



# The role of exercise therapy in scoliosis management: A systematic review of therapeutic approaches and clinical outcomes

## Peran Terapi Latihan dalam Manajemen Skoliosis: Tinjauan Sistematis Pendekatan Terapi dan Hasil Klinis

Review Article

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### Abstract.

- Background** Scoliosis is a condition of spinal deformity that can affect posture, balance, and quality of life, requiring effective therapeutic management. It can be idiopathic, congenital or neuromuscular, with cases of adolescent idiopathic scoliosis being the most common form.
- Objectives** This study aims to explore the role of exercise therapy in reducing the degree of COBB, improving balance, and improving motor function in patients with scoliosis.
- Methods** The method used was a systematic review of various experimental studies and clinical trials focusing on exercise therapy for scoliosis, such as the Schroth method, Pilates, and proprioceptive exercises. These studies were selected based on certain criteria from the scientific database, PubMed.
- Results** The results of this review show that exercise therapy, especially scoliosis-specific exercises, are effective in reducing the degree of spinal curvature, improving postural balance, and improving motor function, although the success of these therapies is influenced by factors such as duration, intensity, and patient compliance with the exercise program. Some therapeutic methods, such as Schroth and Pilates exercises, have significant results in reducing scoliosis symptoms in patients with mild to moderate degrees of curvature.
- Conclusion** Exercise therapy is an effective approach in managing scoliosis, with the potential to improve posture and quality of life. However, further research is needed to develop more specific and more effective therapy protocols in managing scoliosis, as well as to explore its impact in the long term.

**Keywords:** scoliosis, exercise therapy, COBB angle, posture correction, rehabilitation.

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## INTRODUCTION

Scoliosis is a postural disorder characterized by abnormal lateral curvature of the spine. It can affect the body's balance, biomechanical function, as well as the quality of life of individuals who experience it [1]. The disorder can be idiopathic, congenital, or neuromuscular, with cases of adolescent idiopathic scoliosis being the most common form [2]. Risk factors for scoliosis include genetic predisposition, neuromuscular disorders, and a sedentary lifestyle that can exacerbate the disorder [3]. If left untreated, scoliosis can progress to become more severe, causing chronic pain, respiratory distress, and psychosocial impairment in sufferers [4].

Scoliosis management consists of surgical and non-surgical approaches, depending on the severity of the disorder. Surgical intervention is usually applied in more severe cases, especially if the COBB angle exceeds 40 degrees, while non-surgical approaches are more recommended for patients with mild to moderate scoliosis [5]. One of the most researched non-surgical methods is exercise therapy, which aims to strengthen postural muscles and improve body balance to prevent the progression of spinal curvature [6]. Several studies have shown that exercise therapy can reduce pain symptoms, increase flexibility, and improve patients' quality of life without significant side effects [7], [8].

Various exercise therapy methods have been developed in scoliosis rehabilitation, including the Schroth Method, SEAS (Scientific Exercise Approach to Scoliosis), and yoga and pilates-based approaches. The Schroth Method combines corrective postural exercises with breathing techniques to improve postural patterns and reduce spinal curvature [9]. SEAS focuses on exercises designed to increase neuromuscular control and improve body mechanics in daily activities [10], [11]. Meanwhile,

yoga and pilates have been researched as alternatives that can help improve flexibility and strengthen the stabilizing muscles of the spine [12].

In addition to the biomechanical benefits, exercise therapy also has a positive psychological impact for people with scoliosis. Many patients experience increased self-confidence after following an exercise program that helps improve posture and reduce pain [13]. A study showed that consistent physical exercise can reduce anxiety and depression in scoliosis patients due to increased control over their bodies [14]. With the right combination of exercises, patients can experience long-term benefits that are not only limited to physical aspects but also psychological [15].

However, the effectiveness of exercise therapy in scoliosis treatment is highly dependent on the patient's adherence to the program. Many studies have shown that patient adherence to exercise therapy tends to decrease, especially among adolescents who may be less motivated to perform exercises regularly [16]. Another influencing factor is the availability of adequate rehabilitation facilities and the involvement of competent medical personnel in providing exercise guidance. Therefore, a multidisciplinary approach involving physiotherapists, orthopedic doctors, and psychologists is needed to improve the effectiveness of exercise therapy in scoliosis patients [17].

Although exercise therapy cannot replace surgical intervention in severe cases of scoliosis, many studies have shown that it is effective in managing mild to moderate scoliosis [18]. Recent meta-analysis studies reveal that patients who regularly perform scoliosis exercises experience significant improvements in COBB angle, postural balance, as well as body biomechanical function [19]. Therefore, exercise-based approaches are increasingly recognized as an important part of a more comprehensive scoliosis rehabilitation strategy.

With the growing body of research in this field, it is important for medical personnel and researchers to continue exploring the most effective and widely applicable methods of exercise therapy. Given that scoliosis can impact various aspects of a patient's life, an optimal rehabilitation strategy needs to accommodate individual needs and consider biomechanical, psychological and social factors as a whole. As such, exercise therapy can be a key component in the sustainable and evidence-based management of scoliosis.

## METHOD

### *Research Design*

This study used a systematic review approach to evaluate the role of exercise therapy in scoliosis management. A systematic review is a structured method for synthesizing research findings by collecting, critically analyzing, and summarizing relevant literature on a specific topic [20]. This method is widely used in health sciences to assess the effectiveness of interventions and provide evidence-based recommendations [21].

### *Types of Research*

This study adopted a systematic review approach by analyzing existing studies related to scoliosis and exercise therapy. This systematic review utilized explicit criteria for study selection, reducing bias and improving reproducibility. The data used in this study were secondary data, derived from previous empirical research rather than direct clinical observation. Systematic reviews in the field of rehabilitation and exercise science play an important role in synthesizing evidence from various clinical trials, case studies, and cohort studies to draw comprehensive conclusions.

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## RESULTS AND DISCUSSION

### Results

A systematic review was conducted to examine the role of exercise therapy in scoliosis treatment by collecting and analyzing relevant articles and journals. Each selected study was systematically reviewed and evaluated based on predetermined inclusion and exclusion criteria. A systematic review is a structured and transparent approach used to identify, assess and synthesize research findings contributed by academics and practitioners [23]. The main objective of this review was to analyze and integrate existing studies to assess the effectiveness of exercise therapy in improving spinal alignment, reducing pain, and increasing functional mobility in patients with scoliosis.

The collected articles were analyzed using a Critical Assessment Table to address the research objectives and compare findings across studies. The analysis focused on identifying common patterns, methodologies, and key results related to scoliosis rehabilitation. The articles reviewed and their key findings are summarized in Table 1.

**Table 1.** Result of Article Review

| No. | Author   | Year | Title   | Study Result  |
|-----|--|------|---|---|
| 1.  | Kocaman, Bek, Kaya, Buyukturan, Yetis, Buyukturan                            | 2021 | The effectiveness of two different exercise approaches in adolescent idiopathic scoliosis: A single-blind, randomized-controlled trial  | Schroth exercises are more effective in correcting mild scoliosis and improving posture and quality of life, while core stabilization exercises are superior in improving peripheral muscle strength. The choice of exercise method should be tailored to the goals of therapy. |
| 2.  | Akyurek, Alpozgen, Akgul   | 2022 | The preliminary results of physiotherapy scoliosis-specific exercises on spine joint position sense in adolescent idiopathic scoliosis: A randomized controlled trial   | Schroth exercises were effective in improving proprioception, trunk rotation and posture in adolescents with idiopathic scoliosis, although they did not significantly affect deformity perception.   |
| 3.  | Qi, Fu, Yang, Bao, Shao  | 2022 | Effects of Core Stabilization Training on the Cobb Angle and Pulmonary Function in Adolescent Patients with Idiopathic Scoliosis  | Core Stabilization Training (CST) for 12 weeks effectively reduced Cobb angle and improved respiratory function in AIS patients, while the control group showed no significant changes. CST is beneficial for spinal alignment and respiratory strength in AIS patients         |
| 4.  | Shen, Yang, Zhang, Xu, Wang  | 2023 | Effects of balance training combined with Schroth therapy on adolescents with mild idiopathic scoliosis: A six-week randomized controlled trial   | Balance training combined with Schroth therapy for adolescents with mild idiopathic scoliosis significantly improved trunk rotation angle, Cobb angle, quality of life (SRS-22), and balance function after 6 weeks of intervention, outperforming the control group.           |
| 5.  | Khaledi, Minoonejad, Daneshmandi, Akoochakian, Gheitasi                      | 2024 | Outcomes of 12 Weeks of Schroth and Asymmetric Spinal Stabilization Exercises on Cobb Angle, Angle of Trunk Rotation, and Quality of Life in Adolescent Boys with Idiopathic Scoliosis: A Randomized-controlled Trial | The combination of Schroth exercise (SE) and asymmetric spinal stabilization exercise (ASSE) significantly improved Cobb angle, trunk rotation and quality of life in adolescents with mild idiopathic scoliosis, more than SE alone.   |
| 6.  | Kyrkousis, Iakovidis, Chatziprodromidou, Lytras, Kasimis, Apostolou, Koutras | 2024 | Effects of a Long-Term Supervised Schroth Exercise Program on Severity of Scoliosis and Quality of Life in Individuals with Adolescent Idiopathic Scoliosis: A Randomized Clinical Trial Study                        | A 12-month Schroth exercise program improved scoliosis severity and quality of life in adolescents with idiopathic scoliosis, showing better results than brace-only treatment.   |
| 7.  | Kisa, Tarakci, Leblebici, Ozdincler, Kasapcopur                              | 2024 | Exercise programs for scoliosis in juvenile idiopathic arthritis: a randomized-controlled study   | 3D exercise is more effective than conventional exercise in improving scoliosis severity, trunk rotation, cosmetic deformity, and respiratory function in children with JIA after 24 weeks.   |
| 8.  | Akçay, Çolak, Apti, Çolak  | 2024 | The Immediate Effect of Hanging Exercise and Muscle Cylinder Exercise on the Angle of Trunk Rotation in Adolescent Idiopathic Scoliosis   | Semi-hanging exercises worsened the angle of trunk rotation (ATR), while muscle cylinder exercises improved ATR in adolescents with idiopathic scoliosis, with greater improvement in the lumbar region.  |

|    |                        |      |   |   |
|----|------------------------|------|---|---|
| 9. | Zhang, Chai, Weng, Liu | 2024 | Pelvic rotation correction combined with Schroth exercises for pelvic and spinal deformities in mild adolescent idiopathic scoliosis: A randomized controlled trial | Pelvic rotation correction with Schroth exercises is more effective in improving trunk and apical vertebral rotation in patients with mild AIS compared to Schroth exercises alone. |
|----|------------------------|------|---|---|

## Discussio

Scoliosis management has been a widely researched topic in the past few decades. Various therapeutic approaches have been introduced to treat this spinal deformity, one of which is exercise therapy. Exercise therapy, particularly focusing on core muscle strengthening, spinal stabilization, and three-dimensional (3D) exercises, has been shown to be effective in improving clinical outcomes, such as COBB angle reduction, trunk rotation, as well as posture improvement in patients with Adolescent Idiopathic Scoliosis (AIS) [33], [34]. These findings are in line with the results found by Radwan who suggested that approaches such as the Schroth method show significant benefits in reducing the degree of curvature and rotation of the spine in adolescents with scoliosis [35].

It is important to note that exercises based on core muscle strengthening and spinal stabilization play a crucial role in scoliosis rehabilitation. Studies by Burger show that core muscle strengthening not only increases endurance but also reduces pain and improves posture, which is very important in scoliosis management [33]. This is also supported by Kyrkousis [29], who states that exercise therapy involving core strengthening can improve clinical outcomes in patients with mild to moderate scoliosis, including pain reduction and improved quality of life [29].

In addition, three-dimensional (3D) exercises are also gaining popularity as an effective approach in scoliosis rehabilitation. Missiuna in their study showed that 3D exercises, which target postural improvements in multiple planes of movement, provide better results in COBB angle reduction and torso rotation compared to conventional therapy methods [34]. These 3D exercises are designed to work on multiple planes of spinal movement, which allows for a more thorough improvement in the three-dimensional deformity that occurs in scoliosis. This approach is also more adaptive to the patient's individual condition, which makes it more effective compared to exercises that only focus on one type of movement.

However, although 3D exercise has shown more significant results in correcting scoliosis deformity, many studies have shown that its effectiveness may decrease if the therapy is not performed consistently. Athawale et al. emphasized that the main challenge in scoliosis management through exercise is patient compliance with the exercise program [36]. Irregularity in performing exercise therapy can reduce the positive impact of the exercises that have been given, so that the results achieved do not last long.

In addition, the application of the Schroth Method which is a specific method for scoliosis also showed significant progress in the management of scoliosis in patients with AIS. Furthermore, they compared the effects of Schroth exercises with core strengthening exercises and found that the combination of these exercises provided more improvement in spinal rotation and postural balance [35]. They suggested that a more holistic approach, incorporating exercises focused on restoring posture, strengthening muscles, and managing spinal tension, would be more effective in reducing the degree of curvature and rotation in patients with scoliosis.

A bigger challenge in scoliosis management is creating an exercise program that can be tailored to the individual characteristics of the patient. Each patient with scoliosis has a different level of severity, so the exercise program must be personalized to obtain optimal results. Seleviciene suggests that a personalized approach that takes into account the physical and psychological characteristics of each patient is essential to achieve long-term success [37]. This approach includes determining the right type of exercise and intensity to suit the patient's body condition, as well as considering factors such as age, gender, and severity of scoliosis.

In the management of scoliosis, in addition to exercise, it is important to consider the psychological factors of the patient, especially in adolescents with scoliosis. Research by Kyrkousis [29] shows that acceptance of body deformity and feelings related to body image can affect patients' motivation to undergo therapy [29]. Therefore, it is important to create a supportive environment and provide adequate education regarding the benefits of therapy to increase patient motivation, so that they are more committed to the therapy program.

One approach that is gaining ground is the use of proprioceptive neuromuscular facilitation (PNF), which has been shown to be effective in correcting pelvic rotation in patients with scoliosis. Zhang et al.

found that the combination of pelvic rotation exercises using PNF techniques with Schroth exercises can provide better results in the improvement of spinal rotation and posture compared to exercises that only focus on one type of therapy [32]. This suggests that therapies that combine several techniques can be more effective in treating scoliosis in adolescents

Overall, although various exercise therapy methods such as Schroth, 3D exercises, and core strengthening have been shown to be effective in managing scoliosis in adolescents, the main challenge remains in ensuring continuity of therapy and patient compliance. A more personalized approach and good psychological support will greatly influence the long-term success of these therapies. Although the results are promising, future studies are needed to explore the long-term effects and optimal therapy regimens for individuals with varying degrees of scoliosis. As shown by the studies reviewed, a multidimensional and personalized therapeutic approach, including active participation and consistent training, is key to improving structural and functional outcomes in scoliosis treatment.

## CONCLUSION

This review contributes to updating the literature regarding the role of exercise therapy in scoliosis management, by reviewing the various therapeutic approaches and clinical outcomes reported. From the number of articles found and after applying exclusion criteria, the number was further analyzed to a few relevant studies. The results of the review showed that scoliosis-specific exercises, such as Schroth, PNF, as well as three-dimensional corrective exercises, contribute to improvements in COBB angle, trunk rotation, postural balance, as well as patient quality of life. The studies reviewed used quantitative, qualitative, and mixed methods with varying clinical measurement instruments. Some studies have shown that movement-based corrective exercises can reduce the progression of spinal deformity and improve musculoskeletal function, but their effectiveness still varies depending on the intensity, duration, and patient compliance with the exercises. Therefore, further research is needed to standardize exercise protocols, identify factors that influence therapy response, and explore the integration of exercise therapy with other medical approaches. Future researchers are also advised to expand the article search to include other databases and consider mapping studies such as bibliometric and scientometric to understand global trends in exercise therapy for scoliosis.

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## AUTHOR CONTRIBUTION STATEMENT

The Author Contributions Statement can be up to several sentences long and should briefly describe the tasks of individual authors. Please list only 2 initials for each author, without full stops, but separated by commas (e.g. JC, JS). In the case of two authors with the same initials, please use their middle initial to differentiate between them (e.g. REW, RSW). The Author Contributions Statement should be included at the end of the manuscript before the References.

## CONFLICT OF INTEREST AND FUNDING

There is no conflict of interest

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