International Platform of Registered Systematic Review and Meta-analysis Protocols

INPLASY

INPLASY202690131

doi: 10.37766/inplasy2026.9.0131

Received: 30 September 2026

Published: 30 September 2026

Corresponding author:
Qinwei Zhang

libin.upm0319@gmail.com

Author Affiliation:
Universiti Putra Malaysia, Malaysia.

Effects of Natural Environment Interventions on Depression and Anxiety in Older Adults: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Li, B; Hou, Y; Han, Y; Shi, R; Zhang, Q.

ADMINISTRATIVE INFORMATION

Support - This review received no specific financial support.

Review Stage at time of this submission - Data analysis.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202690131

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 30 September 2026 and was last updated on 9 November 2026.

INTRODUCTION

Review question / Objective This systematic review and meta-analysis aims to evaluate the effects of natural environment interventions on depression and anxiety among older adults. The review focuses on randomized controlled trials involving older adults who receive real or virtual natural environment interventions, compared with control conditions without natural environment exposure. The primary outcomes are depressive and anxiety symptoms measured using validated psychological assessment tools. The review also examines whether intervention type and duration influence the effects of natural environment interventions and evaluates heterogeneity and the robustness of the pooled results.

Condition being studied Depression and anxiety are common mental health problems among older adults and can negatively affect emotional well-being, daily functioning, social participation, and quality of life. Older adults may be particularly vulnerable to depressive and anxiety symptoms due to age-related changes in physical health, chronic disease, reduced mobility, social role transitions, and decreased social participation. This review focuses on depressive and anxiety symptoms in older adults, including symptoms assessed using validated psychological instruments such as the Geriatric Depression Scale, Hamilton Depression Rating Scale, Hospital Anxiety and Depression Scale, State-Trait Anxiety Inventory, and other standardized measures. The review evaluates whether exposure to real or virtual natural environments can reduce these symptoms in older adults.

METHODS

Participant or population The population of interest comprises older adults, as defined by the original studies. Participants may include community-dwelling older adults, nursing home or residential care residents, hospital patients, or other older populations. No specific sex, health status, or residential setting restrictions will be

Li et al. INPLASY protocol 202690131. doi:10.37766/inplasy2026.9.0131 Downloaded from https://inplasy.com/inplasy-2026-9-0131/

applied, provided that participants are clearly identified as older adults in the original randomized controlled trials.

Intervention The interventions of interest are exposures to real or virtual natural environments. Real-world interventions may include park walking, horticultural or gardening activities, forest bathing, forest therapy, rehabilitation gardens, green exercise, plant exposure, and other activities involving direct contact with natural environments. Virtual interventions may include immersive virtual reality, virtual therapeutic gardens, biophilic virtual environments, or other digitally mediated forms of nature exposure. Interventions may involve active or passive exposure and may vary in duration, frequency, and intensity.

Comparator Comparator conditions include no natural environment exposure, usual care, wait-list control, routine activities, standard rehabilitation, social or educational activities, conventional exercise, urban or non-natural environments, and non-biophilic virtual environments. Eligible comparator groups should not receive the natural environment component being evaluated in the intervention group.

Study designs to be included Only randomized controlled trials (RCTs) will be included, including parallel-group RCTs, crossover randomized trials, and cluster-randomized controlled trials. Observational studies, cross-sectional studies, case studies, non-randomized intervention studies, reviews, protocols, conference papers, dissertations, books, and preprints will be excluded.

Eligibility criteria Systematic reviews, review articles, study protocols, conference papers, dissertations, books, preprints, and other non-peer-reviewed publications will be excluded. Studies with insufficient information for eligibility assessment or without accessible full text will also be excluded.

Information sources The following electronic databases will be searched: Web of Science, Scopus, PsycINFO, and PubMed.Reference lists of eligible studies and relevant reviews will also be manually screened to identify additional potentially eligible studies.Grey literature, conference abstracts, dissertations, preprints, and other non-peer-reviewed sources will not be included.

Main outcome(s) The primary outcomes are depressive symptoms and anxiety symptoms in older adults. Outcomes will be assessed using validated psychological instruments, including the Geriatric Depression Scale (GDS), Hamilton Depression Rating Scale (HAM-D), Hospital Anxiety and Depression Scale (HADS), State-Trait Anxiety Inventory (STAI), Hamilton Anxiety Rating Scale (HAM-A), Self-Rating Anxiety Scale (SAS), DASS-21, and other validated measures. Post-intervention outcomes will be extracted at the end of the intervention or at the primary post-intervention assessment reported by each study. Because different measurement scales are used across studies, effect sizes will be synthesized using standardized mean differences expressed as Hedges' g with 95% confidence intervals. Negative effect sizes will indicate outcomes favoring the natural environment intervention.

Quality assessment / Risk of bias analysis Methodological quality will be assessed using the QualSyst quality assessment tool for quantitative studies. The tool includes 14 items scored as Yes = 2, Partial = 1, No = 0, or N/A when not applicable. Overall quality scores will be expressed as percentages and classified as strong (>75%), moderate (55%–75%), or weak (<55%).
Risk of bias in randomized controlled trials will be assessed using the Cochrane Risk of Bias 2 (RoB 2) tool. The assessment will cover five domains: randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selection of the reported result. Overall risk of bias will be classified as low risk, some concerns, or high risk. Two reviewers will independently conduct the assessments, and disagreements will be resolved through discussion or consultation with a third reviewer.

Strategy of data synthesis Data will be synthesized using Comprehensive Meta-Analysis Version 3.0 (CMA V3). Because different instruments are used to assess depressive and anxiety symptoms, standardized mean differences (SMDs) will be calculated and expressed as Hedges' g with 95% confidence intervals. Effect directions will be harmonized so that negative values indicate effects favoring the natural environment intervention.
Separate meta-analyses will be conducted for depressive and anxiety symptoms using random-effects models because clinical and methodological heterogeneity is expected across studies. Statistical heterogeneity will be assessed using Cochran's Q test and the I^2 statistic, with $p < 0.05$ considered statistically significant.
Subgroup analyses will be conducted according to intervention form and intervention duration where sufficient data are available. Leave-one-out sensitivity analyses will be performed to examine

Li et al. INPLASY protocol 202690131. doi:10.37766/inplasy2026.9.0131 Downloaded from https://inplasy.com/inplasy-2026-9-0131/

the influence of individual studies on pooled effect estimates and heterogeneity. Publication bias will be explored using funnel plots and Egger's regression test where appropriate. Studies that cannot be quantitatively pooled will be summarized narratively.

Subgroup analysis Subgroup analyses will be conducted, where sufficient data are available, to explore potential sources of heterogeneity in the effects of natural environment interventions on depressive and anxiety symptoms. Subgroups will be defined according to intervention form and intervention duration.
For intervention form, studies will be classified as forest-based interventions, garden or horticultural interventions, and virtual nature interventions. For intervention duration, studies will be classified as short-term interventions (≤4 weeks) and long-term interventions (>4 weeks).
Subgroup analyses will be conducted separately for depressive symptoms and anxiety symptoms. Differences between subgroups will be examined to assess whether intervention characteristics may modify the effects of natural environment interventions.

Sensitivity analysis Sensitivity analyses will be conducted using a leave-one-out approach. Each study will be excluded sequentially, and the pooled effect size and heterogeneity statistics will be recalculated to assess the influence of individual studies on the overall results. Changes in Hedges' g, 95% confidence intervals, statistical significance, and I^2 values will be examined. Sensitivity analyses will be performed separately for depressive symptoms and anxiety symptoms. If the pooled effect remains statistically significant and the direction of effect remains unchanged after excluding individual studies, the findings will be considered robust. Studies that substantially alter the pooled effect estimate or heterogeneity will be identified as potentially influential studies.

Country(ies) involved China, Malaysia, South Korea.

Keywords natural environment; older adults; depression; anxiety; randomized controlled trials; systematic review; meta-analysis.

Contributions of each author
Author 1: Bin Li
Author 2: Yuxin Hou
Author 3: Yan Han
Author 4: Rong Shi
Author 5: Qinwei Zhang

Li et al. INPLASY protocol 202690131. doi:10.37766/inplasy2026.9.0131 Downloaded from https://inplasy.com/inplasy-2026-9-0131/