Perspective Article

Exploring the Effectiveness of Hatha Yoga as a Complementary Treatment for Adolescent Idiopathic Scoliosis: Clinical Effect and Future Research Directions

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Abstract

Adolescent idiopathic scoliosis (AIS) is a common spinal deformity that primarily affects adolescents during the key period of growth and development. While traditional treatment methods often involve bracing or surgery, Hatha yoga, a millennia-old practice rooted in Indian tradition, has emerged as a complementary option for AIS cases. This paper explores the potential benefits of Hatha yoga for adolescents with AIS. It also discusses the limitations of existing research, such as the lack of large-scale randomized controlled trials (RCTs), varying yoga protocols, and challenges in blinding participants and researchers. To address these limitations, I propose future research directions, including conducting large-scale RCTs, long-term follow-up studies, standardized yoga protocols, and assessing safety concerns. I also highlight the need for tailored interventions and comparative effectiveness studies to better understand the potential of Hatha yoga in the holistic treatment of AIS in adolescents.

Keywords: *Adolescent idiopathic scoliosis, hatha yoga, large-scale randomized controlled trials, research standardization*

Introduction

Idiopathic scoliosis is a spinal deformity with unknown etiology and progression mechanism during the growth and development, which is noncongenital scoliosis and susceptible to acquired factors. The most common idiopathic scoliosis is adolescent idiopathic scoliosis (AIS), because the adolescent period is the key period of growth and development, and it is also the high incidence period of scoliosis, among which the high incidence period of males is at the age of 16 years and the highest incidence in females is at the age of 13 years.[1] Moreover, the female-to-male ratio in AIS ranges from 1.5:1 to 3:1. This ratio increases with age, and the prevalence of more severe curvatures is significantly higher in girls than in boys. Specifically, the female-to-male ratio rises from 1.4:1 for curves measuring 10° to 20°, up to 7.2:1 for curves >40°.[2] The common symptoms include uneven shoulders, waist, or hips, and a protrusion of one shoulder blade. If not early detection and intervention in the early and mild period, in the long run with the development of growth and poor posture and habits will increase the degree of scoliosis, will also cause the following effects: Affect the balance of muscles, change the body shape and function, resulting in high and low shoulders, long and short legs, pelvic tilt, shoulder and back uneven, spine deformation, causing shoulder, waist, and back pain. Affect the development of chest and chest, thoracic deformity, squeeze the heart and lung, thereby affecting the heart and lung function, respiratory and digestive system. It affects sleep quality, growth and development, causes mental health problems such as low self-esteem, and reduces quality of life.[3] In view of the harm of AIS, it is necessary for the state, society, schools and parents to pay attention to early detection, and intervention treatment as soon as possible to minimize the harm and impact of scoliosis.

Adam's Forward Bend Test is a clinical examination used to screen for scoliosis or curvature of the spine. During this test, the patient bends forward at the waist, allowing a health-care professional to observe the

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symmetry of the back.[4] Any asymmetry or abnormal spinal curvature becomes more pronounced in this position, making it easier to detect potential scoliosis. Following this initial screening, the grade of spinal scoliosis is usually determined by measuring what is called the "Cobb Angle," which quantifies the degree of scoliosis.[5] The measurement of the Cobb angle involves identifying the top and bottom vertebrae with the most pronounced curvature in the patient's spinal column on a lateral X-ray image. Parallel lines are then drawn along the upper and lower surfaces of these identified vertebrae. The angle where these lines intersect is the Cobb angle. By using a protractor to measure this angle, the extent of spinal curvature can be accurately assessed. A Cobb angle exceeding 10° is generally indicative of spinal scoliosis. In general, the grade of idiopathic scoliosis is classified according to the size of the Cobb Angle, which is usually divided into the following grades: Mild scoliosis: The Cobb Angle is <20°. This is generally considered mild scoliosis and may only require monitoring without aggressive treatment. Moderate side bend: Cobb Angle between 20° and 40°. Moderate scoliosis may require further evaluation and treatment, which usually includes physical therapy, specific exercises, and possible orthotic therapy. Severe lateral bending: Cobb Angle >40°. Severe scoliosis may require more aggressive treatment, including orthotic therapy or surgical intervention.[6]

Hatha Yoga

Hatha yoga, deeply rooted in the Indian tradition, is an ancient system of physical and mental practices with a history spanning 1000 of years. It is one of the most widely practiced forms of yoga globally, named after the Sanskrit words "Ha" (sun) and "Tha" (moon), symbolizing the balance of opposites, a fundamental principle of Hatha yoga. This discipline encompasses various practices designed to harmonize the body, mind, and spirit, focusing on physical strength, flexibility, and balance, as well as mental clarity and inner peace. Hatha yoga combines history, philosophy, asanas (postures), pranayama (breath control), and offers numerous benefits. Central to Hatha yoga is its philosophical foundation, emphasizing the reconciliation of dualities and unity. Hatha yoga offers a wealth of physical, mental, and emotional benefits, including improved flexibility, strength, stress reduction, enhanced focus, balanced energy levels, improved posture, and relief from chronic conditions.[7]

Yoga, increasingly recognized globally as a comprehensive approach to health and well-being, is gaining widespread popularity. This growing adoption has raised awareness about its safety and potential adverse events during practice. Although yoga is commonly viewed as a low-impact, safe activity suitable for individuals of various ages and physical abilities, it's important to have an understanding of the safety aspects of practicing yoga in modern contexts. A study[8] reviewed 301 randomized controlled trials (RCTs) of yoga. The findings indicated that compared to usual care or exercise, yoga did not show differences in the frequency of intervention-related, nonserious, or serious adverse events, nor in dropouts due to adverse events. This review suggests that yoga appears as safe as usual care and exercise, highlighting the importance of adequately reporting safety data in future yoga studies. Another study[9] showed that the incidence proportion of adverse events during a yoga class was 22.7%, the 12-month prevalence was 4.6%, and the lifetime prevalence ranged from 21.3% to 61.8% among yoga practitioners. The most common adverse events related to the musculoskeletal system, primarily sprains and strains. Compared to nonyoga practitioners, yoga practitioners had a comparable risk of falls and falls-related injuries, and a higher risk of meniscus injuries. The study concluded that a considerable proportion of yoga practitioners experienced injuries or other adverse events, but most were mild and transient, and risks were comparable to those of nonyoga practitioners.

Hatha Yoga's Role in Treating Adolescent Idiopathic Scoliosis

Hatha yoga enhances body awareness, posture, and may slow scoliosis progressio. Regular practice increases flexibility and strengthens back muscles, reducing discomfort. Additionally, it aids in managing back pain.[10] A non-RCT[11] enrolled a total of 56 teenagers, with 41 of them participating in exercises such as side-plank, half-moon, and elevated side plank poses, while the remaining 15 teenagers did not partake in these exercises. In the treatment group, there was an average lumbar and thoracolumbar Cobb angle change of −9.2, whereas the control group experienced an average change of 5.4. The mean change in thoracic Cobb angle was −7.1 for the treatment group and 9.3 for the control group. Specific yoga poses, such as the side-plank, half-moon, and elevated side plank, significantly improved lumbar, thoracolumbar, and thoracic Cobb angles in the treatment group compared to controls. Furthermore, Fishman *et al*.[12] enlisted 25 patients diagnosed with idiopathic or degenerative scoliosis, possessing primary curves ranging from 6° to 120° as per the Cobb method. These patients underwent spinal radiographs and received instruction on the side plank pose. Following 1 week of practicing the pose with the convexity facing downward for durations of 10–20 s, they were directed to sustain the posture once daily on that specific side for as long as possible. A subsequent set of spinal radiographs was taken 3–22 months later, allowing for a comparison of Cobb measurements before and after the yoga intervention. The results indicated a noteworthy improvement in the Cobb angle of the primary scoliotic curve, amounting to 32.0% across all patients. Among the 19 compliant patients, the mean improvement

increased to 40.9%. Chen *et al*. team[13] discovered that, in comparison to conventional AIS treatment, core strength training, Physiotherapeutic Scoliosis-Specific Exercise, yoga, Schroth exercises, and the use of a sling collectively resulted in an average reduction of 3.82°, 3.79°, 4.60°, 3.63°, and 3.30°, respectively, in the Cobb Angle. Notably, yoga demonstrated the most significant decrease in the Cobb Angle. Liu *et al*. team[14] selected 24 participants for their study, including 16 male AIS university students and 8 healthy male university students. The 16 AIS patients were randomly divided into a yoga group and a scoliosis control group, while the remaining 8 healthy students formed the normal control group. The yoga group did yoga training 4 times a week for a total of 3 months, while the control group did not have any additional physical training. Before and after the intervention, the researchers compared the thoracic and lumbar Cobb angles of all 24 participants. The study revealed a significant decrease in the thoracic and lumbar Cobb angles in the yoga group after the intervention. A retrospective study[15] revealed that daily practice of yoga movements such as the side plank had a positive impact on 25 patients with AIS with initial Cobb angles <75°. The results showed that after an average of 9.4 months of practice, there was an average improvement of 34.2% in the lumbar/thoracolumbar curves and 20.3% in the thoracic curves of the patients, demonstrating the potential effectiveness of yoga in treating AIS.

Limitations and Future Research Directions of Hatha Yoga in the Treatment of Adolescent Idiopathic Scoliosis

Clinical and research work on the use of Hatha yoga for the treatment of AIS can offer potential benefits, but it also comes with several limitations that need to be considered There is a shortage of large-scale, RCTs specifically focused on the treatment of Hatha yoga for AIS. Most studies in this area are small and lack diverse participant groups, making it difficult to draw definitive conclusions about its effectiveness. The long-term effects of Hatha yoga as a treatment for AIS are not well-established. AIS is a condition that can progress with growth, and it is unclear whether yoga interventions can provide lasting benefits over time. Hatha yoga encompasses a wide range of practices, including postures, breathing techniques, and meditation. The variability in these practices makes it challenging to standardize a yoga intervention for AIS treatment. This lack of standardization can lead to inconsistencies in practice, difficulty in maintaining treatment fidelity in studies, and challenges in determining which specific aspects of yoga are most beneficial for AIS. In addition, compliance among adolescents is a problem. Engaging adolescents in regular yoga practice can be challenging due to varying levels of motivation, interest, and commitment. The poor compliance with yoga practice can significantly affect treatment outcomes, making it difficult to assess the true therapeutic potential of yoga for AIS. Additionally, the time and effort required for regular practice may be a barrier for some adolescents, affecting the feasibility and sustainability of yoga as a long-term treatment approach.

The future clinical research direction for Hatha yoga treatment in AIS should aim to address existing limitations and provide a more comprehensive understanding of its efficacy, safety, and long-term effect. First, large-scale RCTs should be conducted, employing well-designed protocols with a large and diverse population of adolescents with AIS. These trials should compare Hatha yoga interventions to standard treatments or control groups to ensure statistical power and enhance the generalizability of findings. Long-term follow-up studies should also be undertaken to investigate the sustained benefits of yoga interventions, assessing the progression of scoliosis, pain management, and quality of life over several years. Standardized Hatha yoga intervention protocols should be developed and adhered to, encompassing consistent sets of yoga postures, duration, frequency, and intensity, facilitating meaningful cross-study comparisons. In addition, objective outcome measures such as spinal curvature assessments, radiographic imaging, and functional assessments should be incorporated to provide a more accurate evaluation of treatment efficacy. Patient-reported outcomes, including pain levels, quality of life, and psychological well-being, are crucial for assessing the holistic impact of yoga on adolescents with AIS. Safety concerns related to yoga interventions in adolescents, including the risk of injury, should be investigated, and adherence rates should be assessed to determine real-world feasibility. Tailoring interventions to the unique needs of adolescents at different developmental stages and varying degrees of scoliosis severity is essential for determining the most effective approach for different groups. Comparative effectiveness studies should also be conducted to compare Hatha yoga to other nonsurgical treatment options for AIS, such as physical therapy, bracing, or complementary therapies. Additionally, biomechanical studies can provide valuable insights into the effects of yoga on spinal curvature and alignment. Finally, exploring the mind-body aspects of yoga, such as stress reduction, mindfulness, and its potential to enhance coping mechanisms for adolescents dealing with scoliosis, is essential to provide a comprehensive understanding of its holistic impact.

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Conflicts of interest

There are no conflicts of interest.

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