approaches may be considered first-line interventions based on current evidence, though active methods may offer added value depending on individual patient needs and therapeutic goals. The findings also revealed that the duration, frequency, and total number of sessions did not consistently enhance outcomes. This is in line with the flexibility and adaptability in music therapy and the necessity to tailor care plans to the needs and preferences of clients. At the same time, leaving the optimal intervention design unclear. Future research should focus on uncovering the mechanisms underlying music therapy's effectiveness and on identifying the most effective components, therapeutic factors, and combinations for treating anxiety.

Contributors

MdW, SA, AK, TP, and AL contributed to data curation. MdW, SA, AV, AK, and AL contributed to formal analysis. MdW, SA, AV, SF, AK, and AL contributed to investigation. MdW, SA, AV, SF, TP, and AL contributed to methodology. MdW, SA, and FAB contributed to project

administration. MdW, SA, TP, and FAB contributed to resources. MdW, SA, AK, TP, and AL contributed to software. MdW, FAB, AL, and SvH contributed to supervision. MdW, SA, AV, AK, TP, AL, FAB, and SvH contributed to validation. MdW, SA, AV, AK, TP, AL, and SvH contributed to visualization. MdW, SA, SF, FAB, and SvH contributed to writing the original draft. MdW, SA, AV, AL, FAB, and SvH contributed to writing, reviewing, and editing the manuscript. MdW, AK, and AL had access to and verified the underlying data.

Data sharing statement

The data underlying this meta-analysis were obtained from publicly available published sources. No individual participant data were collected. Additional analyses and summary datasets generated supporting this study's findings are available from the corresponding author upon reasonable request.

Declaration of interests

The authors declare no competing interests of relevance for the contents of this work.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.eclinm.2025.103293.

References

1 Kalin NH. Novel insights into pathological anxiety and anxiety-related disorders. *Am J Psychiatry*. 2020;177(3):187–189.
2 Javaid SF, Hashim IJ, Hashim MJ, Stip E, Samad MA, Ahbabi AA. Epidemiology of anxiety disorders: global burden and sociodemographic associations. *Middle East Current Psychiatry*. 2023;30(1).
3 *Anxiety disorders*. WHO; 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/anxiety-disorders.
4 Romanazzo S, Mansueto G, Cosci F. Anxiety in the medically ill: a systematic review of the literature. *Front Psychiatry*. 2022;13:873126.
5 Bandelow B, Michaelis S. Epidemiology of anxiety disorders in the 21st century. *Dialogues Clin Neurosci*. 2015;17(3):327–335.
6 Koelsch S. Brain correlates of music-evoked emotions. *Nat Rev Neurosci*. 2014;15(3):170–180.
7 Drăgulin S, Constantin FA, Rucsanda I, eds. *The use of music therapy for adults' anxiety relief. 2019 5th Experiment International Conference (exp at'19)*. IEEE; 2019.
8 Zatorre RJ, Salimpoor VN. From perception to pleasure: music and its neural substrates. *Proc Natl Acad Sci U S A*. 2013;110 Suppl 2 (Suppl 2):10430–10437.
9 Akin A, Iskender M. Internet addiction and depression, anxiety and stress. *J Educ Sci*. 2011;3(1):138–148.
10 Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;24(4).
11 Pittman S, Kridli S. Music intervention and preoperative anxiety: an integrative review. *Int Nurs Rev*. 2011;58(2):157–163.
12 Pritchard MJ. Identifying and assessing anxiety in pre-operative patients. *Nurs Stand*. 2009;23(51):35–40.
13 Arslan S, Ozer N, Ozyurt F. Effect of music on preoperative anxiety in men undergoing urogenital surgery. *Aust J Adv Nurs*. 2008;26(2):46–54.
14 Bradt J, Dileo C, Potvin N. Music for stress and anxiety reduction in coronary heart disease patients. *Cochrane Database Syst Rev*. 2013;2013(12):CD006577.
15 Blood AJ, Zatorre RJ. Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. *Proc Natl Acad Sci U S A*. 2001;98(20):11818–11823.
16 Salimpoor VN, van den Bosch I, Kovacevic N, McIntosh AR, Dagher A, Zatorre RJ. Interactions between the nucleus accumbens and auditory cortices predict music reward value. *Sci Technol Humanit*. 2013;340(6129):216–219.
17 Zatorre RJ. Musical pleasure and reward: mechanisms and dysfunction. *Ann N Y Acad Sci*. 2015;1337:202–211.
18 Burrai F, Hasan W, Fancourt D, Luppi M, Di Somma S. A randomized controlled trial of listening to recorded music for heart failure patients: study protocol. *Holist Nurs Pract*. 2016;30(2):102–115.
19 Koelsch S, Boehlig A, Hohenadel M, Nitsche I, Bauer K, Sack U. The impact of acute stress on hormones and cytokines, and how their recovery is affected by music-evoked positive mood. *Sci Rep*. 2016;6:23008.
20 Kreutz G, Quiroga Murcia C, Bongard S. Music, health, and wellbeing. In: MacDonald RAR, Kreutz G, Mitchell L, eds. *Psychoneuroendocrine research on music and health: an overview*. Oxford: Oxford University Press; 2012:457–476.
21 Linnemann A, Ditzen B, Strahler J, Doerr JM, Nater UM. Music listening as a means of stress reduction in daily life. *Psychoneuroendocrinology*. 2015;60:82–90.
22 Bernatzky G, Presch M, Anderson M, Panksepp J. Emotional foundations of music as a non-pharmacological pain management tool in modern medicine. *Neurosci Biobehav Rev*. 2011;35(9):1989–1999.
23 Chanda ML, Levitin DJ. The neurochemistry of music. *Trends Cognit Sci*. 2013;17(4):179–193.
24 Salihu D, Chutiyami M, Bello UM, et al. A meta-review of systematic reviews on the effectiveness of music therapy on depression, stress, anxiety, and cognitive function in adults with dementia or cognitive impairment. *Geriatr Nurs*. 2024;60:348–360.
25 de Witte M, Pinho ADS, Stams GJ, Moonen X, Bos AER, van Hooren S. Music therapy for stress reduction: a systematic review and meta-analysis. *Health Psychol Rev*. 2022;16(1):134–159.
26 Agres KR, Schaefer RS, Volk A, et al. Music, computing, and health: a roadmap for the current and future roles of music technology for health care and well-being. *Music Sci*. 2021;4.
27 Archie P, Bruera E, Cohen L. Music-based interventions in palliative cancer care: a review of quantitative studies and neurobiological literature. *Support Care Cancer*. 2013;21(9):2609–2624.
28 Bradt J, Dileo C, Magill L, Teague A. Music interventions for improving psychological and physical outcomes in cancer patients. *Cochrane Database Syst Rev*. 2016;(8):CD006911.
29 Gramaglia C, Gambaro E, Vecchi C, et al. Outcomes of music therapy interventions in cancer patients: a review of the literature. *Crit Rev Oncol Hematol*. 2019;138:241–254.
30 Stanczyk MM. Music therapy in supportive cancer care. *Rep Pract Oncol Radiother*. 2011;16(5):170–172.
31 Adi Try W. The effects of music therapy intervention on the pain and anxiety levels of cancer patient: a systematic review. *Int J Nurs Educ*. 2019;11(4):14–18.
32 Jayakar JP, Alter DA. Music for anxiety reduction in patients undergoing cardiac catheterization: a systematic review and meta-analysis of randomized controlled trials. *Complement Ther Clin Pract*. 2017;28:122–130.
33 Bradt J, Teague A. Music interventions for dental anxiety. *Oral Dis*. 2018;24(3):300–306.
34 Rudin D, Kiss A, Wetz RV, Sottile VM. Music in the endoscopy suite: a meta-analysis of randomized controlled studies. *Endoscopy (Stuttg)*. 2007;39(6):507–510.
35 Kim Y, Evangelista LS, Park YG. Anxiolytic effects of music interventions in patients receiving incenter hemodialysis: a systematic review and meta-analysis. *Nephrol Nurs J*. 2015;42(4):339–347. quiz 48.
36 Van Willenswaard CK, Lynn F, McNeill J, et al. Music interventions to reduce stress and anxiety in pregnancy: a systematic review and meta-analysis. *BMC Psychiatry*. 2017;17(1):271.
37 Bradt J, Dileo C. Music interventions for mechanically ventilated patients. *Cochrane Database Syst Rev*. 2014;2014(12):CD006902.
38 Gillen E, Biley F, Allen D. Effects of music listening on adult patients' pre-procedural state anxiety in hospital. *Int J Evid Based Healthc*. 2008;6(1):24–49.
39 Bradt J, Dileo C, Shim M. Music interventions for preoperative anxiety. *Cochrane Database Syst Rev*. 2013;2013(6):CD006908.
40 Gao Y, Wei Y, Yang W, et al. The effectiveness of music therapy for terminally ill patients: a meta-analysis and systematic review. *J Pain Symptom Manage*. 2019;57(2):319–329.
41 Boehm K, Cramer H, Staroszynski T, Ostermann T. Arts therapies for anxiety, depression, and quality of life in breast cancer patients: a systematic review and meta-analysis. *Evid Based Complement Alternat Med*. 2014;2014:103297.
42 Aalbers S, Fusar-Poli L, Freeman RE, et al. Music therapy for depression. *Cochrane Database Syst Rev*. 2017;11(11):CD004517.
43 Gold C, Solli HP, Kruger V, Lie SA. Dose-response relationship in music therapy for people with serious mental disorders: systematic review and meta-analysis. *Clin Psychol Rev*. 2009;29(3):193–207.
44 Aalbers S, Vink A, Freeman RE, Pattiselanno K, Spreen M, van Hooren S. Development of an improvisational music therapy

intervention for young adults with depressive symptoms: an intervention mapping study. *Art Psychother*. 2019;65.
45 Shadish WR, Cook TD, Campbell DT. *Experimental and quasi-experimental designs for generalized causal inference*. Belmont, CA: Wadsworth/Cengage Learning; 2002.
46 Shadish WR, Clark MH, Steiner PM. Can nonrandomized experiments yield accurate answers? a randomized experiment comparing random and nonrandom assignments. *J Am Stat Assoc*. 2008;103(484):1334–1344.
47 de Witte M, Spruit A, van Hooren S, Moonen X, Stams GJ. Effects of music interventions on stress-related outcomes: a systematic review and two meta-analyses. *Health Psychol Rev*. 2020;14(2):294–324.
48 Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. https://doi.org/10.1136/bmj.n71.
49 ResearchRabbit. Available from: https://www.researchrabbit.ai/.
50 Inciteful. Available from: https://inciteful.xyz/.
51 Lipsey MW, Wilson DB. *Practical meta-analysis*. Thousand Oaks: Sage Publications; 2001.
52 Spielberger C, Gorsuch R, Lushene R, Vagg PR, Jacobs G. *Manual for th e State-Trait Anxiety Inventory (Form Y1–Y2)*. Palo Alto, CA: Consulting Psychologist s Press; 1983.
53 Zung WW. A rating instrument for anxiety disorders. *Psychosomatics*. 1971;12(6):371–379.
54 Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand*. 1983;67(6):361–370.
55 Beck AT, Steer RA. Relationship between the beck anxiety inventory and the Hamilton anxiety rating scale with anxious outpatients. *J Anxiety Disord*. 1991;5(3):213–223.
56 Woodruffe-Peacock C, Turnbull GM, Johnson MA, Elahi N, Preston GC. The Quick Mood Scale: development of a simple mood assessment scale for clinical pharmacology studies. *Hum Psychopharmacol*. 1998;13(1):53–58.
57 McNair DM, Droppleman LF, Lorr M. *Profile of mood states: educational and industrial testing service*. 1981.
58 Ciliska D, Miccuci S, Dobbins M, Thomas BH. Effective public health practice project. Available from: http://www.ephpp.ca/tools.html; 2009.
59 Armijo-Olivo S, Stiles CR, Hagen NA, Biondo PD, Cummings GG. Assessment of study quality for systematic reviews: a comparison of the Cochrane collaboration risk of bias tool and the effective public health practice project quality assessment tool: methodological research. *J Eval Clin Pract*. 2012;18(1):12–18.
60 Jackson N, Waters E, Guidelines for Systematic Reviews in Health P, Public Health T. Criteria for the systematic review of health promotion and public health interventions. *Health Promot Int*. 2005;20(4):367–374.
61 Thomas BH, Ciliska D, Dobbins M, Micucci S. A process for systematically reviewing the literature: providing the research evidence for public health nursing interventions. *Worldviews Evid Based Nurs*. 2004;1(3):176–184.
62 Lonner WJ. Foreword. In: Wong PTP, Wong LCJ, Lonner WJ, eds. *Handbook of multicultural perspectives on stress and coping*. New York: Springer; 2006:5–7.
63 Tweed RG, White K, Lehman DR. Culture, stress, and coping. *J Cross Cult Psychol*. 2004;35(6):652–668.
64 Galanakis M, Stalikas A, Kallia H, Karagianni C, Karela C. Gender differences in experiencing occupational stress: the role of age, education and marital status. *Stress Health*. 2009;25(5):397–404.
65 Kajantie E, Phillips DI. The effects of sex and hormonal status on the physiological response to acute psychosocial stress. *Psychoneuroendocrinology*. 2006;31(2):151–178.
66 Verma R, Balhara YP, Gupta CS. Gender differences in stress response: role of developmental and biological determinants. *Ind Psychiatry J*. 2011;20(1):4–10.
67 de Witte M, Nategh L, Antipas H, et al. The effects of music-based interventions on behavioural and psychological symptoms of people living with dementia: a systematic review and network meta-analysis protocol. *Aging Ment Health*. 2024:1–7.
68 Cassileth BR, Vickers AJ, Magill LA. Music therapy for mood disturbance during hospitalization for autologous stem cell transplantation: a randomized controlled trial. *Cancer*. 2003;98(12):2723–2729.
69 Robb SL, Burns DS, Carpenter JS. Reporting guidelines for music-based interventions. *J Health Psychol*. 2011;16(2):342–352.
70 Viechtbauer W. Conducting meta-analyses in R with the metafor package. *J Stat Software*. 2010;36(3):1–48. https://doi.org/10.18637/jss.v036.i03.
71 Assink M, Wibbelink CJM. Fitting three-level meta-analytic models in R: a step-by-step tutorial. *Quant Meth Psych*. 2016;12(3):154–174.
72 Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Stat Med*. 2002 Jun 15;21(11):1539–1558. https://doi.org/10.1002/sim.1186.
73 Fernández-Castilla B, Declercq L, Jamshidi L, Beretvas SN, Onghena P, Van den Noortgate W. Visual representations of meta-analyses of multiple outcomes: extensions to forest plots, funnel plots, and caterpillar plots. *Methodology*. 2020;16(4):299–315.
74 Sterne JA, Sutton AJ, Ioannidis JP, et al. Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. *BMJ*. 2011;343:d4002. https://doi.org/10.1136/bmj.d4002.
75 Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ*. 1997;315(7109):629–634. https://doi.org/10.1136/bmj.315.7109.629.
76 Armijo-Olivo S, Stiles CR, Hagen NA, Biondo PD, Cummings GG. Assessment of study quality for systematic reviews: a comparison of the Cochrane collaboration risk of bias tool and the effective public health practice project quality assessment tool: methodological research. *J Eval Clin Pract*. 2012;18(1):12–18.
77 Slee A, Nazareth I, Bondaronek P, Liu Y, Cheng Z, Freemantle N. Pharmacological treatments for generalised anxiety disorder: a systematic review and network meta-analysis. *Lancet*. 2019;393(10173):768–777.
78 Windle E, Tee H, Sabitova A, Jovanovic N, Priebe S, Carr C. Association of patient treatment preference with dropout and clinical outcomes in adult psychosocial mental health interventions: a systematic review and meta-analysis. *JAMA Psychiatry*. 2020;77(3):294–302.
79 Page MJ, Boutron I, Hansen C, Altman DG, Hrobjartsson A. Assessing risk of bias in studies that evaluate health care interventions: recommendations in the misinformation age. *J Clin Epidemiol*. 2018;97:133–136.
80 Valentine JC, Thompson SG. Issues relating to confounding and meta-analysis when including non-randomized studies in systematic reviews on the effects of interventions. *Res Synth Methods*. 2013;4(1):26–35.
81 Kennedy-Martin T, Curtis S, Faries D, Robinson S, Johnston J. A literature review on the representativeness of randomized controlled trial samples and implications for the external validity of trial results. *Trials*. 2015;16:495.
82 Tambling RB. A literature review of therapeutic expectancy effects. *Contemp Fam Ther*. 2012;34(3):402–415.
83 Atwood S, Schachner A, Mehr SA. Expectancy effects threaten the inferential validity of synchrony-prosociality research. *Open Mind*. 2022;6:280–290.