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Yangqian Hu

yhazz@qq.com

University of South Florida

Giulia Ripani

Columbia University

Yizhi Xi

Shanghai Conservatory of Music

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Mental health in adults with cancer: an umbrella review and evidence map of creative arts interventions

Yangqian Hu,[1]* Giulia Ripani,[2] Yizhi Xi,[3] Dengyi Ning[4] and Yu Zhu[5]
[1]*School of Music, University of South Florida, Tampa, FL, USA*
[2]*Teachers College, Columbia University, NY, USA*
[3]*Music Art Research Institute, Shanghai Conservatory of Music, Shang Hai, PRC*
[4]*Art History Department, Binghamton University, State University of New York, NY, USA*
[5]*Clinical Sciences Departments, Stanford University, CA, USA*

ABSTRACT

Background. Creative arts interventions, including music, visual art, dance, drama and expressive writing, are increasingly offered as supportive care during cancer treatment. Several systematic reviews have examined their mental health effects, however the review level evidence has not been synthesised. An umbrella review of these reviews, covering anxiety, depression, stress/distress and quality of life in adults with cancer, was therefore conducted.

Methods. Ten systematic reviews, together reporting 20,810 participants, were eligible. Confidence in each review was appraised with A MeaSurement Tool to Assess systematic Reviews 2, certainty was extracted as graded by the reviews, trial overlap was quantified with the corrected covered area, and non-overlapping evidence was re-analysed on a standardised scale with credibility classes, robustness scenarios and an exploratory random-forest heterogeneity analysis.

Results. Here we show that, in reviews drawing on 145 unique trials, creative arts interventions are associated with lowered anxiety (standardised mean differences 0.28 to 1.59), depression (0.23 to 0.91) and stress/distress (1.19), and with improved quality of life (0.42 to 1.42), positive values denoting benefit. After de-duplication, anxiety is supported as a short-term association for receptive music listening (Hedges $g = 0.67$, 32 trials), and depression is weakly supported, by one small visual-art subset only. Findings should be interpreted in view of overlap, as the corrected covered area is 7.6% and 12 of 45 review pairs exceed 15%.

Conclusions. Receptive music listening is a low-burden option that may be offered around procedural anxiety. Agreement across reviews is weaker evidence than it appears, and trials with active comparators are needed before creative arts interventions can be recommended as established care.

Key words: Neoplasms – Art therapy – Music therapy – Anxiety – Depression – Quality of life – Mental health – Systematic review

1 INTRODUCTION

Adults with cancer often experience a substantial and sustained psychological burden during diagnosis and treatment[1–4]. Anxiety, distress and reduced quality of life accompany surgery, chemotherapy and radiotherapy across the course of treatment, and they may influence treatment engagement, the experience of symptoms, and the broader course of recovery[5,6]. Although pharmacological approaches of mental symptoms can provide effective relief in certain contexts, their use may be accompanied by adverse effects or may not align with every patient's needs and preferences[7–9]. Continued interest has therefore been given to non-pharmacological supportive care[10]. Across the current literature, improvements in anxiety and related emotional symptoms have been observed in association with cognitive behavioral approaches[11], mindfulness-based stress reduction[12], engagement with natural environments[13], and structured physical activity[14]. Within this variety of supportive care, increasing attention has been linked toward interventions that engage patients through creative and expressive art making experiences.

Creative arts interventions have consequently been incorporated at different points along the cancer pathway, and have included music and music therapy[15–17], visual art and art therapy[7,18], dance and movement[19,20],

* Yangqian Hu, School of Music, University of South Florida, 3755 USF Holly Drive MUS314, Tampa, Florida 33620, USA.

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drama and psychodrama[21], and creative or expressive writing[1,22]. These interventions have been delivered in forms ranging from brief, single bedside session before a radiotherapy fraction, to multi-week structured group programmes during and after active treatment[5,23]. Creative arts interventions here may be understood as a diverse family of structured experiences through which the context of care can be shaped, allowing distressing procedures or therapeutic experiences to be approached with greater comfort or agency. This breadth may offer meaningful opportunities for patient centered care, while also introducing challenges for evidence synthesis. Even within a single art modality, moreover, the process through which the art is made or received differs in level of participation, therapeutic structure and facilitator involvement, and this within art modality heterogeneity cannot be ignored, as music interventions alone range from passive, self selected listening through headphones[15] to live music therapy with verbal processing[16,24], and writing interventions from brief written emotional disclosure[1] to the structured, multi session self-book art therapy in which a personal book is created[7].

Clinically significant anxiety affects adults with cancer, commonly one in five to one in three, and it intensifies around invasive procedures such as radiotherapy simulation, chemotherapy infusion and surgery, where it predicts poorer adherence, amplified pain and nausea, and reduced quality of life[5,6,25,26]. As commonly used anxiolytic medications may be accompanied by sedation, fall risk, or concerns about dependence, and may not be acceptable to individuals in different stages of cancer, brief and scalable creative arts approaches have been considered as potentially useful adjuncts[27,28]. In this way, supportive care can be offered at a time when comfort, reassurance, and a sense of personal agency may be particularly meaningful[5,6,25]. Several processes have been suggested to help explain these observed benefits. Across randomized studies conducted in surgery and radiotherapy settings, music listening and music therapy have been associated with lowered anxiety and reduced anaesthesia requirements, in relation to calming of physiological arousal and shifting of attention away from threat[5,29]. Visual art therapy is proposed to support the processing and expression of difficult emotions[30]. Expressive writing structures the disclosure of illness-related thoughts and feelings, and randomised trials in breast cancer survivors reported better quality of life after brief writing sessions[31]. Dance and movement therapy works through the body, restoring body awareness and interpersonal connection, and randomised trials in women with breast cancer reported reduced stress and improved quality of life[19,20]. Although these pathways are recognised in the literature, the robustness of the supporting evidence, and how the effects compare across different art forms, remain unclear, so that a structured and comprehensive synthesis of the evidence is needed.

Creative arts interventions for adults with cancer have been examined in several systematic reviews and meta-analyses, and emerging evidence has suggested that their potential mental health benefits may be experienced differently across care settings and location contexts[23,32–34]. However, this growing evidence has yet to be brought together through an umbrella review. The available reviews differ in the art modalities, cancer populations and outcomes that were admitted, part of their primary evidence is shared, and neither the confidence in their conduct nor the certainty of their conclusions has been appraised side by side. Without such an appraisal, agreement across reviews cannot be distinguished from repeated counting of the same trials, and no basis is available for judging which review-level conclusions can be relied upon in supportive care. An umbrella review, in which systematic reviews are the unit of analysis and a common appraisal is applied to each, is the design suited to these questions[35,36]. Two aims were therefore pursued in the present synthesis. First, to appraise the confidence in the conduct, the certainty and the independence of the review-level evidence on creative arts interventions for the mental health of adults with cancer. Second, to re-analyse the non-overlapping primary evidence on a common standardised effect scale, so that a more comparable assessment of the direction and credibility of reported effects can be drawn together. To our knowledge this is the first completed cancer-specific umbrella review of creative arts interventions, and the first in this field in which a quantified overlap analysis is combined with a standardised re-analysis of the non-overlapping trials. We identified and appraised the eligible systematic reviews[37], quantified overlap studies[38], and synthesised findings with de-duplicated estimates, across anxiety, quality of life, depression and stress/distress. Across the ten eligible reviews, generally positive associations were observed, although the consistency and strength of the reported evidence varied across outcomes and art modalities. These findings were further considered alongside the standardised re-analysis, review quality, and study overlap to provide a cautious account of how confidently the available evidence may be generalised and extended to broader mental health care of adults with cancer.

2 RESULTS

2.1 Included reviews

The search returned 5,834 records from the eight databases, of which 5,753 were removed before screening as background or methods records. Of the 81 records screened, 13 were duplicates and 68 reports were assessed in full text; 58 of these were excluded because the population (n = 36), the outcomes (n = 17) or the intervention (n = 5) did not meet the eligibility criteria, leaving ten systematic reviews for synthesis (Supplementary Figure 1). These ten reviews (six with meta-analysis and four with narrative synthesis) searched between three and ten databases each, with final searches between 2012 and February 2025; together they covered anxiety, depression, stress/distress and quality of life in adults with cancer and drew on 145 unique creative arts primary studies and, as reported by the reviews

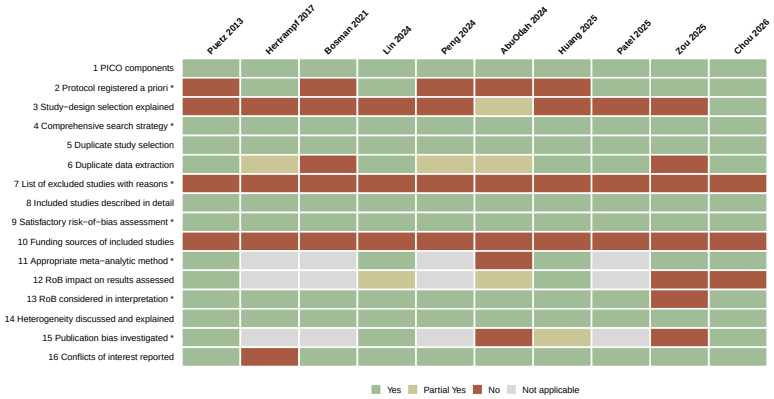


Figure 1. AMSTAR 2 confidence in the ten synthesised reviews. AMSTAR 2 item-level judgements (Yes, Partial Yes, No, or not applicable for reviews without a meta-analysis) for the 16 items, with the overall confidence rating of each review. Asterisks mark the seven critical domains. AMSTAR 2, A MeaSurement Tool to Assess systematic Reviews 2.

themselves, a combined 20,810 participants (Table 1). Within included reviews, 40% focused on women with breast or gynaecological cancer, 10% on patients receiving chemotherapy, and 50% included adults with any cancer. 90% of reviews reported on anxiety, depression and quality of life, whereas 40% reported on stress or distress, and none graded evidence at the outcome level. Visual art or art making approaches were synthesised in four reviews, while two reviews rested predominantly on music trials (81% [54 of 67] of the trials in the largest review, 76% [13 of 17] in the breast cancer focused meta-analysis). Three reviews included mixed art and music formats, with music remaining the most common single art modality among the trials. Dance, drama and creative writing were not examined as the primary focus of any review. Most reviews included mixed cancer samples, typically combining trials of patients in active treatment (chemotherapy, radiotherapy or surgery) with trials of post-treatment survivors, and trials enrolling participants unselected for baseline symptom severity with trials targeting distress around specific procedures. The underlying interventions were delivered face to face at the bedside, in infusion suites, radiotherapy departments, wards and outpatient clinics, or as recorded material for self-directed use, in individual and group formats ranging from a single session to multi-week programmes (Table 1)[39]. Mental health outcomes were assessed with a range of validated psychometric instruments: anxiety most commonly with the State–Trait Anxiety Inventory (STAI) and the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS-A), with the Beck Anxiety Inventory and the Symptom Checklist-90 also represented; depression with the HADS-D, the Beck Depression Inventory and the Profile of Mood States; stress/distress with the Distress Thermometer, the Perceived Stress Scale and the Impact of Event Scale; and quality of life with the EORTC QLQ-C30, the FACT-G/FACT-B, the SF-36 and the WHOQOL-BREF. The use of various measurement tools across the underlying trials may have contributed to heterogeneity in the estimates.

2.2 Confidence in the included reviews

Confidence in the included reviews was appraised with AMSTAR 2[37] (Fig. 1). A low rating was reached by four reviews, namely the largest all-cancer meta-analysis of anxiety, depression and quality of life, the creative art making meta-analysis that contributes the only pooled distress estimate, and the two narrative syntheses restricted to women's breast and gynaecological cancers. A critically low rating was reached by the remaining six, which comprise the meta-analysis of creative arts therapies, both breast cancer only meta-analyses (one focused on anxiety and depression, the other on quality of life), the mixed cancer creative arts meta-analysis, and the two art making narrative reviews (the artist guided review and the chemotherapy review). One critical AMSTAR 2 domain was shared by every included review, as an itemised list of the studies excluded at full text was provided by none. The critical domain covering publication bias was also shared by two of the six meta-analyses, and the critical domain covering the meta-analytic method was additionally carried by one of the two (Supplementary Table 3).

2.3 Risk of bias in the primary trials

Risk of bias here refers to aspects of trial design or conduct that can systematically distort an effect estimate, and is distinct from the limitations of the reviews themselves, which were appraised above as confidence in the reviews. Risk of bias in the underlying trials was assessed by the reviews, and the same two sources of bias were identified across their verdicts. Participants cannot be blinded to a creative arts intervention, and most outcomes are self-reported. In the largest meta-analysis, all 67 trials (100%) were judged at moderate or high risk of bias, a second meta-analysis reached the same overall verdict, and in a third, excluding high-risk trials moved the anxiety estimate modestly toward zero (standardised mean difference, SMD, 1.59 to 1.43) while the depression estimate did not shrink (SMD 0.77 to 1.23; Supplementary Table 4)[34]. These and the following review-level effects are standardised mean differences, values

Table 1. Characteristics of the ten synthesised systematic reviews

Review	Studies (n)	N	Population	Art modality and interventions	Type	Last search	AMSTAR 2
Puetz 2013[43]	27	1,576	Adults with cancer	Music, visual art, dance/movement and expressive writing (CAT); anxiety, depression, QoL	SR, MA	2012	Critically low
Hertrampf 2017[56]	17	1,703	Breast/gynae cancer	Art therapy, music therapy/medicine and dance/movement; anxiety, depression, QoL/well-being, distress	SR	2016	Low
Bosman 2021[23]	7	654	Adults with cancer	Active art making guided by artist or art therapist; anxiety, depression, QoL	SR	Sep 2019	Critically low
Lin 2024[44]	23	3,903	Adults with cancer	Receptive, expressive and integrated art making; anxiety, depression, distress, well-being, QoL	SR, MA	May 2023	Low
Peng 2024[84]	10	495	Cancer patients on chemotherapy	Active art making guided by artist or art therapist; depression, anxiety, QoL, distress	SR	2023	Critically low
AbuOdah 2024[45]	25	1,489	Adults with cancer	Creative arts therapy, mainly painting, drawing and sculpting; QoL, depression, anxiety, distress	SR, MA	Jun 2023	Critically low
Huang 2025[34]	17	1,237	Adult women breast cancer	Music therapy, art therapy, painting/drawing and dance; anxiety, depression	SR, MA	Oct 2024	Critically low
Patel 2025[82]	31	2,108	Breast cancer survivors	Dance, visual art, music and poetry; QoL, anxiety, depression	SR	Apr 2024	Low
Zou 2025[32]	21	1,386	Adult women breast cancer	Art therapy incl. dynamic (dance, tango, yoga) and static (writing, drawing, music listening) forms; QoL	SR, MA	Oct 2023	Critically low
Chou 2026[33]	67	6,259	Adults all cancers	Music therapy (54/67 trials), visual art, dance, drama and writing; anxiety, depression, QoL	SR, MA	Feb 2025	Low

N, total participants as reported by the review. SR, systematic review; MA, meta-analysis; QoL, quality of life; CAT, creative arts therapies; AMSTAR 2, A MeaSurement Tool to Assess systematic Reviews 2.

of about 0.2, 0.5 and 0.8 are conventionally read as small, moderate and large, and all review-level values in the main text are oriented so that positive values denote benefit with creative arts interventions (the reviews reported symptom reductions as negative values, which are listed with their original signs in Supplementary Table 4). The sizes of the observed estimates therefore usually include an expectation component that the prevailing trial designs cannot rule out. Among the reviews, those applying the Cochrane tools did so as RoB 2, with ROBINS-I where non-randomised studies were eligible; half (50%) used the Cochrane tool[40], half used the JBI checklists, and one used GRADE with a fidelity checklist. The dominant concern throughout was deviation from the intended interventions, which is expected in arts trials, where blinding is difficult and in practice almost impossible. When listening to Liszt's Ave Maria[41] and painting with watercolours[42] are synthesised in the same estimate, even the standardisation of the intervention becomes difficult to define.

2.4 Unique and duplicated primary studies

The ten reviews together drew on 145 unique creative arts primary studies (155 publications), and the study-by-review citation matrix is given in Table 2. Overlap was moderate, with an overall corrected covered area (CCA)[38] of 7.6%. The sensitivity analysis collapsing companion reports of the same cohort left this unchanged (7.6%; 7.1% when all mapped publications are counted). Pairwise overlap ranged from 0 to 31.0% (median 8.3%), and 12 of the 45 review pairs (27%) exceeded 15%, the conventional threshold for very high overlap (Supplementary Figure 3; Supplementary Table 6). The contribution of unique evidence also varied across reviews (Supplementary Figure 2). In four reviews (40%), fewer than one in five of the cited trials was unique to that review, while the two largest contributors of unique evidence supplied 58% and 61% of their trials uniquely. Two concerns follow. First, when more than a quarter of review pairs share over 15% of their evidence, concordant conclusions cannot be read as independent replication, as part of the agreement is the same trials being counted again. Second, several reviews carried companion reports of a single cohort as separate studies, which may have increased the relative contribution of those cohorts and aligned with concerns identified through AMSTAR 2. These findings support a de-duplicated synthesis with transparent study mapping and systematic methodological appraisal.

2.5 Review-level findings

All effects in this section are the standardised mean differences reported by the reviews themselves, oriented so that positive values denote improvement. The earliest included meta-analysis (Puetz 2013)[43] reported Hedges *d* with this orientation, whereas the more recent meta-analyses reported symptom reductions as negative values, which are sign-reversed here, both statistics being based on the same standard deviation scale. Within the meta-analysis findings (Fig. 3), direction was consistent across the six meta-analyses, with creative arts interventions associated with reduced anxiety and depression and improved quality of life. For anxiety, the reported effects run from small in a meta-analysis (Puetz 2013; SMD 0.28, 95% CI 0.11 to 0.44, during treatment), through moderate-to-large in the largest and most recent one (Chou 2026[33]; SMD 0.62 immediately post-intervention, strengthening to 1.21, 95% CI

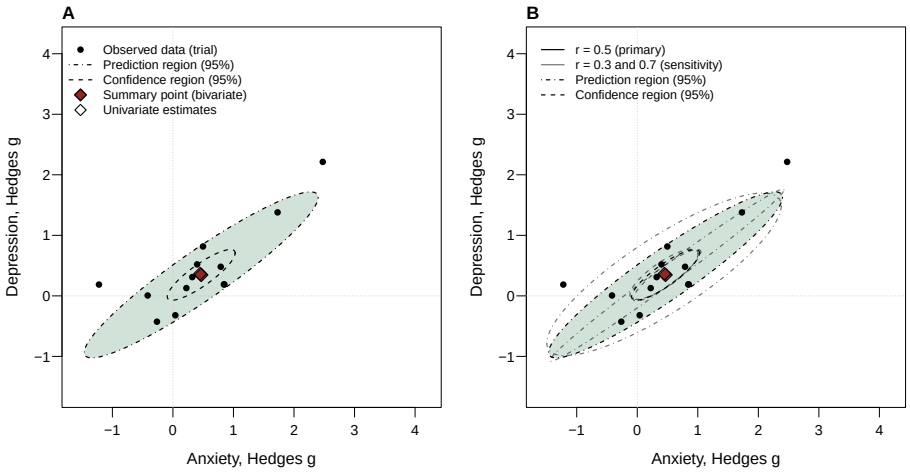


Figure 2. Bivariate sensitivity analysis of anxiety and depression in the 13 trials reporting both outcomes. Panel A, trials reporting both outcomes (points), the bivariate summary point (filled diamond), the univariate estimates for the same trials (open diamond), the 95% confidence region (dashed) and the 95% prediction region (dash-dot, shaded), with the within-trial sampling correlation assumed at 0.5. Panel B, the same regions under assumed correlations of 0.3, 0.5 and 0.7. Effects are Hedges *g*, positive values denoting benefit.

0.34 to 2.08, at 4–6 weeks), to very large but heterogeneous in the art making focused meta-analysis (Lin 2024[44]; SMD 1.12, 95% CI 0.81 to 1.43, $I^2 = 86\%$) and the breast cancer focused meta-analysis (Huang 2025[34]; SMD 1.59, 95% CI 0.78 to 2.41, in women with breast cancer). The same ordering holds for depression (Puetz 2013, SMD 0.23; Chou 2026, SMD 0.44 to 1.14 across time points; Lin 2024, SMD 0.77; Huang 2025, SMD 0.91). Where the earlier meta-analysis pooled follow-up estimates they were small and non-significant (anxiety SMD 0.08, depression −0.09, quality of life 0.22; every 95% CI crosses zero). Heterogeneity was high in most primary pooled estimates of Chou 2026 (I^2 65–96%), Huang 2025 (93–97%) and Lin 2024 (65–95%, and 40% for distress), and lower in Puetz 2013 (21–60%), AbuOdah 2024 (26–79%) and Zou 2025 (47%, and 11% in its music subgroup; Supplementary Table 4). For quality of life, the largest review (Chou 2026) reported effects sustained to six months (SMD 0.42 to 1.42 across time points), the art making meta-analysis (Lin 2024) reported a heterogeneous improvement in total quality of life (SMD 0.81, 95% CI 0.29 to 1.33, $I^2 = 95\%$), with more modest gains in psychological well-being (0.41) and social well-being (0.29, 95% CI 0.04 to 0.54), and the meta-analysis of creative arts therapies during active treatment (Puetz 2013) reported improvement (SMD 0.50, 95% CI 0.25 to 0.74). One further, modest estimate (Zou 2025[32]; SMD 0.38) includes yoga as expressive arts, its music subgroup (SMD 0.51) is a more interpretable number. The improvement claim of the mixed cancer creative arts therapy meta-analysis (AbuOdah 2024)[45] rests on a fixed-effect sensitivity analysis despite heterogeneity, with its non-significant random-effects total (0.67, 95% CI −0.02 to 1.36) beside a significant fixed-effect social quality of life estimate (0.31, 95% CI 0.06 to 0.55), and its pooled depression estimate (0.18, 95% CI −0.39 to 0.74) shows no significant effect. The four narrative reviews were consistent in direction, without effect estimation. Across them, creative arts interventions were associated with reduced anxiety in two of four studies in the artist guided creative art review, and in four of six in the chemotherapy focused art making review, depression in two of three and in five of six, and quality of life in four of six and in two of four (the artist guided and the chemotherapy focused review). The women's cancers synthesis and the breast cancer review reported per study effect ranges (for example, anxiety SMD 0.2 to 0.67 in one), with mixed results also described for dance based formats (Fig. 3). For stress and distress, one review indicated lower distress from a limited base of three trials (SMD 1.19, 95% CI 0.95 to 1.43), while narrative findings included reductions in two of three studies in one review and, in another, individual study effects interpreted as null (SMD 0.07 to 0.19) without a combined estimate. No review graded the certainty of evidence. The reported standardised effects, with each review's AMSTAR 2 confidence rating, narrative findings and each reported certainty assessment, are presented in Fig. 3. The pooled effect estimates reported by each meta-analysis, with their confidence intervals, heterogeneity and GRADE ratings where available, are listed with their original signs in Supplementary Table 4.

2.6 Certainty and credibility of evidence

Certainty and confidence in the reviews (AMSTAR 2) are reported separately, presented in Fig. 3. In certainty, the largest included meta-analysis graded its outcomes with GRADE and rated every one of them low or very low, the narrative synthesis in women's breast and gynaecological cancer graded individual studies instead of outcomes, the breast cancer survivorship review reported an art modality level GRADE assessment (mostly moderate to low), and the remaining seven

Table 2. Study-by-review citation matrix of the 145 unique creative arts studies (244 inclusions; corrected covered area 7.6%). A bullet marks a study cited by that review; *n*, number of the ten reviews citing the study. Reviews in publication order: Pu13, Puetz 2013; He17, Hertrampf 2017; Bo21, Bosman 2021; Li24, Lin 2024; Pe24, Peng 2024; Ab24, AbuOdah 2024; Hu25, Huang 2025; Pa25, Patel 2025; Zo25, Zou 2025; Ch26, Chou 2026. Companion reports of the same cohort are listed under one study.

Study	Pu13	He17	Bo21	Li24	Pe24	Ab24	Hu25	Pa25	Zo25	Ch26	*n*
Akbulak 2023				•						•	2
Alam 2016										•	1
Alcantara-Silva 2018									•	•	2
An 2022										•	1
Ando 2013				•		•					2
Arruda 2016										•	1
Bar-Sela 2007					•	•					2
Bates 2017										•	1
Bell 2022				•		•					2
Binns-Turner 2011		•					•			•	3
Boing 2023								•	•		2
Bozcuk 2017			•		•	•					3
Bradt 2024										•	1
Bro 2019										•	1
Bruera 2008	•										1
Bulfone 2009	•	•						•		•	4
Burns 2001	•										1
Cai and Wang 2022				•							1
Cassileth 2003	•									•	2
Chan 2003		•									1
Chen 2013										•	1
Chen 2018										•	1
Chen 2020										•	1
Chen Li 2020				•							1
Cheng-cheng Zhou 2020				•							1
Chi 2015		•									1
Cho 2024										•	1
Chuang 2024										•	1
Clark 2006	•									•	2
Collette 2021				•		•					2
Conrad 2016										•	1
Czamanski-Cohen 2019				•		•		•		•	4
Da Silveira 2023								•			1
Daboui 2019								•			1
Daboui 2022								•			1
Danhauer 2010										•	1
De Feudis 2019			•			•					2
De Feudis 2022				•							1
de Moor 2002	•										1
Deng 2022							•			•	2
Denig 2022								•			1
Dibbell-Hope 2000	•	•						•			3
Du 2024										•	1
Duzgun 2024										•	1
Elimimian 2020					•	•					2
Ferrer 2007	•									•	2
Firmeza 2017										•	1
Gellaitry 2010	•										1
Geue 2013			•			•					2
Geue 2017						•					1
Giordano 2023										•	1
Glinzak 2016				•							1
Hanser 2006	•	•		•			•	•	•	•	7
He 2022								•	•	•	3
Hilliard 2003	•									•	2
Ho 2016		•					•	•		•	4
Hsieh 2019								•			1
Huang 2010	•										1
Jalambadani 2019			•					•			2
Jang 2016			•		•		•	•		•	5
Joly 2022				•		•				•	3
Joshi 2021					•						1
Kaimal 2020				•							1
Kaltsatou 2011								•			1
Karadag 2019							•	•		•	3
Klagsbrun 2005				•		•					2
Koolaee 2017								•			1
Koom 2016						•					1
Kwekkeboom 2003	•									•	2
Lazaro-Garcia 2024										•	1
Lee 2017						•					1
Lefevre 2016						•					1
Leite 2021								•			1

Study	Pu13	He17	Bo21	Li24	Pe24	Ab24	Hu25	Pa25	Zo25	Ch26	*n*
Li 2011	•	•					•	•		•	5
Li 2012 companion		•									1
Liao 2013										•	1
Lifeng Shen 2022				•							1
Lili Yang 2021				•							1
Lima 2020							•		•	•	3
Lin 2011	•									•	2
Lin 2012						•					1
Lingyu Su 2022				•							1
Liou 2022				•							1
Lu 2018									•		1
Lu 2019									•		1
McCabe 2013										•	1
Meghani 2018					•						1
Mische Lawson 2016				•							1
Mollaoglu 2024							•	•		•	3
Mondanaro 2021										•	1
Monti 2006	•				•					•	3
Monti 2012										•	1
Monti 2013		•								•	2
Moradian 2015		•									1
Mou 2020										•	1
Nainis 2006				•		•					2
Nguyen 2010	•										1
O'steen 2020										•	1
Oei 2023								•			1
Oster 2006		•						•			3
Oster 2014								•			2
Palmer 2015		•					•				2
Porter 2018			•								1
Puig 2006	•	•		•		•		•		•	6
Rabinowitch 2023										•	1
Radl 2015				•							1
Radl 2018			•		•	•	•				4
Raglio 2021										•	1
Romito 2013		•								•	2
Rong Xie 2022				•							1
Rosenberg 2002	•										1
Rossetti 2017										•	1
Rubio 2023								•			1
Sabo 1996	•										1
Sahan 2024										•	1
Sandel 2005	•	•						•	•		4
Schad 2023								•	•		2
Shabanloei 2010	•										1
Smith 2001	•										1
Stordahl 2009	•	•					•				3
Svensk 2009	•	•						•	•	•	6
Tang 2021										•	1
Tanriverdi 2023										•	1
Thyme 2009	•	•			•	•	•	•	•	•	8
Thyme 2022								•			1
Tollabzadeh 2023										•	1
Tuinmann 2017										•	1
UnalToprak 2024										•	1
Vachiramon 2013										•	1
Weizi Song 2021				•							1
Wiswell 2019				•	•	•					3
Wren 2019							•				1
Xing Liu 2022				•							1
Yakar 2021						•					1
Yang 2024										•	1
Yao Zhang 2021				•							1
Yates 2015										•	1
Yazici 2024										•	1
Yildirim 2024										•	1
Yuqiao Sun 2017				•							1
Zengin 2013										•	1
Zeppegno 2021							•				1
Zhou 2011		•					•	•		•	4
Zhou-K 2015		•					•				2
Zimmerman 1989	•										1
Total	27	21	7	28	10	25	17	31	11	67	244

(70%) did not grade certainty. Confidence in the conduct of the reviews (AMSTAR 2) was low in four (40%) and critically low in six (60%). Anxiety was reported by nine reviews (four meta-analytic and four narrative positive effect reports with one mixed per study range; GRADE was low to very low in the single review that graded it; AMSTAR 2 was low or critically low). Depression by nine (four meta-analytic effect estimates, one non-significant estimate, three narrative positive reports, one mixed); quality of life by nine (five quantitative reports of which one is non-significant under random effects, two narrative reports, two mixed); stress/distress by four (one positive effect estimate, one narrative report, one null per-study range, one mixed report).

2.7 Robustness of the synthesis

Every outcome-level direction statement held under both restricted scenarios (Supplementary Table 5 and Supplementary Figure 4). Restricted to the four reviews rated low, the CCA rose slightly (9.3%, moderate), and all four outcome statements were unchanged. Anxiety and depression each retained two quantitative and one narrative positive-effect report with one mixed narrative, quality of life retained two quantitative reports, and

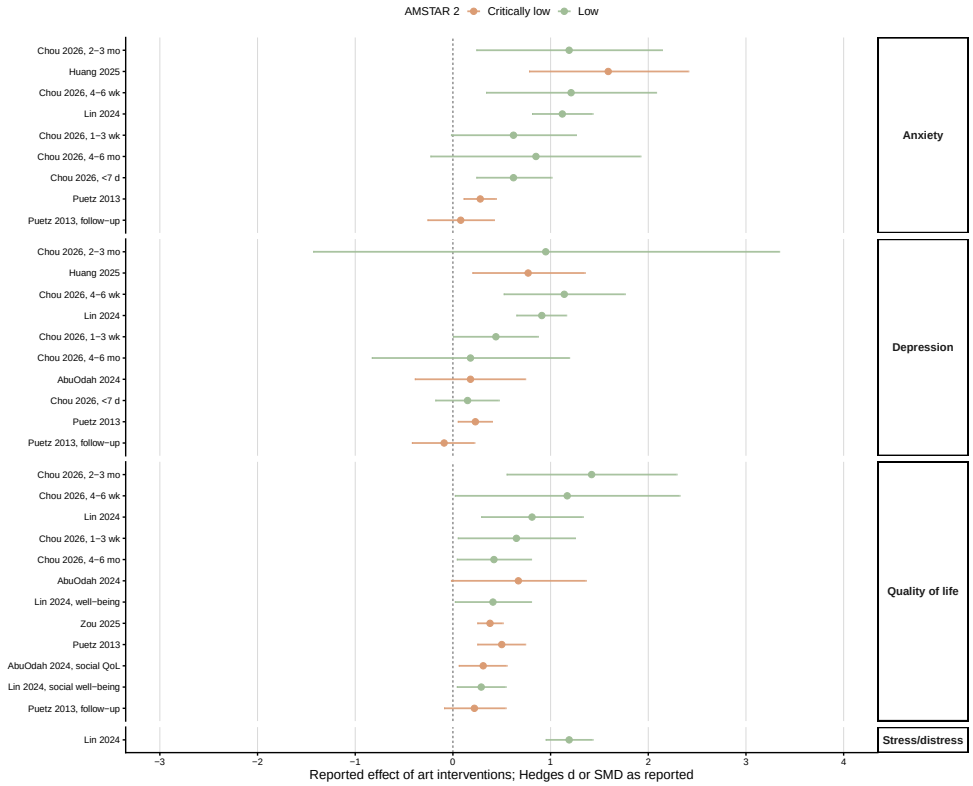


Figure 3. The reported effects, by review and outcome. Estimates from the six meta-analyses (points with 95% CIs; standardised mean differences oriented so that positive values denote benefit). Colour gives each review's AMSTAR 2 confidence.

stress/distress remained insufficient. Restricted instead to the two reviews that survive pruning of every high-overlap pair, the CCA fell to 5.6% and all four statements held again, now on purely quantitative support. In numbers, 8 of 8 scenario level direction statements matched the primary synthesis (Fig. 3).

2.8 Sources of heterogeneity in the de-duplicated trials

Before the pooled re-analysis, the recorded characteristics of the de-duplicated randomised trials were examined together as candidate sources of heterogeneity. 102 effects from 73 trials entered an exploratory random-forest analysis (MetaForest) with fifteen pre-specified moderators, of which 15 were retained by preselection (Supplementary Table 7). The tuned clustered forest did not predict the variation in effect size in trials that were not used to grow it (out-of-bag R^2 = -0.05), and the between-trial variance was not reduced once the moderators were taken into account ($\tau^2 = 0.66$ before and 0.71 after the forest). Region, session length and mean age ranked highest in permutation importance, all at low values, and none of the moderators reached significance in the confirmatory three-level meta-regression after control of the false discovery rate (Supplementary Table 8, Supplementary Figures 5 and 6). The leading moderator was unchanged in 6 of 8 sensitivity forests, in which the out-of-bag R^2 ranged from -0.29 to 0.08 (Supplementary Table 9). When the standard error of each effect was added as a diagnostic moderator, it ranked first, which points to small-study effects as a larger source of variation than any recorded trial characteristic.

2.9 Standardised re-analysis of non-overlapping evidence

To examine the extent to which shared evidence supports the reviews' conclusions after each trial was counted only once, study level effects were re-analysed within non-overlapping subsets defined by outcome, art modality and format, comparator class and assessment time point. In the most populated subset, 32 randomised trials comparing receptive music listening with passive controls for anxiety immediately post-intervention (N = 2,789) yielded a pooled Hedges g of 0.67 (95% CI 0.31 to 1.02; $p = 2.2 \times 10^{-4}$). Heterogeneity was high ($I^2 = 95\%$), with the 95% prediction interval (−1.38 to 2.72). The largest trial yielded a larger effect than the combined estimate. Egger's test showed no small-study asymmetry ($p = 0.54$)[46], and the 22 of 32 nominally significant trials did not exceed the number expected from the effect observed in the largest trial[47]. Under umbrella-review credibility criteria[35], which grade each pooled association from convincing (Class I) to weak (Class IV) on the basis of its p value, the number of participants, heterogeneity, the prediction interval and the bias diagnostics (Methods), this association is Class III, that is, suggestive. A suggestive class indicates an

association that is statistically robust in a large sample but whose heterogeneity and prediction interval do not yet permit a convincing claim. Four further subsets reached Class IV, the weak class in which only nominal significance ($p < 0.05$) is attained, including a small association for anxiety with visual art ($g = 0.29$, 95% CI 0.05 to 0.54), quality of life with receptive music (0.44), a limited three-trial estimate for depression with visual art (0.42) and a heterogeneous three-trial estimate for quality of life with visual art (0.83). Five subsets showed estimates that did not reach statistical significance, including music therapy in active formats for anxiety, receptive music interventions for depression, a small creative writing estimate against active controls for anxiety, a limited three-trial estimate for dance and quality of life, and the follow-up subset including anxiety with receptive music. No subset met Class I or II, provisional outcome-level GRADE was low or very low. The full diagnostic summary is reported in Table 3, and the summary of effect, credibility class, provisional certainty and review quality presented in Table 4. Taken together, the non-overlapping re-analysis therefore remained consistent with the overall estimates of the review-level findings, while giving smaller anxiety and depression estimates than the largest effects reported by the reviews, with anxiety supported as a short-term association for receptive music listening and depression weakly supported, by one small visual-art subset only. The credibility and certainty assessments support a suggestive and cautious interpretation of the included effects. In the bivariate sensitivity analysis of the 13 trials reporting both anxiety and depression, the joint estimates (anxiety $g = 0.47$, depression $g = 0.35$) were within 0.02 of the univariate estimates, the between-trial correlation of the two true effects was 0.94, the 95% prediction region extended from below zero to large positive values, and the results were unchanged under assumed within-trial correlations of 0.3 to 0.7 (Fig. 2, Supplementary Table 10). The available evidence across these subsets is mapped in Fig. 4, and the trial-level effects behind every estimable subset of the re-analysis are shown as a subgroup forest plot with prediction intervals (Fig. 5).

Music interventions supplied most of the de-duplicated evidence. Five of the ten estimable subsets concerned music, together contributing 53 of the 72 trial-level effects and 4,341 of the 5,823 participants summed across subsets (Fig. 5 and Table 3). Within music, the receptive format carried the only suggestive association, for anxiety immediately after the session, together with a weak association with quality of life, whereas music therapy in active formats for anxiety, receptive music for depression and receptive music at follow-up did not reach statistical significance. The de-duplicated music evidence was therefore both the most abundant and the most credible in this synthesis, and it was concentrated on short-term anxiety (Fig. 4).

3 DISCUSSION

Across the evidence synthesised in this umbrella review, creative arts interventions were associated with reduced anxiety, further supporting findings for depression and quality of life[32,34], and a less consistent positive effect for stress/distress in adults undergoing cancer treatment[48,49]. After de-duplication, anxiety was supported as a short-term association for receptive music listening, and depression was weakly supported, by one small visual-art subset only. In the art making evidence, which came from reviews rated low or critically low in confidence, gains in quality of life were more consistent than the changes reported for fatigue, pain, psychological functioning or coping in the mixed-population syntheses[44,45,50]. Although creative arts interventions are positively associated with the mental health of adults with cancer, the consistency of the evidence varies to an extent that cannot be overlooked across clinical settings and art modalities. The earlier synthesis reported post-treatment improvements in anxiety, depression and quality of life, with effects generally diminished at follow-up[43]. In the largest review, the time-stratified estimates included effects on depression at about six weeks and on anxiety at about three months after the intervention (Supplementary Table 4)[33]. Because follow-up effects were reported by relatively few reviews and underlying trials, our re-analysis yielded only one estimable follow-up subset, which did not reach a convincing or statistically significant estimate. Among the ten included reviews, scattered data on fatigue, pain, psychological functioning or coping were also reported but were not included in this synthesis.

At the level of individual mental health outcomes, the results of our re-analysis were broadly consistent with the included reviews, and the immediate estimates were, overall, larger than those reported in the earliest synthesis, although differences in study composition and analytic methods should be considered. For anxiety and depression, the de-duplicated re-analysis supported the overall pattern reported across reviews with revised size (Fig. 3). After de-duplication, the anxiety and depression estimates were smaller than the largest effects reported by the more recent reviews, which is consistent with part of those larger review-level effects reflecting repeated counting of shared trials and broader pooling across art modalities and comparators. Findings for quality of life were further aligned with the effect size based synthesis, whereas the evidence for stress/distress remains too limited for more than a cautious statement. Compared with the included reviews, a quantified account of shared evidence and a credibility classification of the non-overlapping estimates are added by the present synthesis, so that agreement across reviews can be weighed against the extent to which it rests on the same trials. Some randomised trials addressed little detail on sources of heterogeneity, partly because contextual and experiential influences may be difficult to measure consistently. Participants and intervention providers could identify the experience and received condition, and subjective outcomes were susceptible to expectation[23,32]. In some settings,

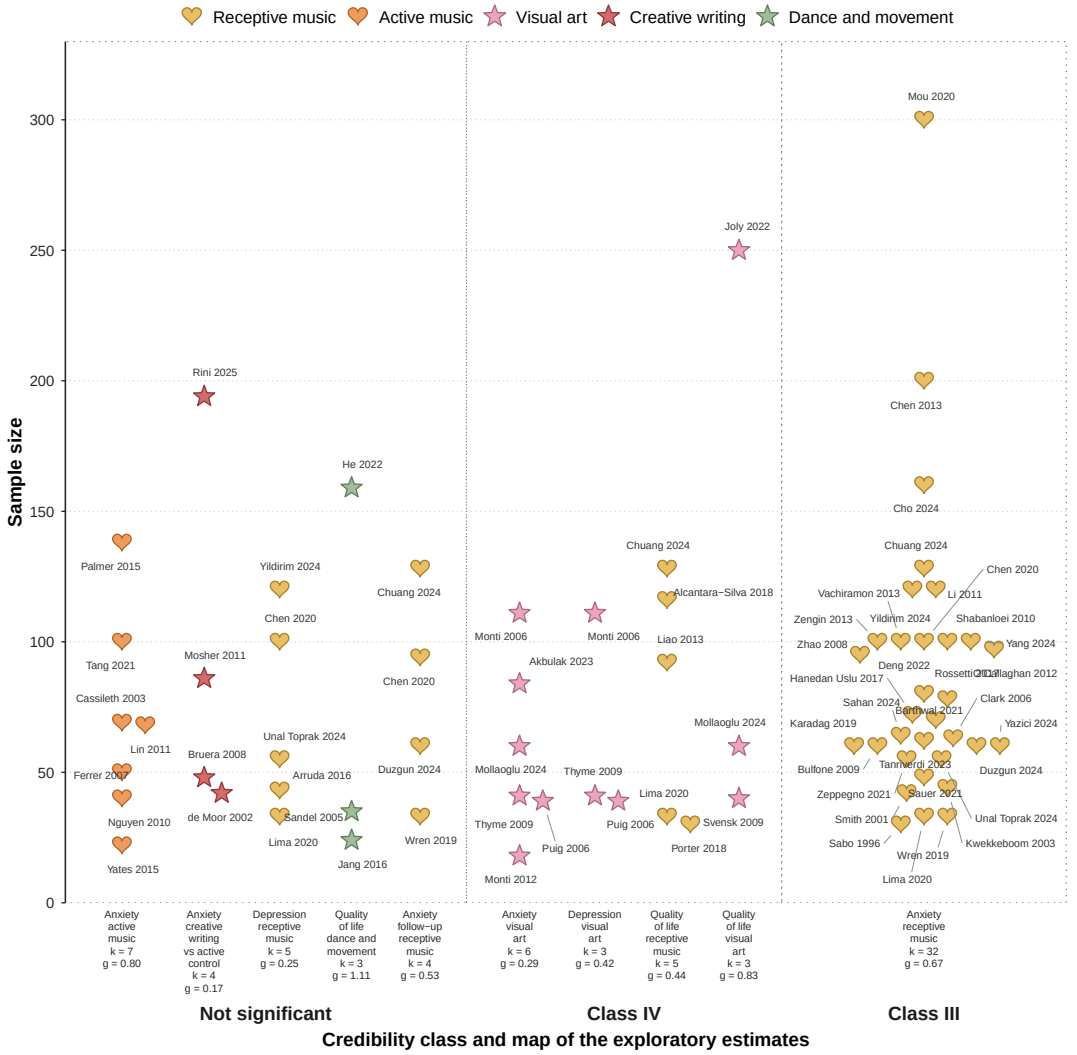


Figure 4. Evidence map of the de-duplicated randomised trials. Each mark is one trial in one of the ten estimable non-overlapping subsets, placed in three zones by the umbrella-review credibility class of its subset (not statistically significant, Class IV and Class III) and by its sample size (participants analysed, vertical axis). Hearts mark music trials (golden, receptive music, and orange, active music) and stars mark trials of the other creative arts (pink, visual art, red, creative writing, and green, dance and movement). Labels give the first author and year of each trial. Below each band the subset is described by outcome, assessment time where it is follow-up, intervention, comparator where it is active, number of trials (*k*) and pooled Hedges *g* (positive values denote benefit). No estimate is pooled across subsets.

usual care comparators may be accompanied by lower expectations, blinding and allocation concealment may be less complete, baseline anxiety may allow greater improvement, and reporting practices may vary.

Three further aspects of the evidence base are noteworthy in our synthesis. First, heterogeneity was high in most of the pooled estimates reported by the reviews. Second, the reviews may agree largely because they share trials. Twelve of 45 review pairs exceeded the very-high overlap threshold, and the reviews with the fewest unique trials are among the most emphatic. Therefore, the concordance is weaker evidence than its unanimity suggests. Third, the only review that graded its own certainty rated it low to very low. Taken together, creative arts, and music in particular, were observed to be associated with reduced acute, treatment-related anxiety and distress, an association that may well be genuine, but the effects should be generalised as context-dependent, and more rigorously designed trial evidence is still needed to support the reported effect estimates. Most reviews that examined moderators did not find that art modality, dose of treatment, or intervention timing explained the heterogeneity. The exploratory random-forest analysis of the de-duplicated trials pointed the same way, as the fifteen recorded trial characteristics considered together did not predict effect size out of sample. The unexplained heterogeneity may reflect underlying cultural-context factors of music and art practices[51,52], different usual-care baselines,

Table 3. Standardised re-analysis of non-overlapping evidence: summary per meta-analysis

Meta-analysis	N	g (95% CI)	p	I^2,%	τ^2	95% PI	Largest g (p)	Egger p	URC
Anxiety, music/music therapy (receptive), immediate	2789	0.67 (0.31 to 1.02)	0.00022	94.8	0.98	-1.38 to 2.72	1.85 (6.3e-41)	0.54	III
Anxiety, music/music therapy (active), immediate	487	0.80 (-0.22 to 1.83)	0.13	95.4	1.81	-2.91 to 4.51	1.02 (2e-08)	NA[a)]	NSA
Anxiety, visual art/art therapy (active), immediate	353	0.29 (0.05 to 0.54)	0.02	7.8	0.01	-0.13 to 0.72	0.32 (0.3)	NA[a)]	IV
Depression, music/music therapy (receptive), immediate	351	0.25 (-0.32 to 0.81)	0.39	84.2	0.34	-1.81 to 2.30	0.48 (0.0094)	NA[a)]	NSA
Quality of life, music/music therapy (receptive), immediate	399	0.44 (0.06 to 0.81)	0.023	67.1	0.12	-0.81 to 1.68	-0.11 (0.52)	NA[a)]	IV
Anxiety, creative writing (active), vs active control, immediate	370	0.17 (-0.04 to 0.38)	0.12	0.0	0.00	-0.30 to 0.64	0.22 (0.12)	NA[a)]	NSA
Anxiety, music/music therapy (receptive), follow-up	315	0.53 (-0.33 to 1.39)	0.22	92.1	0.70	-3.52 to 4.59	-0.05 (0.79)	NA[a)]	NSA
Depression, visual art/art therapy (active), immediate	191	0.42 (0.06 to 0.78)	0.022	0.0	0.00	-1.92 to 2.77	0.31 (0.32)	NA[a)]	IV
Quality of life, dance/movement (active), immediate	218	1.11 (-0.02 to 2.24)	0.054	89.2	0.86	-12.75 to 14.97	0.62 (0.00013)	NA[a)]	NSA
Quality of life, visual art/art therapy (active), immediate	350	0.83 (0.14 to 1.52)	0.018	83.8	0.31	-7.49 to 9.15	0.25 (0.049)	NA[a)]	IV

Largest-N effect per trial; independent-group RCT data only. Hedges $g > 0$ denotes greater improvement with creative arts. REML random effects; 95% prediction interval (PI) with t_{k-2}; Egger test run only where the number of contributing trials is at least 10. All comparisons are versus passive control. N, participants; I^2, heterogeneity; τ^2, between-study variance; URC, umbrella review criteria class (I–IV/NSA; NSA, no statistically significant association). [a)]Not assessable below the 10-trial threshold.

Table 4. Standardised re-analysis of non-overlapping evidence: decision summary

Meta-analysis	g (95% CI)	URC	GRADE	AMSTAR 2	Interpretation
Anxiety, music/music therapy (receptive), immediate	0.67 (0.31 to 1.02)	III	Low	Low–Critically low	positive association (Class III)
Anxiety, music/music therapy (active), immediate	0.80 (-0.22 to 1.83)	NSA	Very low	Low–Critically low	no significant association
Anxiety, visual art/art therapy (active), immediate	0.29 (0.05 to 0.54)	IV	Low	Low–Critically low	positive association (Class IV)
Depression, music/music therapy (receptive), immediate	0.25 (-0.32 to 0.81)	NSA	Very low	Low–Critically low	no significant association
Quality of life, music/music therapy (receptive), immediate	0.44 (0.06 to 0.81)	IV	Very low	Low–Critically low	positive association (Class IV)
Anxiety, creative writing (active), vs active control, immediate	0.17 (-0.04 to 0.38)	NSA	Low	Low–Critically low	no significant association
Anxiety, music/music therapy (receptive), follow-up	0.53 (-0.33 to 1.39)	NSA	Very low	Low–Critically low	no significant association
Depression, visual art/art therapy (active), immediate	0.42 (0.06 to 0.78)	IV	Low	Low–Critically low	positive association (Class IV)
Quality of life, dance/movement (active), immediate	1.11 (-0.02 to 2.24)	NSA	Very low	Low–Critically low	no significant association
Quality of life, visual art/art therapy (active), immediate	0.83 (0.14 to 1.52)	IV	Very low	Low–Critically low	positive association (Class IV)

Effect (Hedges g, > 0 denotes greater improvement with creative arts interventions), URC class, GRADE, AMSTAR 2, and a one-line interpretation. All comparisons are versus passive control unless stated otherwise. URC, umbrella review criteria; GRADE, Grading of Recommendations Assessment, Development and Evaluation; AMSTAR 2, A MeaSurement Tool to Assess systematic Reviews 2; NSA, no statistically significant association.

less active control conditions, or selective publication of small studies with positive findings.

Across creative arts interventions, positive effect is repeatedly observed where the intervention may offer the individual patient a workable form of participatory agency. This was reflected in opportunities to select music around screening[53], surgery[29,54,55] or radiotherapy, non-invasive and immediately usable[56–58]; a therapist oriented opportunity to externalise[30,59,60], revisit and reinterpret difficult feelings in visual form[61–63]; and to engage in group movement programme that supports embodiment and interpersonal connection[19,64,65]. The consistent intervention process appears to involve structured opportunities for choice, attention regulation, expression, and connection[21,66,67]. During creative arts interventions, patients' active participation and personal preference may therefore be of comparable importance to passive exposure to an artistic performance. A random dance sequence may demand energy that a patient in active treatment does not have[20], and offers less choice than self-selected music or visual media. A music therapy trial in metastatic breast cancer showed no group difference in quality of life and was limited by attrition[68]. Low session time or widely spaced sessions can dilute a relational intervention[69]. On this side, attrition in some cancer contexts can indicate poor art delivery fit, not absence of value, and our umbrella observation that the music listening effect was not tied to stated preference matching points the same way[6,15]. Participant engagement offers a similar perspective. Across the underlying trials, music interventions were taken up readily, and mixed-methods reports describe patients completing scheduled sessions and speaking positively

about the experience during chemotherapy and procedural care[16,70,71].

This form of engagement was observed to be most evident for music interventions. The importance of receptive listening, or of active participation in music-based interventions, may be obscured when diverse creative arts interventions are discussed broadly. Music-based interventions account for 81% of the trials in the largest review (Table 1), and music trials reported across the reviews more frequently than any other creative arts interventions[69,72]. Several reviews that identified as art therapy syntheses also drew substantially on music studies. When art modalities were examined separately, anxiety effects were reported as most consistent for music interventions[33]. In the largest review, the largest depression effect was reported for music interventions, at the 4–6-week time point. By comparison, findings for dance based interventions were mixed, and evidence for creative poetry interventions remained limited[73]. Further clarification is needed regarding who delivers the music[74], and whether the music genre is critical. The repertoires span Turkish folk and Rast-makam pieces[70], Mandarin songs[75], Western classical and film selections[76] and Chinese five-element relaxation music[77], and the investigators' choices were rarely justified in the trial reports[2,3]. From some detailed evidence, the positive effect appears not to be tied to the matching of music to underlying preferences[78], preferred recorded music did not reduce distress in the trial by Clark et al.[15], and a later genre choice trial reported the same null result[6], in both cases apparently irrespective of music type/genre[79]. It follows that the positive effect of music on the mental health of adults with cancer[33], where present, may be general, not tied to a particular genre or to preference matching, a question that has not yet been addressed directly by any included review. Beneath their apparent agreement on the evidence for creative arts as an intervention, disagreement about music is in fact present among the included reviews. The strongest music claim of the largest review holds only at one time point; in another review the music including subgroup (SMD 0.51) exceeds the non-significant painting-and-writing subgroup (0.09) so clearly that the review's own art therapy discussion becomes misleading; in a third, thirteen music trials are filed under art therapy without separation; and dance is reported as mixed where music and visual art are reported as helpful. Part of this apparent convergence may be explained by our overlap analysis, as the same music trials can be observed multiple times across these reviews (Supplementary Figure 3).

The strongest association in our re-analysis was observed for receptive music and anxiety immediately post-intervention (Table 3). A creative arts intervention session can be accompanied by relieved immediate distress[80], even when broad composite measures of global quality of life remain unchanged. For adults with cancer, the most certain clinical value may therefore center on short-term mental symptom relief.

Music therefore carries most of the weight of this evidence base, in volume as well as in credibility. Receptive music listening is also the format most easily offered around predictable peaks of anxiety, because it needs little equipment and can be provided as recorded material for self-directed use, as in some of the included trials. Its association with anxiety was nonetheless short term, context dependent and estimated against passive controls, and the music subsets for active formats, for depression and for follow-up did not reach statistical significance. Future music trials would add most by testing receptive listening against attention-matched listening controls, by reporting how the music was selected and delivered, and by following participants beyond the immediate session.

3.1 Implications

Many brief, receptive, or self-directed creative arts interventions are considered low burden, relatively inexpensive, and broadly acceptable to adults with cancer, although harms, cost and uptake were not synthesised here. Depending on their aims and clinical settings, these interventions may be delivered by credentialed arts therapists, professional musicians or artists, or by clinical research staff with appropriate training. Brief creative arts interventions, and receptive music listening in particular, may be considered as a low-burden option and adjunct to standard supportive care around procedural anxiety, especially before or after anxiety provoking clinical contexts such as the infusion suite, or radiotherapy waiting area, when interventions from a variety of creative arts forms may provide comfort and support mental health. Expectations should remain modest, and these interventions may complement evidence based mental health management and standard cancer care.

For implementation, a graded clinical design is indicated by the evidence, one in which intensity increases with clinical need, available resources, and patient preferences. In the simplest design, oncology services can use brief, low-cost creative options as comfort oriented adjuncts around predictable peaks of anxiety. Low burden receptive or self directed activities, including recorded music and simple art materials[81], may be particularly suitable for acute or time limited care. In intermediate designs, facilitated expressive work can be offered to patients who seek deeper mental processing, delivered by trained research staff or clinicians[68,82,83]. At the high intensive designs, care services considering more demanding art, structured art therapy, dance and movement, or music therapy programmes when trained staff, repeated contact, physical readiness, rehabilitation goals, and patient preference support aims extending beyond brief sensory distraction[5,6,15]. Within this graded design, a preference sensitive, intensity matched approach is the point on which the reviews' own implication sections converge[33,44,56,84]. Choice of creative arts interventions can be documented as a core evidence because individual agency may be an important shared process across various modalities of creative arts. Pace, sensory load, movement intensity, individual or group format, artist involvement, and personal or community meaning can then be adjusted to the clinical cancer care context. Alignment with identity, traditions, and lived

experience should also be treated as part of implementation. In parallel, future trials should use credible active comparators to distinguish the contribution of the creative activity from attention, expectation, and structured contact.

A consequential design concern is that nearly all included trials used passive usual care or wait-list controls. The estimated effects to creative arts treatments can hardly be separated from non-specific attention, expectancy, or structured contact, thus adequately powered trials with credible active or attention-matched controls are therefore needed[85]. Routine, equity oriented reporting of sample location and care setting would also help explain the large between-region differences observed in included studies, and support interpretation in relation to the settings in which adults with cancer receive care. Finally, given the distance between the modest estimates reported in this umbrella review, and the larger effects sometimes claimed in individual trials further cautious interpretation, and continued attention to small-study and reporting biases in future syntheses[46].

Many primary trials concluded by calling for larger samples or a definitive Phase III trial or evaluation. From the available review evidence, statistical power appears to be only one part of the design setting in creative arts based interventions. Reviews that examined intervention session dose, number of sessions and programme duration reported no consistent association with the effect. That is, simply enrolling more patients into the prevailing usual care controlled design would mainly add precision to estimates already inflated, although potential expectancy and other sources of bias risk would remain unresolved. Further work may be depend less on sample size alone than on linked commitments, including active or attention-matched control that better balance expectancy and contact, equity oriented reporting of trial location, care setting, and delivery model to help explain the between-region variation observed[27], and the accumulation of adequately controlled evidence, especially dance and movement and for receptive music interventions[86].

Future research may also be supported by treating implementation as part of efficacy evaluation. Reports should be described with sufficient detail, including facilitator qualifications, session duration and dose, setting, degree of personalisation, implementation costs, workforce requirements, patient preferences and any adverse events. A focused set of outcomes would improve interpretability, with primary measures aligned with the processes and the clinical aims that each intervention is expected to influence. Consistent assessment intervals and sufficiently long follow-up periods would allow the durability of early improvements to be examined more carefully. Attention may also be given to subgroup and equity considerations, including tumour type and stage, treatment phase, age, lived experience cultural context[31], caregiver status, disability, and resource availability. Together, these perspectives may allow practicality, accessibility, and clinical value to inform future cancer care service and policy decisions.

Particular priority may be given to the populations that are left thinner by the review literature. Gynaecological cancers are one such group, as trials remain scarce even within the women's-cancers evidence[56]. Advanced disease is another, where the evidence base is shown by a mapping review to be fragmented, so that clinicians cannot yet be told which form, dose or professional support is practicable near the end of life[87]. Informal caregivers form a third group, for whom the available syntheses remain too heterogeneous for a firm claim of efficacy in supporting them[88]. These are not add-on populations. In fact, they are where supportive care is needed most, and where creative arts are most scalable.

3.2 Strengths and limitations

We sought to avoid presenting non-independent estimates as corroboration, and to report the extent of shared evidence transparently. The synthesis combines an assessment of review overlap with a standardised re-analysis of non-overlapping subsets (Fig. 4 and Tables 3–4) and an exploratory random-forest search across fifteen trial characteristics, allowing effect estimates, credibility classifications, and certainty judgements to be considered within a common scale. Transparency was further supported by item-level AMSTAR 2 judgements associated to verbatim quotations (Supplementary Table 3), the study-by-review citation matrix (Table 2) and overlap outputs (Supplementary Table 6), PRIOR reporting (Supplementary Table 2) and robustness scenarios (Supplementary Table 5 and Supplementary Figure 4).

Some limitations should be addressed. The confidence in the reviews was generally rated as low to critically low, thus the synthesis is necessarily narrative. Many of the included reviews were missing registered protocols or exclusion reporting, which limited confidence in the completeness and reproducibility of the available evidence. Evidence for stress and distress outcomes remained particularly limited, as these outcomes were addressed by limited number of reviews and were not formally graded. Interpretation was further complicated by substantial heterogeneity across the underlying studies. Creative arts interventions were delivered through different creative arts sessions, and across varied physical locations and clinical settings, with considerable differences in how interventions were organized and experienced. Baseline characteristics also differed across participant cancer stages, including variation in clinical severity, and contextual conditions at the start of intervention.

3.3 Conclusion

Included systematic reviews overall agree that creative arts interventions are associated with lowered cancer-related anxiety, depression, and stress/distress, with more preliminary effects for quality of life. After deduplication, anxiety is supported as a short-term association for receptive music listening, and depression is weakly supported, by one small visual-art subset only.

The largest single contribution comes from receptive music listening, which was delivered mainly without professional musicians. Receptive music listening is a low-burden option that may be offered as an adjunct around procedural anxiety, although harms, cost and uptake were not synthesised. Adequately powered trials with active comparators, and methodologically complete reviews, are needed before creative arts interventions can be recommended as fully established supportive care.

Creative and participatory arts are supported by this evidence as being associated with meaningful mental relief for adults with cancer, especially when the target is immediate distress such as anxiety[89], and the creative art modality offers agency, expression or regulation[30,31]. A universal arts prescription is not supported by this synthesis, and null results were most often observed between creative arts interventions and outcomes[90]. A culture is needed that builds arts programmes around real clinical needs, specifies their active ingredients, and tests them with outcomes and implementation measures that matter to patients, caregivers, clinicians, and health systems and policymakers. Such an approach respects both the promise in this evidence and the people whose time, energy and trust make the evidence possible.

4 METHODS

4.1 Study design and registration

Abbreviations used in the text, tables and figures are defined in Supplementary Table 1. This umbrella review[35,36] is reported against the PRIOR statement[91] (Supplementary Table 2). This review was registered on PROSPERO (CRD42023440053).

4.2 Search strategy and information sources

The systematic search was conducted on 17 January 2026 in eight digital databases (APA PsycINFO, Campbell Collaboration, Cochrane CENTRAL, EBSCO, Embase, Epistemonikos, PubMed and Web of Science) with no language restriction; the full search strategy for every database is reproduced in the Supplementary Methods. Screening and data appraisal were performed by two reviewers, and a third reviewer was consulted when discrepancies arose. Records were first screened by title and abstract against the eligibility criteria, and potentially eligible reports were then assessed in full text by all three reviewers; the selection process is summarised in Supplementary Figure 1.

4.3 Eligibility of reviews

Eligible reviews were peer-reviewed systematic reviews, with or without meta-analysis, that stated a research question and eligibility criteria, and synthesised controlled primary studies of creative arts interventions (music/music therapy, visual art/art therapy, dance/movement, drama/psychodrama, creative/expressive writing) in adults with cancer with at least one mental health outcome (anxiety, depression, stress/distress, quality of life). Reviews restricted to children or adolescents, to non-cancer populations or to non-arts interventions were excluded. Protocols, scoping, mapping and narrative reviews, umbrella reviews and primary studies were not eligible. Where a review had been updated or reported more than once, the most recent complete version was used.

4.4 Review quality appraisal

Confidence in each included review was appraised with AMSTAR 2[37]. The overall confidence rating (high, moderate, low or critically low) was derived by the standard critical-domain algorithm; item-level judgements were anchored to verbatim quotations from each full text (Supplementary Table 3). Scores from different appraisal instruments were not combined, and no numeric summary score was formed. AMSTAR 2 confidence ratings were carried into the narrative synthesis, so that higher rated reviews were weighted more heavily.

4.5 Primary-study overlap

Study overlap was quantified with the corrected covered area[38] (CCA), overall and pairwise for every review pair; values were interpreted as slight (<5%), moderate (5–10%), high (10–15%) or very high (>15%). The primary analysis was restricted to creative arts studies; a sensitivity analysis collapsed companion reports of the same cohort to a single study. Because an aggregate CCA can conceal locally concentrated redundancy, we also report the distribution of pairwise values and, for each review, the proportion of its cited trials unique to it. Overlap was displayed as a unique-versus-shared contribution plot and a pairwise heatmap (Supplementary Figures 2 and 3).

4.6 Data analysis of evidence

Within each non-overlapping subset, every unique trial contributed one effect. Where a trial offered several eligible effects for one subset, the effect from the largest analysed sample was carried forward, with established instruments preferred as the tie-break. Effects were expressed as Hedges g[92,93] and oriented such that positive values indicated greater improvement associated with creative arts interventions. Anticipating methodological and clinical heterogeneity among the underlying trials, every subset with at least three trials was pooled with inverse-variance random-effects models[93], with the between-study variance τ^2 estimated by restricted maximum likelihood (metafor[93]). Heterogeneity was tested with Cochran's Q and summarised with I^2, and each pooled result is reported with k, N, the estimate, its 95% confidence interval and p value. To express where the effect of a future trial would be expected to fall, a 95% prediction interval (t distribution, $k-2$ degrees of freedom)[94] accompanies every random-effects estimate. Small-study effects were evaluated with Egger's regression asymmetry test[46], and were considered

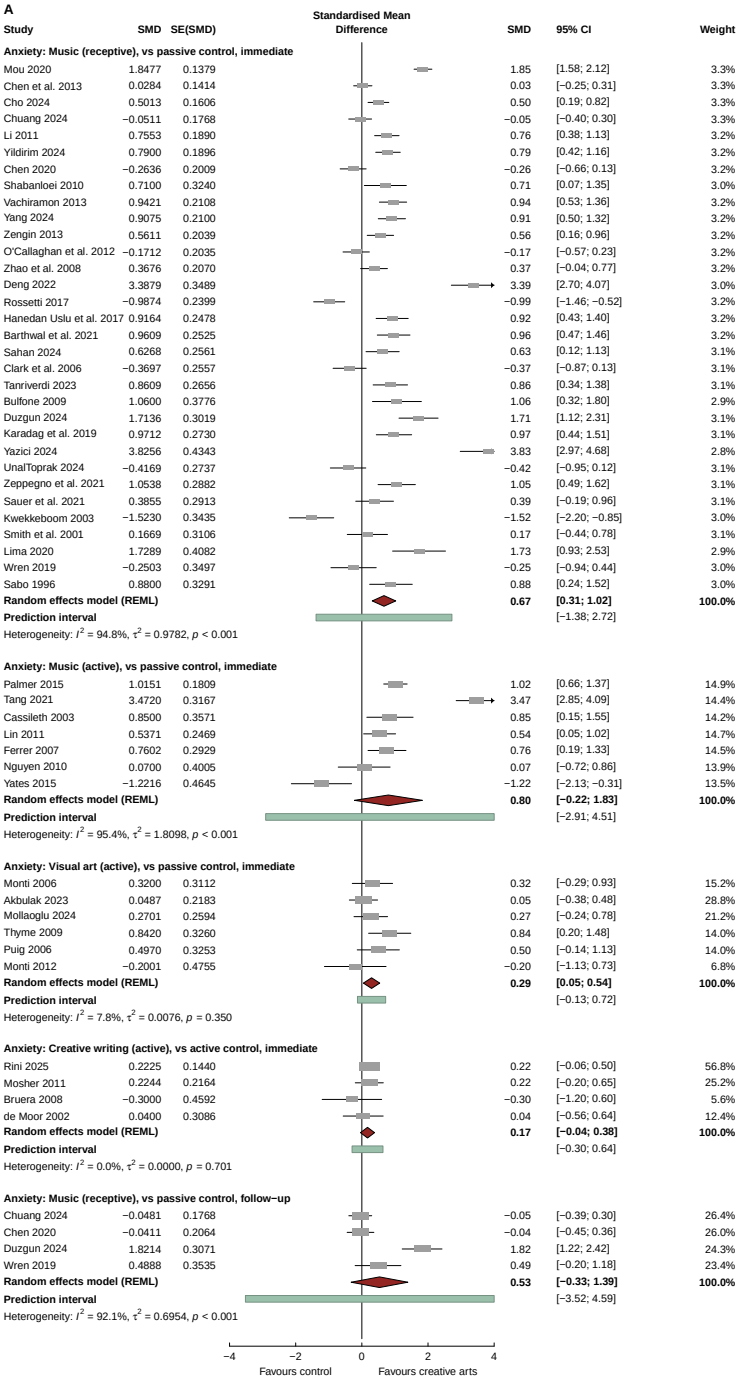


Figure 5. Standardised re-analysis of the non-overlapping evidence, trial level. Each block is one estimable subset (outcome, art modality and format, comparator, assessment time), with every contributing randomised trial, the subset random-effects estimate (diamond), its 95% prediction interval (shaded bar) and heterogeneity. No estimate is pooled across subsets. Hedges $g > 0$ denotes greater improvement with creative arts. Panel A, anxiety subsets. Panel B (next page), depression and quality-of-life subsets.

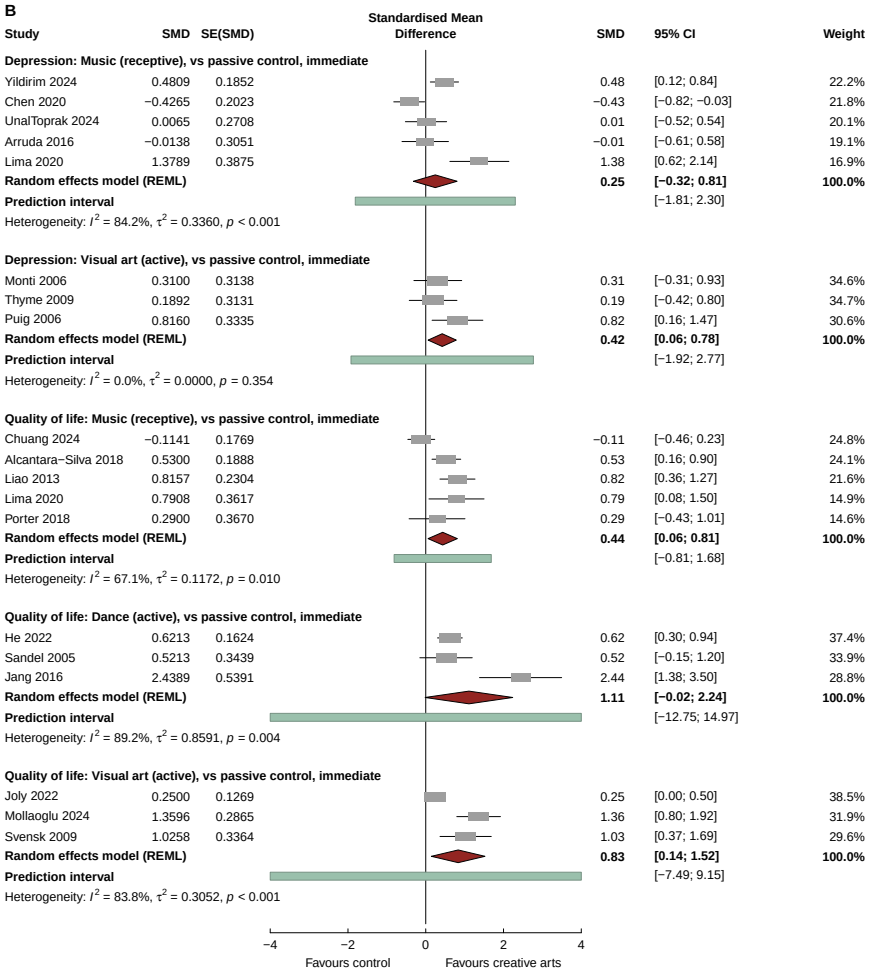


Figure 5 – *continued* Panel B, depression and quality-of-life subsets.

present when the Egger p value was ≤0.10 and the largest trial gave a more conservative estimate than the pool. Excess significance[47] was assessed by comparing the observed number of nominally significant trials (O, $p < 0.05$) with the number expected (E), obtained by summing the statistical power of every trial in the subset computed at the effect of its largest trial, and was considered present when O exceeded E with $p \leq 0.10$; both diagnostics were run only in subsets with at least ten trials and are otherwise reported as not assessable. The credibility of each pooled association was then classified with umbrella-review criteria[35]. Convincing (Class I) required $p < 10^{-6}$, more than 1,000 participants, low or moderate heterogeneity ($I^2 < 50\%$), a 95% prediction interval excluding the null, a nominally significant largest trial, and assessable diagnostics indicating neither small-study effects nor excess significance; highly suggestive (Class II) required $p < 10^{-6}$, more than 1,000 participants and a nominally significant largest trial; suggestive (Class III) required $p < 0.001$ and more than 1,000 participants; weak (Class IV) required $p < 0.05$; associations with larger p values were classified as not significant, and the criterion-by-criterion trail is retained.

4.7 Exploratory analysis of heterogeneity

Because the stratified re-analysis conditions on five design factors and still leaves most of the between-trial variance unexplained, the sources of that variance were explored with MetaForest[95], a random-forest adaptation for meta-analytic data that ranks a larger set of candidate moderators than a conventional meta-regression can carry at this number of trials. The de-duplicated randomised trials contributed one largest-sample effect per trial and outcome, and fifteen pre-specified moderators were entered, namely outcome domain, art modality, format, comparator, assessment time, number of sessions, session length, programme duration, total dose, region, acute or course setting, mean age, proportion of women, publication year and pilot design. Because effects were nested within trials, a clustered forest

was grown with the trial as the clustering unit, moderators were preselected by a 100-replication recursive algorithm, tuning parameters were chosen by ten-fold cross-validation with folds formed by trial, and predictive performance was summarised as the out-of-bag R^2 together with the between-trial variance before and after the forest. MetaForest yields no confidence intervals or tests. Fourteen of the retained moderators, describing participants, interventions, comparators, outcomes, timing, publication year and design, were therefore examined afterwards in a three-level meta-regression with cluster-robust standard errors[96,97] and Benjamini–Hochberg control of the false discovery rate at 10%. The pooled estimates in Tables 3–4 were not altered by this analysis. As a further sensitivity analysis, the anxiety and depression effects of the trials reporting both outcomes were modelled jointly in a bivariate random-effects model with 95% confidence and prediction regions, under assumed within-trial correlations of 0.3, 0.5 and 0.7 (Supplementary Methods).

4.8 Certainty assessment

Two distinct constructs were reported separately, certainty as reported by the included reviews (extracted verbatim), and confidence in the conduct of each review (AMSTAR 2)[37]. We did not re-grade other authors' estimated effects, and no composite grade was formed. For the ten subsets of the standardised re-analysis, a provisional outcome-level certainty was assigned with the GRADE approach[98] by one reviewer using a rule-based algorithm (Table 4). Randomised evidence started at high certainty and was downgraded by one level for risk of bias in every subset, because participants could not be blinded and outcomes were self-reported, by one level for inconsistency when I^2 was 50% or more, by one level for imprecision when the subset included fewer than 400 participants or its 95% confidence interval included no effect, and by one level for publication bias when small-study effects were detected. Indirectness was not downgraded because each subset was specific to outcome, modality, comparator and time point, and the lowest rating was very low.

4.9 Risk of bias in the primary trials

Risk of bias in the underlying trials was not re-assessed. It is reported as each review assessed it, with the instrument named (RoB 2[99], ROBINS-I[100], the earlier Cochrane tool[40], the JBI checklists, or GRADE with a fidelity checklist), together with that review's overall verdict. Outcome assessment in creative arts trials is rarely blinded. Usually participants are necessarily aware of a creative arts intervention, and most outcomes are self-reported, thus the blinding related factors were expected to dominate the reviews' judgements, and they may well have.

4.10 Software

Statistical analyses used R 4.6.0 with ggplot2 4.0.3, and metafor 5.0.1[93]. The exploratory analyses used metaforest 0.1.5[95] and ranger 0.18.0.

DATA AVAILABILITY

The data supporting the findings of this study are the published systematic reviews and the trials they include, all of which are cited in the reference list and the Supplementary Information. No new data were collected. The study-by-review citation matrix is provided in Table 2. The full extraction data matrix (CSV) is available from the corresponding author on reasonable request by any principal investigator or independent researcher, through the corresponding author's personal Facebook or official institutional WeChat contact only, and the author will be happy to provide information.

CODE AVAILABILITY

No custom software was developed. Analyses used the published R packages named in the Methods, and the analysis scripts are available from the corresponding author on reasonable request, through the corresponding author's personal Facebook or official institutional WeChat contact, and the author will be happy to provide information.

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AUTHOR CONTRIBUTIONS

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Collected the data: All authors.
Contributed data or analysis tools: All authors.
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Wrote the paper: All authors.

COMPETING INTERESTS

The authors declare no competing interests.

GENERATIVE AI STATEMENT

The author(s) declared that Generative AI was not used in the creation of this manuscript.

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