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Effects of the Virtual Therapeutic Garden on Older Adults' Cognition and Emotion: A Systematic Review

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Mao, FH; Zhang, YF; Zhu, BW.

Corresponding author:

Fang-Han Mao

maofanghan2020@163.com

Author Affiliation:

Macau university of science and technology.

ADMINISTRATIVE INFORMATION**Support** - This research was supported by the Faculty Research Grants funded by Macau University of Science and Technology (No. FRG-24-066-FA).**Review Stage at time of this submission** - Completed but not published.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202570018**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 4 July 2025 and was last updated on 4 July 2025.**INTRODUCTION**

Review question / Objective Among older adults, does exposure to virtual therapeutic garden promote cognitive function and enhance emotional well-being?

PICO Elements:

Population (P): Older adults, regardless of the presence or absence of cognitive or emotional difficulties

Intervention (I): Exposure to virtual healing gardens (e.g., virtual reality-based garden simulations or garden-related therapeutic activities)

Comparison (C): No intervention or traditional indoor activities not involving nature exposure

Outcomes (O): Cognitive function and emotional well-being (e.g., stress reduction, mood improvement, enhancements in memory and attention).

Condition being studied The condition being studied includes cognitive and emotional health

challenges commonly observed in older adults, such as age-related cognitive decline, dementia, depression, and anxiety. This review specifically focuses on older individuals who have limited access to real outdoor natural environments due to physical, mobility, institutional, or environmental barriers—for example, residents in long-term care facilities, nursing homes, or those with mobility impairments. These populations may benefit from alternative interventions such as virtual healing gardens, designed to simulate nature exposure and support psychological and cognitive well-being.

METHODS

Participant or population The population of interest includes older adults (typically aged 60 and above), regardless of clinical diagnosis, who experience cognitive decline, emotional distress (such as anxiety or depression), or age-related functional limitations. This includes those living in

long-term care facilities or nursing homes, as well as individuals with limited physical mobility or environmental access, which prevents them from engaging with real outdoor therapeutic gardens. Both community-dwelling and institutionalized older adults are considered eligible, provided they are involved in studies evaluating the effects of virtual healing garden exposure.

Intervention The interventions of interest include a broad range of garden-based or garden-related activities that are delivered in virtual formats. These may involve simulated garden visits, virtual horticultural activities, therapeutic gardening experiences, Japanese garden scenes, and other interventions featuring immersive or interactive garden environments. Interventions are included if they are designed to promote psychological or cognitive benefits through exposure to virtual representations of natural or garden-like settings.

Comparator Eligible comparators include no intervention, standard care, or conventional indoor activities that do not involve nature or garden-related elements. Examples of acceptable comparators include sedentary leisure activities (e.g., watching television, reading), cognitive games without natural content, or other standard recreational or therapeutic interventions used in institutional or community settings that lack a nature-based component.

Study designs to be included This review will include experimental and quasi-experimental study designs that quantitatively evaluate the effects of virtual garden-based interventions on cognitive and/or emotional outcomes in older adults. Eligible study designs include randomized controlled trials (RCTs), non-randomized controlled trials, controlled before-and-after studies, and pre-post intervention studies with or without comparison groups. Observational studies (e.g., cross-sectional or cohort designs) will be excluded unless they include clear pre- and post-intervention measurements relevant to the outcomes of interest.

Eligibility criteria Studies will be included if they meet the following criteria:

The study population primarily consists of older adults, generally aged 60 years and above. Studies including mixed-age samples will be eligible if the data relevant to older adults are clearly reported or if the average participant age falls within the older adult range.

The study reports quantitative data on relevant outcomes.

The outcomes include measures related to cognitive and/or emotional functioning.

The intervention involves virtual technology and clearly features a therapeutic garden environment or a horticulturally enhanced natural landscape within the virtual setting.

Information sources The following electronic databases will be searched: PubMed, Scopus, and Web of Science. Grey literature will be included by searching ProQuest Dissertations & Theses, Google Scholar, and relevant conference proceedings.

Main outcome(s) The primary outcomes of this review are the effects of virtual garden-based interventions on cognitive and emotional functioning in older adults.

Cognitive outcomes may include measures such as attention, memory, executive function, or global cognition, assessed using standardized tools (e.g., MMSE, MoCA, digit span tasks, Stroop test). Emotional outcomes include changes in anxiety, depression, stress, or overall emotional well-being, measured by validated scales (e.g., Geriatric Depression Scale, State-Trait Anxiety Inventory, PANAS).

Quality assessment / Risk of bias analysis The risk of bias in the included studies will be assessed using standardized tools based on study design. For randomized controlled trials (RCTs), the Cochrane Risk of Bias 2 (RoB 2) tool will be applied. For non-randomized or quasi-experimental studies, the JBI Checklist will be used. Two reviewers will independently assess the quality of each study, and any disagreements will be resolved through discussion or consultation with a third reviewer.

Strategy of data synthesis Due to heterogeneity in outcome measures and assessment tools across the included studies—including four RCTs, one being a secondary analysis—a meta-analysis will not be feasible. A narrative synthesis will be conducted, organized by study design, intervention type, and outcome domains (cognitive and emotional). Results will be compared qualitatively, with attention to the direction and magnitude of effects. Where feasible, effect sizes (e.g., standardized mean differences) will be calculated to aid interpretation, though synthesis will primarily remain descriptive.

Subgroup analysis Given the heterogeneity of outcome measures and study designs, formal statistical subgroup analyses are unlikely to be feasible. However, where possible, findings will be

descriptively compared across subgroups based on study design (e.g., RCT vs. non-RCT), type of virtual garden intervention, and specific intervention features. These may include the presence of therapeutic components such as reminiscence-based design (e.g., culturally familiar landscapes), or psychological frameworks (e.g., use of Erikson's theory). Such characteristics may be linked to variations in emotional or cognitive outcomes and will be explored narratively.

Sensitivity analysis Given that a meta-analysis is not planned due to heterogeneity of outcome measures and intervention characteristics, sensitivity analyses will be limited. However, where feasible, a narrative sensitivity analysis will be conducted to assess the influence of study quality and risk of bias. For example, findings from studies rated as high risk of bias (according to RoB 2 or JBI Checklist) may be compared with those rated as low risk to determine whether study quality affects the consistency of reported outcomes. This approach will help to evaluate the robustness of the overall conclusions.

Country(ies) involved Macau SAR, P. R. China.

Keywords therapeutic garden; virtual nature; virtual reality; cognition; emotion; systematic review.

Contributions of each author

Author 1 - Fang-Han Mao.

Email: maofanghan2020@163.com

Author 2 - Yi-Fan Zhang.

Author 3 - Bo-Wei Zhu.