

INPLASY

Effects of Sports App-Based Interventions on Physical Fitness Outcomes among Adolescents and University Students: A Systematic Review and Meta-Analysis

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - The review has not yet started.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202620027

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 6 February 2026 and was last updated on 6 February 2026.

INTRODUCTION

Review question / Objective Population (P): Adolescents (generally aged 10–19 years) and university students of any sex, nationality, or educational background.

Intervention (I):

Sports app-based interventions are defined as exercise or physical activity interventions primarily delivered through smartphone or tablet applications, including fitness guidance, training programs, monitoring, or feedback. Interventions may be implemented independently or integrated into physical education or extracurricular exercise programs.

Comparator (C):

Control conditions include traditional physical education, usual practice, no intervention, or alternative non-app-based exercise programs.

Outcomes (O):

Objectively measured physical fitness outcomes, including body mass index, cardiorespiratory fitness (e.g., VO₂max or vital capacity), muscular strength, muscular endurance, and flexibility.

Study design (S):

Randomized controlled trials and non-randomized controlled or quasi-experimental studies with pre- and post-intervention data.

Rationale The use of sports applications has become increasingly common among adolescents and university students, and a growing number of studies have examined their potential role in improving physical fitness. However, existing findings are inconsistent, and the reported effects vary across different populations, intervention formats, and fitness outcomes. Moreover, current evidence has not been systematically synthesized to quantify the overall effects of sports app-based interventions on objectively measured physical fitness indicators. Therefore, a systematic review and meta-analysis is warranted to summarize and evaluate the available evidence, clarify the effectiveness of sports app-based interventions on physical fitness, and provide evidence-based guidance for physical education practice and future research.

Condition being studied Physical fitness refers to a set of attributes related to the ability to perform physical activity and maintain overall physical health. It is commonly conceptualized as a multidimensional construct that includes body composition, cardiorespiratory fitness, muscular strength, muscular endurance, and flexibility. Adequate physical fitness during adolescence and young adulthood is associated with improved health status, reduced risk of chronic diseases, and better functional performance across the lifespan. In recent years, concerns have been raised about declining physical fitness levels among adolescents and university students, highlighting the need for effective and scalable intervention strategies. This review focuses on objectively measured physical fitness outcomes and examines whether sports app-based interventions can effectively improve key components of physical fitness in these populations.

METHODS

Search strategy Electronic databases to be searched will include Web of Science, PubMed, Scopus, and Embase. Additional searches will be conducted in relevant discipline-specific databases where appropriate. Reference lists of included studies and relevant reviews will also be manually screened to identify potentially eligible studies.

The search strategy will combine keywords and controlled vocabulary terms related to sports applications, physical fitness, and the target populations. Key search terms will include combinations of the following concepts:

- (1) sports applications (e.g., “sports app”, “fitness app”, “mobile application”, “exercise app”, “mHealth”);
- (2) physical fitness outcomes (e.g., “physical fitness”, “cardiorespiratory fitness”, “muscular strength”, “muscular endurance”, “flexibility”, “body composition”, “BMI”);
- (3) population characteristics (e.g., “adolescents”, “youth”, “students”, “university students”, “college students”).

Boolean operators (AND, OR) will be used to combine search terms, and database-specific filters will be applied where appropriate. No restrictions will be imposed on publication year at the initial search stage. Only studies published in English will be considered.

Participant or population Adolescents and university students of any sex, nationality, or educational background will be included. Adolescents are individuals aged 10-19 years,

while university students are those enrolled in higher education institutions. No restrictions will be imposed regarding geographic location or baseline physical fitness level.

Intervention Sports app-based interventions will be included. These interventions are defined as exercise or physical activity programs primarily delivered through smartphone or tablet applications, which provide functions such as exercise guidance, training plans, monitoring, or feedback. The sports applications may be used independently by participants or integrated into physical education classes or extracurricular exercise programs. No restrictions will be imposed on the specific type or brand of sports application.

Comparator Comparator conditions will include traditional physical education, usual practice, no intervention, or alternative exercise programs that do not involve the use of sports applications. These comparators represent commonly used control conditions in intervention studies and allow for the evaluation of the independent effects of sports app-based interventions.

Study designs to be included Randomized controlled trials and non-randomized controlled or quasi-experimental studies that evaluate sports app-based interventions and report pre- and post-intervention physical fitness outcomes will be included.

Eligibility criteria Studies will be eligible for inclusion if they are original empirical studies published in peer-reviewed journals and provide sufficient quantitative data to calculate effect sizes. Only studies reporting objectively measured physical fitness outcomes will be included. Studies must provide pre- and post-intervention data for both intervention and comparator groups or sufficient information to derive change scores. Studies will be excluded if they are conference abstracts, editorials, commentaries, protocols, theses, or review articles. Studies that report only self-reported physical activity behaviors without physical fitness outcomes will be excluded. Studies involving multi-component interventions in which the independent effect of sports applications cannot be isolated will also be excluded. Only studies published in English will be considered.

Information sources The primary information sources will include electronic bibliographic databases, namely Web of Science, PubMed, Scopus, and Embase. To ensure comprehensive coverage, the reference lists of all included studies

and relevant systematic reviews will be manually screened to identify additional eligible studies. When necessary, corresponding authors of included studies may be contacted to obtain missing or unclear data required for analysis. No trial registers or grey literature sources will be systematically searched.

Main outcome(s) The primary information sources will include electronic bibliographic databases, namely Web of Science, PubMed, Scopus, and Embase. To ensure comprehensive coverage, reference lists of all included studies and relevant systematic reviews will be manually screened to identify additional eligible articles. Where necessary, corresponding authors of included studies may be contacted to obtain missing or unclear data required for analysis. No trial registers or grey literature sources will be systematically searched.

Additional outcome(s) Additional outcomes will include secondary physical fitness indicators such as muscular strength, muscular endurance, and flexibility, assessed using standardized or validated physical fitness tests. Where available, alternative objective measures of body composition or cardiorespiratory fitness not included as primary outcomes will also be considered. These additional outcomes will be synthesized when sufficient data are available and will be reported descriptively or quantitatively as appropriate.

Data management All records identified through database searches will be imported into reference management software to remove duplicates. Titles and abstracts will be screened independently by two reviewers, followed by full-text assessment for eligibility. Data extraction will be performed using a standardized data extraction form, and extracted data will be stored in electronic spreadsheets for analysis. Any discrepancies will be resolved through discussion or consultation with a third reviewer. All data will be securely stored and backed up throughout the review process.

Quality assessment / Risk of bias analysis The methodological quality and risk of bias of included studies will be assessed independently by two reviewers. Randomized controlled trials will be evaluated using the Cochrane Risk of Bias tool (RoB), while non-randomized or quasi-experimental studies will be assessed using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS) tool. Any disagreements will be resolved through discussion or consultation with a third reviewer. The results of the risk of bias assessment will be considered in the interpretation

of findings and explored through sensitivity analyses where appropriate.

Strategy of data synthesis Quantitative data will be synthesized using meta-analysis when sufficient homogeneity in study design, participants, interventions, and outcomes is present. Effect sizes will be calculated as standardized mean differences (SMDs) with 95% confidence intervals when outcomes are measured using different scales, or as mean differences (MDs) when the same measurement units are used. A random-effects model will be applied to account for between-study heterogeneity.

Statistical heterogeneity will be assessed using the I^2 statistic. Subgroup analyses will be conducted where data permit, based on age group (adolescents vs. university students), intervention duration, and mode of intervention implementation (standalone app-based intervention vs. app-integrated physical education). Sensitivity analyses will be performed by excluding studies with a high risk of bias to evaluate the robustness of the findings.

When meta-analysis is not feasible due to substantial heterogeneity or insufficient data, a narrative synthesis will be provided. Publication bias will be assessed using funnel plots and Egger's test when a sufficient number of studies are available.

Subgroup analysis Subgroup analyses will be conducted when sufficient data are available to explore potential sources of heterogeneity. Planned subgroup analyses include age group (adolescents vs. university students), intervention duration (short-term vs. longer-term interventions), and mode of intervention implementation (standalone sports app-based interventions vs. sports app-integrated physical education). Additional subgroup analyses may be performed based on the type of physical fitness outcome assessed, provided that an adequate number of studies are available for comparison.

Sensitivity analysis Sensitivity analyses will be conducted to assess the robustness of the pooled results. These analyses will include excluding studies judged to be at high risk of bias, removing studies one at a time to evaluate the influence of individual studies on the overall effect estimates, and assessing the impact of alternative analytical decisions where applicable. The consistency of findings across sensitivity analyses will be used to inform the interpretation of results.

Language restriction Only studies published in English will be included.

Country(ies) involved Malaysia.

Other relevant information This systematic review and meta-analysis will be conducted and reported in accordance with the PRISMA guidelines. Any amendments to the protocol after registration will be clearly documented and justified in the final publication. The findings of this review are intended to inform evidence-based physical education practice and future research on sports app-based interventions.

Keywords sports app; physical fitness; adolescents; university students; systematic review; meta-analysis.

Dissemination plans The results of this systematic review and meta-analysis will be disseminated through publication in a peer-reviewed international journal. Findings may also be presented at relevant academic conferences and used to inform future research and evidence-based physical education practice.

Contributions of each author

Author 1 - ZHOU CONG - Author 1 conceived the study, developed the protocol, conducted the literature search, performed study selection and data extraction, assessed risk of bias, conducted data analysis, and drafted the manuscript.

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