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Art-based interventions for improving anxiety, stress and physiological stress response among students across educational stages: a network meta-analysis providing evidence for campus mental-health practice

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ADMINISTRATIVE INFORMATION

Support - City University of Macau; no additional external research funding.

Review Stage at time of this submission - Data analysis.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202680070

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 17 August 2026 and was last updated on 17 August 2026.

INTRODUCTION

Review question / Objective Participants: Students across all educational stages including primary, secondary, undergraduate and postgraduate students. Interventions: Various art-based interventions including 16 modalities (music therapy, expressive writing, painting-mandala, dance-movement therapy, VR-art interventions etc.). Comparators: Non-art psychological interventions and no-intervention blank control. Outcomes: Primary outcomes: STAI-anxiety, PSS-perceived stress, PHQ-9 depression; secondary outcome: salivary cortisol. Study design: Parallel randomised controlled trials. Objective: To compare relative efficacy of multiple art-based interventions on emotional and physiological-stress outcomes and provide evidence for stratified campus mental-health programmes.

Rationale Campus academic burden causes chronic stress, anxiety and depressive symptoms

among students. Conventional verbal counselling faces barriers such as stigma and insufficient counsellor resources. Art-based therapy provides non-verbal emotional release suitable for student populations. Previous pairwise meta-analyses cannot simultaneously compare multiple art interventions. Existing network meta-analyses seldom combine subjective emotional scales with salivary-cortisol physiological biomarker. This network meta-analysis synthesises direct and indirect evidence of 16 art-based interventions and 5 non-art controls to fill this evidence gap and support stratified mental-health decision-making for schools.

Condition being studied Study focuses on school-student-related psychological distress induced by academic load, including subjective state anxiety, chronic perceived stress and depressive symptoms. These psychological disturbs may trigger over-activation of the hypothalamic-pituitary-adrenal (HPA) axis, reflected by elevated salivary-cortisol level. Persistent distress may impair learning motivation and

increase risk of clinical mood disorders and school dropout among children and adolescents.

METHODS

Search strategy Electronic databases: Cochrane Library (CENTRAL), Web of Science, PubMed, Embase, Medline, ProQuest. Time span: January 2005-April 2026. Four search modules: student participants; traditional and digital art-based interventions; anxiety-depression-perceived-stress outcomes; randomised controlled trial filters. PubMed uses MeSH terms combined with free-text words. Full detailed search strings are provided in supplementary appendix.

Participant or population In-school students covering primary, secondary, undergraduate, master and doctoral educational stages of any age.

Intervention Sixteen categories of art-based interventions: music therapy, expressive-writing therapy, colouring-mandala interventions, dance-movement therapy, drama therapy, cinema therapy, visual-art therapy, integrated performing-arts therapy, culturally-adapted bibliotherapy, mindfulness-based art therapy, neutral clay-manipulating task and four distinct digital-art interventions (DAAI, DGT, VRAT, VRIT).

Comparator Five non-art psychological interventions: cognitive behavioural therapy(CBT), mindfulness-only intervention, progressive muscle relaxation, logical puzzle task, supportive verbal psychotherapy; plus no-intervention blank control.

Study designs to be included Parallel-group randomised controlled trials (RCTs), including multi-arm RCTsExclude non-RCTs, duplicate publications with overlapping samples; studies without complete required outcome data after contacting authors; art intervention not independently defined; trials missing at least one of STAI / PSS / PHQ; composite interventions where art component cannot be separated; participants with severe organic disease or confirmed severe mental disorders.

Eligibility criteria Exclude non-RCTs, duplicate publications with overlapping samples; studies without complete required outcome data after contacting authors; art intervention not independently defined; trials missing at least one of STAI / PSS / PHQ; composite interventions where art component cannot be separated; participants with severe organic disease or confirmed severe mental disorders.

Information sources Six main English electronic bibliographic databases (Cochrane Library, Web of Science, PubMed, Embase, Medline, ProQuest). Reference lists of included papers and relevant systematic reviews were screened. We attempted to contact original study authors for missing outcome data. Grey literature and trial registries were not searched.Six main English electronic bibliographic databases (Cochrane Library, Web of Science, PubMed, Embase, Medline, ProQuest). Reference lists of included papers and relevant systematic reviews were screened. We attempted to contact original study authors for missing outcome data. Grey literature and trial registries were not searched

① State-Trait Anxiety Inventory (STAI) score for anxiety;

② Perceived Stress Scale (PSS) score for perceived stress;

③ Patient Health Questionnaire (PHQ) score for depressive symptoms.

Outcomes measured at post-intervention. Effect size: standardised mean difference (SMD) with 95% confidence intervals.

Main outcome(s) ① State-Trait Anxiety Inventory (STAI) score for anxiety;

② Perceived Stress Scale (PSS) score for perceived stress;

③ Patient Health Questionnaire (PHQ) score for depressive symptoms.

Outcomes measured at post-intervention. Effect size: standardised mean difference (SMD) with 95% confidence intervals.

Additional outcome(s) Salivary-cortisol concentration reflecting physiological HPA-axis stress response measured after intervention, treated as secondary biomarker outcome.

Data management Literature imported into EndNote for deduplication. Two independent reviewers performed title-abstract screening and full-text assessment. Disagreements resolved by a third senior reviewer. Standardised data-extraction form was used to collect publication metadata, participant characteristics, intervention parameters and outcome effect sizes.

Quality assessment / Risk of bias analysis

Risk-of-bias assessment using Cochrane risk-of-bias tool for RCTs. Six domains: random sequence generation, allocation concealment, blinding of participants-personnel, blinding of outcome assessment, incomplete outcome data, selective reporting and other bias. Each domain

judged as low / high / unclear risk by two independent raters; conflicts arbitrated by third reviewer.

Strategy of data synthesis Frequentist random-effects network-meta-analysis performed via Stata 18.0 and RevMan5.4. SMD and 95%CI as effect sizes. Global consistency test and node-splitting local inconsistency test to evaluate direct-indirect evidence inconsistency. SUCRA for probabilistic ranking of intervention performance. Comparison-adjusted funnel plot for qualitative small-study-effect evaluation; Egger test was not performed.

Subgroup analysis No pre-specified subgroup analyses were performed in this review, due to high heterogeneity of intervention duration, frequency and limited number of primary studies for stratified grouping. Subgroup exploration is suggested for future primary research.

Sensitivity analysis No formal sensitivity analysis was pre-planned and conducted. We evaluated consistency of network evidence via global consistency and node-splitting test to assess robustness of network meta-analysis outputs.

Language restriction No language restrictions were applied.

Country(ies) involved China.

Other relevant information This is retrospective INPLASY registration. PRISMA-NMA reporting guideline was followed for this network-meta-analysis manuscript. No prospective public review protocol had been registered before starting work. Supplementary materials contain full search strings, baseline table of included RCTs, figures of network plots, risk-of-bias plots, SUCRA scatter plots and funnel plots.

Keywords art-based therapy; students; anxiety; perceived stress; depression; salivary cortisol; network meta-analysis; mental health.

Dissemination plans Manuscript will be submitted to peer-reviewed academic journal. Findings will also be shared in academic conferences for school-mental-health researchers. Raw analysis outputs and supplementary materials will be attached as appendix of the final paper.

Contributions of each author

Author 1 - Yu Min - performed literature screening, data extraction, bias-risk assessment, statistical analysis and drafted the full manuscript.

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Author 2 - Guoxun Wen - Supervised this research, revised manuscript and provided critical intellectual feedback.

Author 3 - Wang Zi - assisted literature retrieval, preliminary screening of studies and manuscript polishing.