

Yoga Effects on Quality of Life, Endurance, and Flexibility in Adolescents with Low Back Pain: A Systematic Review

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Abstract

Background: Low back pain (LBP) is increasingly reported among adolescents and may impair physical function, spinal flexibility, muscular endurance, and quality of life. Exercise-based interventions are widely used in conservative management, and yoga has emerged as a promising approach due to its integration of stretching, strengthening, breathing, and relaxation techniques.

Objective: This systematic review aimed to evaluate the effects of yoga exercise on quality of life, muscle endurance, and spinal flexibility in adolescents with LBP.

Methods: A systematic search was conducted in PubMed, Scopus, ScienceDirect, and Google Scholar for studies published between 2020 and 2025. Articles were screened using predefined inclusion and exclusion criteria. Experimental studies involving adolescents with LBP undergoing yoga interventions were included. The selection process followed PRISMA 2020 guidelines. Methodological quality was assessed using the Physiotherapy Evidence Database (PEDro) scale. Due to heterogeneity in interventions and outcomes, a narrative synthesis was performed.

Results: Five experimental studies met the inclusion criteria, comprising randomized controlled trials and quasi-experimental designs. Yoga interventions lasting four to eight weeks were consistently associated with improvements in spinal flexibility, trunk muscle endurance, and health-related quality of life.

Conclusion: Yoga may improve flexibility, muscle endurance, and quality of life in adolescents with LBP. Further high-quality randomized controlled trials are needed to strengthen the evidence.

Keywords

Yoga; Low Back Pain; Adolescents; Quality of Life; Muscle Endurance; Flexibility

Introduction

Low back pain (LBP) is increasingly recognized as a significant musculoskeletal health issue among adolescents. Although traditionally considered a condition affecting adults, growing evidence indicates that LBP frequently occurs during adolescence and may persist into adulthood if not properly managed. Epidemiological studies have reported substantial prevalence rates of LBP among adolescents, particularly during periods of rapid growth and increased academic demands. For example, the prevalence of LBP among adolescent populations has been reported to range widely, with lifetime prevalence estimates reaching up to 80% in some cohorts.¹ Furthermore, pooled prevalence estimates suggest that approximately 42% of adolescent athletes experience LBP within a 12-month period.² These findings highlight the importance of early prevention and management strategies targeting musculoskeletal health during adolescence.

Several factors contribute to the development of LBP in adolescents. Prolonged sitting during school activities, poor ergonomic posture, excessive use of digital devices, and insufficient physical activity have been identified as key contributors.³ In addition, psychosocial and lifestyle factors such as sleep disturbances, psychological stress, and family history of musculoskeletal disorders may further increase the risk of LBP in this population.⁴ The increasing prevalence of sedentary behaviors among adolescents, particularly related to digital technology use, has also been associated with reduced physical fitness and impaired spinal function. These factors collectively contribute to biomechanical stress on the lumbar spine and surrounding musculature, potentially leading to pain and functional limitations.⁵

Beyond physical discomfort, LBP in adolescents may produce multidimensional consequences affecting physical, psychological, and social well-being. Functionally, adolescents experiencing LBP often demonstrate reduced trunk muscle endurance, decreased spinal flexibility, and limitations in daily physical activities.⁶ Reduced flexibility and impaired neuromuscular control may alter spinal biomechanics, which can further increase the risk of recurrent pain episodes.⁷ Additionally, persistent musculoskeletal pain during adolescence may negatively influence academic participation, recreational activities, and psychosocial well-being. Several studies have reported that adolescents with chronic musculoskeletal pain exhibit lower health-related quality of life, including impairments in emotional functioning, social participation, and school performance.⁸ Importantly, early-onset LBP has also been identified as a potential predictor of chronic LBP in adulthood, suggesting long-term health implications if appropriate interventions are not implemented.⁹

Exercise-based interventions are widely recommended as first-line non-pharmacological treatments for managing nonspecific LBP. Among these interventions, yoga has gained considerable attention as a therapeutic exercise modality. Yoga integrates multiple components, including stretching, strengthening, breathing techniques, and relaxation practices. These elements may collectively contribute to improved musculoskeletal function and pain modulation. Physiologically, yoga practice may enhance flexibility of the spinal and paraspinal structures, improve muscular endurance of the trunk stabilizers, and promote neuromuscular

coordination.¹⁰ In addition, the mindfulness and breathing components of yoga may reduce pain perception and psychological stress, thereby contributing to improved overall well-being.¹¹

Previous studies have reported beneficial effects of yoga in individuals with LBP, including reductions in pain intensity, improvements in functional ability, and enhanced quality of life.¹² Systematic reviews and meta-analyses conducted primarily in adult populations have demonstrated moderate evidence supporting yoga as an effective intervention for chronic LBP.⁸ Furthermore, yoga programs have been associated with improvements in spinal flexibility and trunk muscle endurance, both of which are important determinants of functional recovery in individuals with LBP.⁸ Despite these promising findings, most existing studies focus predominantly on adult populations, and evidence specifically addressing adolescents remains limited.

Another limitation in the current literature is the tendency of previous studies to focus primarily on pain outcomes while providing less attention to broader functional outcomes. In adolescents, however, LBP may affect multiple aspects of health simultaneously, including physical performance, musculoskeletal endurance, and quality of life. These outcomes are physiologically interconnected. Reduced spinal flexibility may impair movement efficiency, which can increase muscular fatigue and reduce endurance capacity. Similarly, decreased muscular endurance and persistent discomfort may limit physical activity participation, ultimately affecting overall quality of life. Understanding the relationship among these outcomes is therefore important for developing comprehensive rehabilitation strategies for adolescents with LBP.

To date, few studies have systematically synthesized evidence regarding the combined effects of yoga on quality of life, muscle endurance, and flexibility specifically in adolescent populations with LBP. Existing systematic reviews primarily focus on adult patients or emphasize pain reduction as the primary outcome. Consequently, there remains a lack of consolidated evidence evaluating the broader functional benefits of yoga among adolescents with LBP.

Therefore, the present study aimed to conduct a systematic literature review to synthesize current scientific evidence on the effects of yoga exercise on quality of life, muscle endurance, and flexibility in adolescents with low back pain. By integrating findings from recent experimental studies, this review seeks to provide a clearer understanding of the potential role of yoga as a non-pharmacological intervention for improving musculoskeletal health and functional outcomes in adolescents with LBP.

Methods

This study was conducted as a systematic literature review to synthesize current scientific evidence regarding the effects of yoga exercise on quality of life, muscle endurance, and flexibility among adolescents experiencing low back pain. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines in order to ensure methodological transparency, reproducibility, and comprehensive reporting throughout the review process. The review process consisted of several sequential stages, including identification of relevant studies, screening of titles and abstracts, full-text eligibility assessment, methodological quality appraisal, and synthesis of the findings. Because of substantial heterogeneity across studies in terms of intervention protocols, outcome measures, and study designs, the findings were synthesized using a narrative approach rather than quantitative meta-analysis.

Prior to conducting the literature search, a review protocol was developed to define the research question, eligibility criteria, and methodological procedures used in this study. The protocol followed general methodological recommendations for systematic reviews in health sciences to ensure that the review process was conducted systematically and transparently. However, the protocol was not formally registered in an international database such as PROSPERO. Although protocol registration is recommended to enhance transparency and reduce duplication of systematic reviews, the methodological procedures used in this study were predefined and applied consistently throughout the review process.

The research question guiding this review was formulated using the Population, Intervention, Comparison, and Outcome (PICO) framework in order to ensure a structured and focused evidence synthesis. The population of interest consisted of adolescents aged 12–19 years who experienced low back pain. The intervention evaluated in this review was yoga-based exercise. The comparison condition included no intervention, usual care, or other types of exercise therapy. The outcomes of interest included health-related quality of life, muscle endurance, and spinal flexibility. Based on this framework, the primary research question of this review was whether yoga exercise improves quality of life, muscle endurance, and flexibility among adolescents with low back pain compared with no intervention or other forms of exercise therapy.

A comprehensive literature search was conducted across four electronic databases: PubMed, Scopus, ScienceDirect, and Google Scholar. The search covered publications from January 2020 to March 2025 and combined Medical Subject Headings (MeSH) and free-text keywords related to the population, intervention, and outcomes of interest. The search strategy included the following terms: (“yoga” OR “yoga exercise” OR “yoga intervention”) AND (“low back pain” OR “lumbar pain” OR “nonspecific low back pain”) AND (“adolescent” OR “teenager” OR “youth”) AND (“quality of life” OR “muscle endurance” OR “flexibility”). This search string was adapted for each database as required. All records identified through the database search were imported into Mendeley Reference Manager, which was used to organize citations and remove duplicate records prior to the screening process.

Eligibility criteria were established prior to the screening process in order to ensure consistency and minimize selection bias. Studies were included if they met the following criteria: (1) randomized controlled trials or quasi-experimental studies; (2) participants aged 12–19 years diagnosed with low back pain; (3) studies evaluating yoga-based exercise interventions; (4) studies reporting at least one of the following outcomes: quality of life, muscle endurance, or spinal flexibility; (5) articles published in peer-reviewed journals; and (6) studies available in full-text format in either English or Indonesian. Studies were excluded if they were observational studies without intervention, case reports, case series, review articles, editorials, or conference abstracts. Studies were also excluded if the participants were adults without separate data reported for adolescents or if the intervention did not specifically involve yoga exercise.

The study selection process followed the PRISMA 2020 flow structure. All records identified through the database searches were exported into a reference management system to facilitate the organization of citations and the removal of duplicate records. The screening process consisted of two stages. In the first stage, titles and abstracts were screened to identify potentially relevant studies and to remove articles that were clearly unrelated to the research question. In the second stage, the full texts of potentially eligible articles were retrieved and assessed in detail according to the predefined inclusion and exclusion criteria.

To reduce the risk of selection bias, the screening and eligibility assessment were conducted independently by two reviewers. Any disagreements between reviewers during the screening or eligibility assessment process were resolved through discussion and consensus. If consensus could not be reached, a third reviewer was consulted to make the final decision regarding study inclusion. This process ensured that study selection was conducted systematically and minimized the risk of subjective bias in the inclusion of studies.

Data extraction was performed using a standardized data extraction form developed for this review. The extracted information included the author and year of publication, country in which the study was conducted, study design, sample size, participant characteristics including age range, characteristics of the yoga intervention such as the type of yoga practiced, duration of each session, frequency of sessions per week, and total intervention period, as well as the comparison or control intervention used. Information regarding outcome measures was also extracted, including the instruments used to measure quality of life, muscle endurance, and spinal flexibility. Commonly reported outcome measures included the Oswestry Disability Index (ODI) and Short Form-36 (SF-36) for quality of life and functional status, the Biering–Sorensen Test for trunk muscle endurance, and the Modified Schober Test for lumbar flexibility. The extracted data were organized into a summary table to facilitate comparison across studies and support the narrative synthesis.

The methodological quality of the included studies was assessed using the Physiotherapy Evidence Database (PEDro) scale, which is commonly used to evaluate the internal validity and reporting quality of physiotherapy-related clinical trials. The PEDro scale consists of 11 items assessing methodological criteria such as random allocation, concealed allocation, baseline comparability, blinding of participants and assessors, adequacy of follow-up, and appropriate statistical analysis. Each satisfied criterion receives a score of one point, with the first item not included in the final score, resulting in a maximum possible score of 10. Studies scoring 8–10 were considered to have high methodological quality, scores of 5–7 were categorized as moderate quality, and scores of 4 or below were considered low methodological quality. Quality assessment was conducted independently by two reviewers, and disagreements were resolved through discussion until consensus was reached.

In addition to methodological quality appraisal, potential risk of bias within individual studies was evaluated by considering factors related to participant selection, allocation procedures, blinding, completeness of outcome data, and selective outcome reporting. Particular attention was given to common sources of bias in exercise intervention studies, including performance bias due to lack of participant blinding and attrition bias resulting from incomplete follow-up data. The methodological quality and risk of bias assessments were taken into account when interpreting the strength and reliability of the evidence synthesized in this review.

Due to substantial heterogeneity among the included studies in terms of intervention characteristics, study designs, and outcome measures, statistical pooling through meta-analysis was considered inappropriate. Instead, a narrative synthesis approach was adopted. The narrative synthesis involved grouping the findings according to the primary outcomes evaluated, namely quality of life, muscle endurance, and spinal flexibility. Within each outcome category, results were compared and interpreted based on the direction and magnitude of reported effects, methodological quality of the studies, and the consistency of findings across studies. This approach follows methodological recommendations for systematic reviews when quantitative meta-analysis cannot be conducted due to clinical and methodological heterogeneity across the included studies.

Results

The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) framework to ensure transparent reporting of the identification, screening, eligibility, and inclusion stages. The initial literature search across four electronic databases: PubMed, Scopus, ScienceDirect, and Google Scholar, identified a total of 1,250 records. After removing 350 duplicate records, 900 studies remained for title and abstract screening. During the screening stage, 750 studies were excluded because they did not meet the predefined eligibility criteria. The most common reasons for exclusion included studies unrelated to yoga interventions, studies not involving adolescents with low back pain, and studies using non-experimental designs.

A total of 150 full-text articles were then assessed for eligibility. Following the full-text review, 141 studies were excluded for several reasons, including the absence of yoga-based interventions, outcomes unrelated to quality of life, muscle endurance, or flexibility, observational study designs without intervention, or studies involving adult populations without separate reporting for adolescents. Ultimately, nine studies met all inclusion criteria and were included in the final qualitative synthesis. The detailed study selection process is presented in Figure 1.

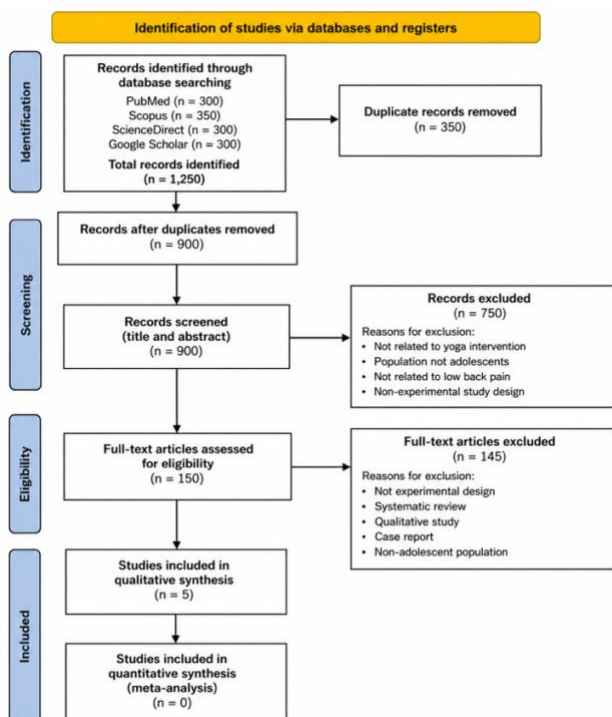


Figure 1. PRISMA Flow Diagram of Study Selection

The nine included studies were conducted in several countries, including Indonesia, India, China, and South Korea. The total number of participants across all studies exceeded 1,200 individuals, with sample sizes ranging from 24 to 500 participants per study. Most studies included adolescents aged 12–19 years, although some studies included late adolescents or young adults, in which case only data relevant to adolescents were considered in the synthesis.

Regarding study design, the included studies consisted of randomized controlled trials (RCTs) and quasi-experimental studies. RCTs represented the majority of the included experimental studies, while several studies used pretest–posttest quasi-experimental designs. The intervention duration ranged from 4 to 8 weeks, with yoga sessions typically conducted two to five times per week.

Most interventions were based on Hatha yoga programs, incorporating a combination of stretching postures, breathing exercises, and relaxation techniques. Several studies also included specific spinal mobility exercises such as Cobra pose and Cat–Cow pose, which are commonly used to improve spinal flexibility and trunk muscle activation.

Outcome measures varied across studies. Quality of life and functional outcomes were commonly measured using the Oswestry Disability Index (ODI) and Short Form-36 (SF-36). Lumbar flexibility was typically assessed using the Modified Schober Test, while trunk muscle endurance was commonly measured using the Biering–Sorensen Test.

Table 1. Characteristics of Included Studies

Author (Year)	Country	Study Design	Sample Size	Participant Age	Yoga Intervention	Duration	Outcome Measures
Kumar & Natarajan (2024) ¹³	India	Quasi-experimental	40	Adolescents	Selected yoga asanas	8 weeks	Lumbar flexibility
Setiani et al. (2025) ¹⁴	Indonesia	Quasi-experimental	23	Adolescents	Yoga with meditation	4 weeks	Quality of life
Atmaja et al. (2024) ¹⁵	Indonesia	Randomized controlled trial	60	Adolescents	Cobra and Cat-Cow poses	8 weeks	Functional outcomes
Lampah et al. (2020) ¹⁶	Indonesia	Pretest-posttest	21	Adolescents	General yoga program	4 weeks	Muscle endurance
Song et al. (2022) ¹⁷	South Korea	Randomized controlled trial	24	Adolescents	Yoga vs stabilization exercise	6 weeks	Pain and flexibility

Overall, the methodological quality of the studies ranged from moderate to high, with scores ranging from 5 to 9 out of 10. Most randomized controlled trials demonstrated adequate methodological quality, particularly in terms of random allocation, baseline comparability, and statistical reporting. However, several methodological limitations were identified across the included studies. Blinding of participants and assessors was rarely implemented, which is common in exercise-based intervention studies. In addition, some studies had relatively small sample sizes and short intervention durations, which may limit the generalizability of the findings.

Several studies reported improvements in quality-of-life following yoga interventions among adolescents with low back pain. Improvements were typically reflected by reductions in disability scores and increases in health-related quality of life measures. Studies using the SF-36 and Oswestry Disability Index reported improvements ranging from 20% to 40% in functional outcomes after yoga-based interventions lasting between 6 and 8 weeks. These findings suggest that yoga may positively influence physical functioning and overall well-being among adolescents with musculoskeletal pain conditions.

Muscle endurance improvements were commonly reported in studies measuring trunk muscle performance using the Biering–Sorensen Test. Several studies demonstrated statistically significant increases in trunk muscle endurance following yoga interventions, with reported improvements ranging between 11% and 43% after 4–8 weeks of training. The observed improvements in muscular endurance are likely associated with the strengthening of trunk stabilizing muscles and improved neuromuscular coordination during yoga practice.

All included studies evaluating spinal flexibility reported improvements following yoga interventions. Flexibility was commonly measured using the Modified Schober Test, which assesses lumbar spine mobility during forward flexion. Across studies, lumbar flexibility improvements ranged from approximately 15% to 35% following yoga training programs lasting several weeks. Specific yoga postures, such as Cat–Cow and Cobra poses, were frequently associated with improvements in spinal mobility and reduction in musculoskeletal stiffness.

Discussion

This systematic review synthesized current evidence regarding the effects of yoga exercise on quality of life, muscle endurance, and flexibility among adolescents experiencing low back pain. Overall, the findings suggest that yoga-based exercise programs may provide beneficial effects across multiple functional domains, particularly spinal flexibility, trunk muscle endurance, and health-related quality of life. Despite variations in study design and intervention protocols, most included studies consistently reported improvements in physical function and reductions in disability following structured yoga interventions.

One of the most consistent findings across the included studies was the improvement in spinal flexibility following yoga practice. Flexibility is an important biomechanical factor associated with the development and persistence of low back pain, particularly in adolescents whose musculoskeletal systems are still undergoing growth and adaptation.¹⁸ Limited spinal mobility may increase mechanical stress on the lumbar structures, including intervertebral discs, ligaments, and surrounding musculature.

Several studies included in this review reported significant improvements in lumbar range of motion after yoga interventions lasting between four and eight weeks.¹⁸ These findings are consistent with previous research indicating that yoga postures emphasizing spinal extension, flexion, and controlled movement patterns may enhance the elasticity of soft tissues surrounding the spine and improve overall spinal mobility.¹⁹

Another important outcome observed in several studies was the improvement in trunk muscle endurance. Adequate endurance of the trunk stabilizing muscles plays a critical role in maintaining spinal stability during daily activities. Reduced endurance of these muscles may lead to fatigue and compromised postural control, which can increase mechanical loading on the lumbar spine.²⁰ Yoga practice involves sustained activation of core stabilizing muscles through static postures and controlled movements.

As a result, regular yoga training may enhance neuromuscular coordination and improve the endurance capacity of the trunk musculature. Improvements in trunk muscle endurance observed in the included studies were commonly measured using the Biering–Sorensen Test, with several studies reporting statistically significant increases after several weeks of intervention.²¹

In addition to improvements in physical function, several studies reported positive effects of yoga on health-related quality of life. Adolescents with chronic musculoskeletal pain often experience limitations not only in physical activities but also in emotional

well-being and social participation. Improvements in quality of life reported in the included studies were typically associated with reductions in pain intensity, improvements in physical functioning, and increased confidence in performing daily activities.²²

These findings suggest that yoga may influence both physical and psychosocial aspects of health. The integration of breathing exercises and relaxation techniques in yoga practice may contribute to reductions in psychological stress and pain perception, which are known to influence overall well-being.¹⁷

The potential mechanisms underlying the beneficial effects of yoga on low back pain are likely multifactorial. From a biomechanical perspective, yoga exercises may improve the flexibility of the paraspinal muscles and surrounding connective tissues, thereby reducing mechanical stiffness and improving spinal mobility.²³ From a neuromuscular perspective, yoga postures require controlled muscle activation and balance, which may enhance proprioception and neuromuscular control. Furthermore, breathing regulation and mindfulness components of yoga may activate parasympathetic responses and reduce central sensitization associated with chronic pain conditions. These combined mechanisms may contribute to both physical and psychological improvements observed in individuals practicing yoga.²⁴

Although the findings of this review suggest promising benefits of yoga for adolescents with low back pain, several methodological limitations should be considered when interpreting the results. One of the main challenges identified in this review was the heterogeneity of the included studies. Differences in study design, intervention protocols, duration of yoga programs, and outcome measures limited the possibility of conducting a quantitative meta-analysis. Some studies implemented structured yoga programs based on Hatha yoga traditions, whereas others used modified exercise protocols incorporating selected yoga postures. These variations make direct comparison across studies difficult and highlight the need for more standardized intervention protocols in future research.

Another limitation concerns the relatively small number of studies focusing specifically on adolescent populations. Although low back pain is increasingly recognized among adolescents, much of the existing literature on yoga interventions for low back pain has been conducted in adult populations. Consequently, some findings reported in the literature may not fully reflect the physiological and developmental characteristics of adolescents. Adolescents differ from adults in terms of musculoskeletal growth, neuromuscular development, and physical activity patterns, which may influence both the causes of low back pain and responses to exercise-based interventions.

Several methodological issues were also observed in the included studies. Blinding of participants and assessors was rarely implemented, which may introduce performance and detection bias. In addition, some studies had relatively small sample sizes, limiting the statistical power of their findings. Short intervention durations were also common, with most studies implementing yoga programs lasting between four and eight weeks. While these durations may be sufficient to observe initial improvements in flexibility or muscle endurance, longer follow-up periods are necessary to determine whether the benefits of yoga are sustained over time. The relatively small number of included studies reflects the limited availability of experimental research focusing specifically on adolescents with low back pain. Nevertheless, restricting the inclusion criteria to experimental designs improves the methodological rigor of this review.

Despite these limitations, this review provides several important implications for clinical practice, particularly in the field of physiotherapy and rehabilitation. Yoga may represent a feasible and accessible non-pharmacological intervention for adolescents experiencing low back pain. Compared with many other exercise-based rehabilitation approaches, yoga requires minimal equipment and can be implemented in various settings, including schools, community centers, and clinical rehabilitation environments. Incorporating yoga into school-based health promotion programs may also help address lifestyle factors associated with low back pain, such as sedentary behavior and poor posture during prolonged sitting.

Future research should aim to address the methodological limitations identified in this review. High-quality randomized controlled trials focusing specifically on adolescents with low back pain are needed to strengthen the evidence base. Future studies should also aim to standardize intervention protocols, including the type of yoga practiced, session frequency, and program duration. In addition, the use of validated outcome measures and longer follow-up periods would help clarify the long-term effectiveness of yoga interventions in this population.

Conclusion

This systematic review synthesized current evidence regarding the effects of yoga exercise on quality of life, muscle endurance, and spinal flexibility among adolescents with low back pain. Overall, the findings indicate that yoga-based exercise programs may contribute to improvements in several functional outcomes relevant to musculoskeletal health. Evidence from the included experimental studies suggests that yoga may improve flexibility, muscle endurance, and quality of life in adolescents with low back pain.

The potential benefits of yoga appear to be related to its combined effects on musculoskeletal function, neuromuscular control, and psychosocial well-being. The integration of stretching, strengthening, breathing regulation, and relaxation techniques may help reduce mechanical stress on the lumbar spine while simultaneously improving physical function and overall well-being in adolescents experiencing low back pain.

However, the strength of the available evidence remains moderate due to several limitations identified in the included studies. These limitations include heterogeneity in intervention protocols, relatively small sample sizes, short intervention durations, and the limited number of studies focusing specifically on adolescent populations. As a result, caution is required when generalizing the findings.

Despite these limitations, yoga may represent a feasible and accessible non-pharmacological intervention that can be incorporated into rehabilitation programs or health promotion initiatives for adolescents with low back pain. Future research should focus on well-designed randomized controlled trials involving adolescent populations, with standardized yoga protocols and longer follow-up periods to better evaluate the long-term effectiveness of yoga-based interventions.

Author Contribution

Nabila Azaria Putri contributed to the study conception and design, literature search, data screening, data extraction, data analysis, and manuscript writing.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This study was conducted as a systematic literature review using previously published studies, and therefore ethical approval was not required. All data used in this study are derived from previously published articles included in the systematic review and are available in the cited sources.

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