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Effects of Physical Exercise on Depressive Symptoms in University Students: A Systematic Review and Meta-Analysis

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Corresponding author:
Carlos Poblete

carlos.poblete.aro@gmail.com

Author Affiliation:
17402173-2.

Fuentes-Vargas, N; Quezada-Cornejo, E; Russell-Guzman, J; Espoz-Lazo, S; Ferrero-Hernández, P; Castillo-Paredes, A; Montalva-Valenzuela, F; Poblete-Aro, C.

ADMINISTRATIVE INFORMATION

Support - No support.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 2 October 2025 and was last updated on 2 October 2025.

INTRODUCTION

Review question / Objective To determine the impact of physical exercise on symptoms of depression in university students.

Rationale Depression is one of the most prevalent and disabling mental health disorders worldwide, with university students being particularly vulnerable due to academic stress, life transitions, and psychosocial pressures. Although numerous individual studies have examined the potential benefits of physical exercise on depressive symptoms, the evidence remains heterogeneous regarding the type, intensity, and duration of interventions. Existing reviews often lack focus on the university population specifically or fail to perform meta-analytical synthesis. Therefore, this systematic review and meta-analysis aims to consolidate and analyze the available evidence on the effects of physical exercise on depression in university students, addressing a critical gap in the literature and providing evidence-based recommendations for non-pharmacological mental health strategies in higher education settings.

Condition being studied Major depressive disorder (MDD) and depressive symptoms in university students. Depression is a common, recurrent, and disabling mental health condition characterized by persistent low mood, anhedonia, cognitive impairments, and functional limitations. This review focuses on the impact of physical exercise interventions on depressive symptomatology in individuals enrolled in higher education, a population at increased risk due to academic, psychological, and social stressors.

METHODS

Search strategy ("Students" OR "student*" OR "universitari*" OR "university student*") AND ("Universities" OR "universit*" OR "college" OR "higher education") AND ("exercise" OR "resistance training" OR "endurance training" OR "circuit-based training" OR "sport*") AND ("Depression" OR "depression" OR "depressive"

OR "depressive symptoms") AND ("randomized controlled trial").

Participant or population The population included in this review comprises university students aged between 18 and 30 years, of any gender, enrolled in higher education institutions. Studies were included if participants were either diagnosed with depression or assessed using validated depression symptom scales. Participants were excluded if they had comorbid psychiatric disorders (e.g., bipolar disorder, personality disorders) or physical conditions (e.g., cardiovascular, renal, or respiratory diseases) that could limit their ability to perform physical exercise.

Intervention The intervention of interest is physical exercise, defined as planned, structured, and repetitive bodily movement intended to improve or maintain physical fitness. This includes aerobic training, resistance training, Pilates, high-intensity interval training (HIIT), Tai Chi, and exergames. Eligible studies must include a clearly described exercise intervention delivered either in person or online, with a minimum duration of 3 weeks. Interventions must be designed to affect depressive symptoms and must be distinct from general physical activity or non-specific movement.

Comparator Comparators in the included studies were either passive control groups (e.g., no intervention, waitlist, usual lifestyle), or active comparators involving non-exercise interventions such as online cognitive-behavioral therapy (CBT). Some studies also included head-to-head comparisons between different exercise modalities (e.g., vibratory platform vs. strength training, Tai Chi with vs. without mindfulness). This diversity of comparators allows for a nuanced assessment of the specific contribution of physical exercise to depressive symptom improvement, as well as its relative efficacy compared to other mental health strategies.

Study designs to be included Randomized controlled trials (RCTs) and pilot studies with a control group, regardless of blinding. Both parallel-group and crossover designs were eligible, provided they included a comparison group and reported pre- and post-intervention depression outcomes.

Eligibility criteria Studies were eligible for inclusion if they met the following criteria:
Population: University students aged 18–30 years.
Intervention: Structured physical exercise (e.g., aerobic, strength, Pilates, HIIT, Tai Chi, exergames) with a minimum duration of 4 weeks.
Comparator: Passive control (no intervention, waitlist) or active non-exercise interventions (e.g., CBT).
Outcomes: Depression measured using validated instruments (e.g., BDI, DASS-21, SDS, SCL-90).
Study design: Randomized controlled trials (RCTs) or pilot studies with control group.
Language: Articles published in English or Spanish.
Full-text availability: Only studies with accessible full text were included.
Exclusion criteria:
Participants with comorbid severe psychiatric or neurological disorders.Studies lacking a control group or using non-structured physical activity.Observational, cross-sectional, or qualitative studies.Studies with intervention durations shorter than 3 weeks.Non-peer-reviewed sources, dissertations, or conference abstracts.

Information sources Literature exploration was performed on Pubmed, Scopus, and Web of Science databases.

Main outcome(s) The primary outcome is the change in depressive symptoms following a physical exercise intervention, assessed using validated instruments such as the Beck Depression Inventory (BDI), the Depression, Anxiety, and Stress Scale (DASS-21), the Zung Self-Rating Depression Scale (SDS), or the depression subscale of the Symptom Checklist-90-Revised (SCL-90-R). Results are analyzed by comparing pre- and post-intervention scores within and between groups.

Additional outcome(s) Secondary outcomes were selected based on their conceptual and clinical association with depressive symptomatology. These included changes in anxiety and stress levels, as measured by validated tools such as the Depression, Anxiety, and Stress Scale (DASS-21), the Symptom Checklist-90-Revised (SCL-90-R), and the Beck Anxiety Inventory (BAI). Other outcomes considered relevant to the depressive spectrum, such as perceived quality of life (e.g., Nottingham Health Profile – NHP) and physical activity level (e.g., IPAQ-SF), were also included when reported by primary studies. These variables contribute to a broader and more nuanced understanding of the effect of physical exercise on mental health in university students.

Data management After completing the search strategy, all references were imported into Rayyan QCRI for deduplication and blinded screening. Two

independent reviewers screened titles and abstracts, followed by full-text evaluation of potentially eligible studies based on pre-established criteria. Disagreements were resolved through discussion or adjudicated by a third reviewer.

A standardized data extraction form was developed in Excel. The following variables will be extracted: (1) authorship and year of publication; (2) sample characteristics, including total sample size, number of intervention and control groups, and age (mean or range); (3) detailed description of the exercise intervention, including type/model of exercise (e.g., aerobic, strength, mind-body), frequency (sessions per week), duration (minutes per session and total intervention period), software or platform used (if applicable); and (4) primary and secondary outcomes as reported, with corresponding pre- and post-intervention measures.

Quality assessment / Risk of bias analysis Two tools will be used to assess the quality and risk of bias of the included studies. The PEDro scale will be used to evaluate the methodological quality of the trials, focusing on randomization, blinding, and follow-up. Additionally, the Cochrane Risk of Bias 2.0 (RoB 2) tool will be applied to assess bias across five domains: the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Assessments will be conducted independently by two reviewers. Any discrepancies will be resolved through discussion or arbitration by a third reviewer.

Strategy of data synthesis A qualitative synthesis will be conducted for all included studies, summarizing key characteristics in a structured table including author(s), sample size, age range, intervention type, frequency, duration, delivery method, and primary and secondary outcomes. This will allow for a comprehensive overview of study contexts, exercise protocols, and outcome patterns.

A meta-analysis will be conducted for studies that provided sufficient data for statistical pooling. The meta-analysis will compare post-intervention scores in the exercise group versus post-intervention scores in the control group, using standardized mean differences (Hedges' g) with 95% confidence intervals. A random-effects model will be applied to account for clinical and methodological heterogeneity. Heterogeneity will be assessed using I^2 and Cochran's Q test.

All analyses will be performed using the Meta-Analysis module in JAMOVI. Forest plots will illustrate individual and pooled effects, and funnel plots will be used to explore potential publication bias when ≥10 studies are available.

Subgroup analysis If sufficient data are available, subgroup analyses will be conducted to explore potential sources of heterogeneity. Planned subgroups include: (1) exercise modality (aerobic, strength, combined, mind–body); (2) intervention duration (short ≤8 weeks vs. long >8 weeks); (3) frequency of sessions per week; and (4) delivery format (in-person vs. online). These analyses aim to identify whether specific characteristics of the intervention or context are associated with greater improvements in depressive symptoms.

Sensitivity analysis Sensitivity analyses will be conducted to assess the robustness of the meta-analytic findings. These will include the exclusion of studies with low methodological quality (defined as PEDro score ≤4) and those classified as high risk of bias across multiple domains according to the RoB 2 tool.

It is acknowledged that certain structural limitations are inherent to physical exercise interventions. Specifically, blinding of participants and therapists is unfeasible, which systematically reduces PEDro scores despite otherwise rigorous study designs. In the present review, most studies were rated as moderate quality (PEDro 5–6), and none reached full blinding criteria.

Similarly, the use of self-reported depressive symptom questionnaires—common and validated in clinical and psychological research—results in high risk of bias ratings under RoB 2 in the domain of outcome measurement (D4). This domain alone led to a high overall RoB 2 classification in all included studies, despite acceptable performance in other domains.

These intrinsic limitations of the field will be explicitly considered in the interpretation of sensitivity analyses. Any substantial changes in pooled effect sizes following the exclusion of lower-quality or high-risk studies will be reported and discussed accordingly.

Language restriction Studies published in English and Spanish were included.

Country(ies) involved Chile.

Other relevant information This systematic review is being registered retrospectively in

INPLASY, as the review process is already in advanced stages. The research team consists of professionals with clinical and academic experience in physical exercise, mental health, and evidence synthesis.

No external funding was received for this project. All stages of the review—search, screening, data extraction, and quality appraisal—were conducted independently by multiple reviewers using transparent and replicable tools such as Rayyan, PEDro, and RoB 2.

Recognized limitations include the structural impossibility of participant and therapist blinding in exercise interventions, and the reliance on self-reported depressive symptom scales, which may impact risk of bias ratings but reflect real-world practice.

The authors are committed to methodological transparency and plan to submit the final manuscript to an indexed peer-reviewed journal upon completion.

Keywords Depression, Depressive symptoms, Physical exercise, University students, College students.

Dissemination plans The findings of this systematic review will be submitted for publication in a peer-reviewed, indexed journal in the fields of sport sciences, mental health, or rehabilitation.

The authors also plan to disseminate results through presentations at academic conferences and professional seminars related to physical activity and mental health.

Efforts will be made to ensure that the results are accessible to both academic and clinical audiences. Open-access publication will be pursued to maximize visibility and impact.

Contributions of each author

Author 1 - Nicolás Fuentes-Vargas - Conceptualization, Methodology, Literature search and data curation, Study selection and data extraction, Writing – original draft, PEDro scoring.
Email: nicolas.fuentes.v@usach.cl
Author 2 - Esteban Quezada Cornejo - Writing – review & editing, Discussion and critical interpretation, RoB 2 – third reviewer.
Email: estebanquezadaco@santotomas.cl
Author 3 - Javier Russell Guzmán - Writing – review & editing, Discussion and critical interpretation, PEDro – third reviewer.
Email: javierrussellguzman@gmail.com
Author 4 - Claudio Farias Valenzuela - Writing – review & editing, Discussion and critical interpretation.
Email: claudio.farias.v@usach.cl
Author 5 - Paloma Ferrero Hernández - Writing – review & editing, English language review, Discussion and critical interpretation.
Email: paloma.ferrero@usach.cl
Author 6 - Antonio Castillo-Paredes - Writing – review & editing, Discussion and critical interpretation.
Email: antonio.castillo@udla.cl
Author 7 - Felipe Montalva-Valenzuela - Risk of Bias 2 (primary assessment), Writing – review & editing.
Email: fmontalva@docente.ubo.cl
Author 8 - Carlos Poblete Aro - Conceptualization, Methodology, Literature search and data curation, Study selection and data extraction, Writing – original draft, Meta-analysis, Risk of Bias 2 (second reviewer), PEDro scoring (with Nicolás Fuentes-Vargas).
Email: carlos.poblete.aro@gmail.com