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STUDY PROTOCOL

The effectiveness of school-based exercise interventions for low back pain in adolescents: Systematic review protocol

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Abstract

Background: Low back pain (LBP) has emerged as a significant public health issue among adolescents, with lifetime prevalence reaching 40%. Sedentary behaviors, such as excessive screen time, are linked to increased risk, while the school environment offers a strategic setting for early intervention. This systematic review aims to identify the most effective school-based exercise interventions for reducing non-specific LBP in this population. **Methods:** Developed according to PRISMA-P guidelines and registered in PROSPERO (CRD420261297319), this review focuses on non-randomized studies involving adolescents aged 10–19 with non-specific LBP. Primary outcomes include pain intensity measured by validated scales like the Visual Analogue Scale. Electronic searches will be conducted in MEDLINE, PubMed, Scopus, and CENTRAL. Selection, data extraction, and risk of bias assessment (using the ROBINS-I tool) will be performed independently by two reviewers. **Results:** A narrative synthesis will be performed, with potential meta-analysis using a random-effects model if methodological homogeneity is met. **Conclusion:** By synthesizing "real-world" interventions, this review will provide evidence-based guidelines for healthcare and education professionals. Addressing LBP in adolescence serves as a crucial preventive strategy against chronic disability in adulthood.

Keywords: Adolescent health; low back pain; exercise therapy; school health services; systematic review.

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BACKGROUND

Low back pain (LBP) is no longer a condition exclusive to adults, having become a significant public health problem among children and adolescents worldwide. Estimates indicate that the point prevalence of LBP in young people is approximately 12%, with lifetime prevalence reaching 40%[1, 2].

The impact of this condition is not only clinical but also social, as adolescents with persistent low back pain are four times more likely to develop chronic conditions in adulthood, creating a cycle of disability and high costs for healthcare systems[2-4].

Several factors contribute to the onset of LBP in this age group. Recent studies highlight a concerning association between sedentary behavior—specifically excessive screen time and an increased risk of non-specific low back pain. In the Brazilian context, evidence demonstrates that using devices such as smartphones and tablets for more than three hours a day significantly raises the chances of painful episodes, possibly due to the maintenance of poor posture for prolonged periods[5, 6]. In contrast, physical activity has been investigated as a protective or therapeutic factor, although the relationship between activity levels and pain occurrence remains controversial in the literature, varying according to the intensity and type of exercise performed[7].

In this context, the search for effective preventive and therapeutic procedures becomes a priority. Although various exercise-based interventions exist, there is a gap in knowledge regarding which protocols—such as core stabilization exercises, global strengthening, or postural education—offer the best results when applied specifically within the school setting[2, 8, 9]. The school represents a strategic environment for public health interventions, as it allows for reaching a large portion of the youth population during a crucial stage of musculoskeletal development.

Despite the relevance of this topic, the heterogeneity of school-based interventions hinders both clinical and pedagogical decision-making. Therefore, this systematic review aims to synthesize the available evidence to identify the best exercise intervention for reducing low back pain in adolescents within the school environment, providing a foundation for the implementation of more assertive and effective programs.

METHODS

Study Design and Registration

This systematic review protocol was developed in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines. The project is formally registered with the International Prospective Register of Systematic Reviews (PROSPERO) under the identification number CRD420261297319.

Eligibility Criteria

Study selection will be guided by the **PICO** framework:

Population: The review will include adolescents of both sexes, aged between 10 and 19 years, following the World Health Organization definition. Participants must present a clinical complaint of non-specific low back pain (LBP) and be formally enrolled in school settings, including primary, middle, or high school.

Intervention: Exercise-based interventions, including exercise therapy, core strength training, and postural exercises.

Comparator: Studies utilizing placebo, usual care, or health education as a control group will be included.***Comparator:***

***Outcomes**:* The primary outcome is the intensity of low back pain, which must be measured using validated quantitative scales, such as the Visual Analogue Scale (VAS), the Numeric Rating Scale (NRS), or standardized pediatric pain scales.

***Study Design**:* Only non-randomized study types will be included in this review.

Exclusion Criteria

Adolescents with specific spinal pathologies or "red flags," such as spinal fractures, tumors, infections, or inflammatory diseases, will be excluded. Furthermore, individuals with significant structural deformities (e.g., severe idiopathic scoliosis), neurological disorders, or any medical condition contraindicating physical exercise will be ineligible.

Search Strategy

Searches will be conducted without language or date restrictions in the following bibliographic databases: CENTRAL (Cochrane Central Register of Controlled Trials), MEDLINE, PubMed, and Scopus. This strategy will be supplemented by searching for unpublished studies, contacting experts, and performing backward citation searching (reference list checking).

Pubmed: ("Adolescent"[Mesh] OR "Students"[Mesh] OR "Adolescent" OR "Child" OR "Teenager" OR "Student" OR "Young population") AND ("Low Back Pain"[Mesh] OR "Back Pain"[Mesh] OR "Lumbago" OR "Backache" OR "Spine pain") AND ("Exercise"[Mesh] OR "Exercise Therapy"[Mesh] OR "Physical Education and Training"[Mesh] OR "Physical Activity" OR "Physical Education" OR "Strength training" OR "Postural correction" OR "Stabilization" OR "Core")

Scopus: TITLE-ABS-KEY ((adolescent OR child OR teenager OR student OR youth OR "young population") AND ("low back pain" OR "back pain" OR lumbago OR backache OR "spine pain") AND (exercise OR "exercise therapy" OR "physical activity" OR "physical education" OR "strength training" OR "postural correction" OR stabilization OR core))

Selection Process and Data Collection

The selection process will involve two stages: initial screening of titles and abstracts, followed by a full-text review. Both phases will be conducted independently and in a masked (blinded) manner by two researchers, G.M.T. and J.P.R.A.. Any disagreements will be resolved through consensus or by consulting a third reviewer.

Data extraction will follow the same independent and masked dual-review regime involving G.M.T. and J.P.R.A.. Extracted data will include sample characteristics, intervention details (dosage, frequency, and intensity), and pain-related outcomes.

Risk of Bias Assessment

The risk of bias for the included studies will be assessed using the ROBINS-I (*Risk of Bias in Non-randomized Studies of Interventions*) tool. This assessment will be performed independently and in a masked manner by researchers G.M.T. and J.P.R.A..

Data Synthesis

A narrative synthesis of the findings will be performed, structured around the type of intervention and the school setting. If the included studies demonstrate sufficient clinical and methodological homogeneity, a meta-analysis will be conducted using a random-effects model. For continuous outcomes (pain intensity), the Mean Difference (MD) or Standardized Mean Difference (SMD) with 95% Confidence Intervals (CI) will be calculated. Statistical heterogeneity will be assessed using the I^2 statistic, with values above 50% indicating substantial heterogeneity. Quantitative analyses will be performed using R software.

DISCUSSION

This systematic review aims to address a critical issue regarding musculoskeletal health management within the educational system. Although the prevalence of non-specific low back pain in adolescents is high reaching up to 40% there is still a lack of consensus on the most effective exercise protocols for the school environment aimed at preventing this condition. By specifically exploring the school setting, this study moves beyond traditional clinical rehabilitation, examining a context where sedentary behaviors, such as excessive screen time and prolonged sitting, are more prevalent and impactful.

A fundamental contribution of this review will be the identification of the ideal dosage including frequency, intensity, and modality—of physical exercise interventions within the school curriculum. Current literature suggests that while physical activity is generally beneficial, the relationship between specific types of exercises (e.g., core stabilization versus postural education) and pain reduction in adolescents has not yet been fully elucidated. Furthermore, by analyzing non-randomized studies using the ROBINS-I tool, this review will provide a robust synthesis of "real-world" interventions, which are often more representative of diverse school infrastructures than strictly controlled clinical trials.

The results of this research are expected to provide evidence-based guidelines for physical education teachers and healthcare professionals working in school health programs. Addressing low back pain during this developmental stage is not merely about immediate pain relief; it is a preventive strategy against the transition from acute discomfort to chronic disability in adulthood. Ultimately, this systematic review seeks to inform educational policies and public health strategies, advocating for the integration of specific exercise interventions as an essential component of health promotion in adolescence.

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