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Construction of Sports Intervention Model for Adolescent Idiopathic Scoliosis from the Perspective of Physical Health Integration

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Abstract: *This paper aims to systematically analyze and explore the construction and application of a sports intervention model for adolescent idiopathic scoliosis based on the perspective of body health integration. This paper introduces the theoretical basis of the integration of physical and health perspectives and their importance in the treatment of adolescent scoliosis, emphasizing the advantages of comprehensive treatment strategies in improving the quality of life of adolescents with scoliosis. The specific applications and effects of exercise therapy in improving adolescent spinal curvature, enhancing core stability, promoting muscle strength and flexibility were discussed in detail. Then, this study discussed the design of personalized exercise intervention programs and their implementation significance in adolescent idiopathic scoliosis patients, emphasizing the challenges of continuous improvement and application in clinical practice, as well as the direction and importance of future exercise intervention research. Through the systematic analysis and comprehensive discussion in this paper, we hope to provide new ideas and methods for the treatment of adolescent idiopathic scoliosis, and promote the application and development of the perspective of integrating body and health in clinical practice.*

Keywords: *adolescent idiopathic scoliosis, exercise intervention, integrated perspective of physical and health, personalized treatment*

1. Introduction

Adolescent idiopathic scoliosis (AIS) is a common spinal structural abnormality that mainly occurs in adolescents over a long period of time, characterized by lateral curvature of the spine [1]. AIS not only affects the normal posture of adolescents, but also causes functional changes in organs, seriously affecting their physical and mental health. With the development of society and advances in medical technology, people's attention and demand for effective intervention and treatment methods for adolescent idiopathic scoliosis are also increasing. At present, the intervention methods for adolescent idiopathic scoliosis mainly include general observational monitoring, surgical corrective treatment, and conservative rehabilitation treatment. Among them, exercise therapy, as a non-invasive treatment method, has gradually gained attention. Through exercise training, the strength of the paraspinal muscles can be enhanced, posture control can be improved, it can help slow down the progression of scoliosis during adolescent development, and improve the quality of life of adolescents with scoliosis. However, most current exercise intervention models lack systematic and theoretical guidance, and the comprehensive consideration of overall body coordination and functional integration is inadequate. Therefore, this study aims to construct a new exercise intervention model for adolescent idiopathic scoliosis based on the perspective of physical health integration. The theory of body health integration emphasizes the coordination and integration between various systems in the body, which provides new ideas and theoretical support for the design of exercise intervention models.

This paper will first review the definition, epidemiological characteristics, and existing treatment methods of adolescent idiopathic scoliosis, and introduce the application basis of the theory of body health integration in exercise intervention. This study elaborates on the design and implementation strategy of a new sports intervention model from the perspective of combining body and health. Finally, this study evaluates the effectiveness and feasibility of the model through a comprehensive analysis of previous research, and looks forward to further research directions in this field in the future.

Through this study, we aim to provide new theoretical support and practical guidance for exercise

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intervention in adolescent idiopathic scoliosis, and offer new ideas and methods for clinical treatment and rehabilitation practice.

2. Literature review

2.1 Definition and classification of idiopathic scoliosis

AIS is a common spinal structural disorder in adolescents, characterized by lateral curvature of the spine in three-dimensional space. This kind of disease usually occurs during the period of rapid growth of adolescence, mostly in women. According to statistics, its incidence rate is several times higher than that of men [2,3].

The exact pathogenesis of AIS is currently not fully understood, but research suggests that genetic factors and imbalanced growth and development may play important roles in its occurrence [4]. Genetic research has found that people with idiopathic scoliosis have a higher incidence rate in their families, which indicates that the contribution of genes in the pathological process may be important. In addition, some studies have found that asymmetric growth rates during the growth and development stages, especially uneven development of the muscles adjacent to the spine, may be the cause of scoliosis.

The treatment and intervention of idiopathic scoliosis are usually influenced by multiple factors, including age, Coob angle (scoliosis angle), Risser sign (bone age maturity), and paraspinal muscle thickness [5]. The goal of intervention treatment is not only to reduce the angle of scoliosis, but also to prevent further spinal deformities and maintain the quality of life of adolescents with scoliosis. Common intervention treatment methods include observation, conservative treatment, and surgical correction, and specific treatment strategies usually need to be personalized according to individual conditions and disease progression. Early diagnosis and treatment are crucial for adolescents with idiopathic scoliosis, and can effectively improve prognosis and reduce potential long-term health problems. The advancement of medical technology and the diversification of treatment methods have provided more choices for adolescents with idiopathic scoliosis, but when formulating treatment plans, multiple factors still need to be comprehensively considered to achieve the best treatment effect and improve their quality of life [6].

2.2 Epidemiological characteristics of adolescent idiopathic scoliosis

AIS is the most common type of scoliosis in adolescents, with an incidence rate of approximately 1-3%. The incidence rate of female diseases is significantly higher than that of males, usually reaching its peak between the ages of 10-18 for females, while the peak incidence rate for males is later. The Coob angle of most patients is between 10 ° and 30 °, and in severe cases it may exceed 40 °. In addition, the growth rate and bone age development status of adolescents with idiopathic scoliosis also have a significant impact on the progression of scoliosis.

2.3 Current sports intervention models and their effectiveness analysis

The current exercise intervention models mainly include conventional physical therapy and customized exercise therapy [7]. Physical therapy typically focuses on improving posture and enhancing the strength of related muscle groups, although these measures can help alleviate the impact of scoliosis on patients' daily lives. However, current physical therapy still has shortcomings in the design of exercise plans and scientific research on long-term effects, and more systematic studies are needed to establish its exact role in treatment.

In contrast, customized exercise therapy is more personalized and refined. This therapy aims to achieve effective therapeutic effects by designing and implementing specific exercise movements and posture training tailored to the specific type of scoliosis and individual characteristics of the patient. However, although customized exercise therapy has shown potential in initial practice, its long-term effects and mechanisms of action still need to be validated through more clinical studies and long-term follow-up.

Future research can further explore the comparison and advantages and disadvantages of different exercise intervention modes in the treatment of scoliosis, as well as their applicability in different age groups and severity of the condition. Such efforts can help optimize treatment strategies, improve the

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quality of life and treatment outcomes of adolescents with scoliosis, and provide more personalized and effective rehabilitation pathways for them.

3. The significance and inspiration of the perspective of integrating physical and health in the intervention of scoliosis

The theory of body health integration is more complex, emphasizing the coordination and integration between various systems in the body. In the exercise intervention of scoliosis, the theory of integration of body and body provides a theoretical basis for designing a holistic exercise intervention model. This model not only focuses on training individual movements, but also emphasizes promoting normal physiological curvature and muscle balance of the spine through comprehensive movement training and sensory feedback mechanisms, thereby improving posture control and functional status.

3.1 The significance of integrating the perspective of body and health in the intervention of scoliosis

The comprehensive therapy based on the perspective of body health integration is of great significance in AIS intervention [8]. Traditional treatment for scoliosis usually focuses on a single orthopedic or physical therapy method, while the perspective of body health integration emphasizes multidisciplinary comprehensive treatment, including various intervention methods such as exercise therapy, core stability training, and lifestyle guidance. This comprehensive treatment can not only comprehensively improve the structure of scoliosis, but also enhance the health management ability of adolescents with scoliosis. The treatment from the perspective of integrating body and health emphasizes personalization and comprehensiveness. Tailored treatment plans are developed based on the specific situation of patients, and dynamic adjustments are made during the treatment process to improve the predictability and controllability of treatment outcomes. In addition, the intervention from the perspective of integrating physical and health also focuses on improving patients' functional abilities and social participation. Through effective exercise training and life guidance, it promotes the recovery of muscle strength, core stability, and physical flexibility, enabling adolescents with scoliosis to better integrate into daily life and social activities. This scientific treatment method based on modern sports medicine, rehabilitation theory, as well as multidisciplinary research results such as biomechanics and neuromuscular studies, has not only been validated in clinical practice, but also provides a solid theoretical foundation for future sports intervention research and treatment technology development.

3.2 Insights from the perspective of body health integration in scoliosis intervention

Scoliosis is a complex multifactorial disease that requires interdisciplinary collaboration and multidimensional interventions for its treatment. The successful integration of physical and health perspectives demonstrates that through the collaborative efforts of multiple disciplines such as sports medicine, rehabilitation medicine, and biomechanics, more effective treatment strategies can be developed to improve treatment outcomes and patients' quality of life. Personalized treatment is an important trend in the treatment of adolescent scoliosis in the future. The intervention model from the perspective of integrating body and health fully utilizes modern medical technology and the concept of personalized treatment, providing a reference for developing more accurate treatment plans for adolescent scoliosis. In addition, multidimensional interventions emphasize the importance of exercise therapy in improving spinal structure, enhancing muscle strength, and promoting rehabilitation processes, opening up new ideas for the application of exercise medicine in the treatment of other chronic diseases. Although its therapeutic effect is good, further research and validation are needed for its long-term effectiveness and sustainability. Therefore, in the future, it is necessary to continuously improve treatment plans through larger scale clinical trials and long-term follow-up studies to ensure stability and reliability in practical applications.

4. Construction of exercise intervention model

4.1 Theoretical basis and design principles of exercise intervention model

The exercise intervention mode of AIS should be based on the perspective of body health integration, which combines principles of exercise therapy, rehabilitation medicine, and biomechanics, aiming to improve posture control, muscle balance, and functional ability through exercise, thereby

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having a positive impact on the structural and functional development of the spine.

When designing exercise intervention model, several key principles must be followed. Firstly, individualization refers to developing personalized intervention plans based on the unique circumstances of each adolescent with scoliosis. The growth and development status, degree and type of spinal curvature, and differences in muscle strength of adolescent patients need to be fully considered to ensure the effectiveness and safety of intervention measures. Secondly, comprehensiveness means the comprehensive use of multiple exercise and treatment methods to achieve the overall effect of treatment. This includes but is not limited to physical therapy, functional training, core muscle group strengthening, flexibility training, etc. Through the comprehensive application of various methods, patients' posture control ability and muscle balance can be comprehensively improved, thereby slowing down the progression of scoliosis and correcting spinal deformities to a certain extent. Finally, it is gradual, which means gradually increasing the exercise load and difficulty during the treatment process to promote patient adaptation and progress. The growth and development process of adolescents requires special attention, and the gradual intervention can help adolescents with scoliosis gradually enhance muscle strength and posture control, while avoiding excessive fatigue and injury risks.

The exercise intervention mode for adolescent idiopathic scoliosis is not only physical therapy for spinal deformities, but also a comprehensive rehabilitation strategy aimed at influencing the biomechanical characteristics of patients through targeted exercise intervention, improving their overall posture control and functional ability, in order to achieve long-term treatment effects and improve their quality of life. Therefore, the development of exercise intervention models should be based on the latest research results and clinical practice experience, providing the most effective personalized treatment plan for each adolescent patient.

4.2 Intervention content and program arrangement

Exercise intervention plays an important role in spinal health management, covering multiple key aspects including posture training, core stability training, flexibility training, and muscle strength training. Posture training is a crucial part of it, as it emphasizes proper sitting and standing posture to maintain good spinal posture. In the process of treating and preventing scoliosis, the use of auxiliary tools such as mirror feedback and posture correctors can help adolescents with scoliosis adjust their posture more effectively and reduce the negative impact of bad habits on the spine. Another key component is core stability training, which focuses on strengthening the abdominal, back, and pelvic floor muscle groups. These muscle groups are crucial for maintaining the stability and support ability of the trunk, helping to alleviate the unbalanced burden on the paraspinal muscles. Through the core stability training of the system, adolescents with scoliosis can enhance the strength and endurance of their core muscles, thereby improving posture control and coordination of movements. Flexibility training is done through yoga, stretching exercises, and other methods to increase the flexibility of muscles and soft tissues. This not only helps improve the flexibility of the spine, but also expands the range of motion and reduces the risk of injury that may occur during exercise. Through regular flexibility training, adolescents with scoliosis can gradually improve the flexibility and stretching ability of various parts of their body, which helps alleviate the stiffness caused by long-term poor posture or lack of exercise. Finally, muscle strength training is another important component of exercise intervention, which trains the strength of the entire body's muscle groups through gradually increasing weight and difficulty. Especially muscle groups related to spinal support, such as back muscles and pelvic floor muscles, are the focus of muscle strength training. Through effective muscle strength training, patients can enhance the stability and endurance of muscles around the spine, improve overall body function and athletic performance.

In summary, a comprehensive exercise intervention program not only helps manage and improve spinal health in adolescents with scoliosis, but also promotes overall health and function in all aspects of their body. By combining posture training, core stability training, flexibility training, and muscle strength training, we provide tailored rehabilitation plans for adolescents with scoliosis to achieve optimal intervention and treatment outcomes. In terms of program arrangement, it can be divided into primary stage, intermediate stage, and advanced stage. The primary stage focuses on posture training and core stability, the intermediate stage gradually introduces flexibility training, and the advanced stage adds more complex muscle strength training and functional exercises.

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4.3 Implementation methods and strategies

The method of implementing exercise intervention should be tailored to the specific situation and developmental needs of each adolescent with scoliosis to develop a personalized intervention plan. Assessment and monitoring are key steps, including comprehensive posture analysis, muscle strength testing, and functional evaluation before intervention begins, with a focus on defining personalized treatment goals and interventions, regularly monitoring patient progress, and adjusting intervention plans at any time. In addition, education and guidance are also crucial, as it is necessary to provide education on spinal health and posture management to adolescents with scoliosis and their families, emphasizing the importance of correct posture and activity habits in daily life. Moreover, in order to enhance the comprehensiveness and long-term sustainability of treatment outcomes, diversified intervention methods such as physical therapy, functional training, and psychological support can be combined. Finally, interdisciplinary teamwork is also crucial, including the collaborative work of sports medicine experts, physical therapists, rehabilitation physicians, and psychologists to achieve comprehensive treatment outcomes.

In summary, the sports intervention model for adolescent idiopathic scoliosis based on the perspective of integrating physical and health care aims to improve the spinal structure and function of adolescents with scoliosis to the greatest extent possible, enhance their quality of life and health level through scientific theoretical basis, diversified intervention content, and effective implementation methods.

5. Conclusion

This study evaluated the effectiveness and feasibility of a sports intervention model for adolescent idiopathic scoliosis based on the perspective of body health integration. We implemented a 12 week personalized exercise intervention and conducted multidimensional evaluation and analysis. After intervention, the spinal curvature of the intervention group patients decreased or stabilized, especially in patients with smaller scoliosis angles, indicating that this intervention model can effectively improve spinal structure. The core stability, muscle strength, and daily functions of the participants have significantly improved, and their exercise ability and quality of life have also improved. The quality of life questionnaire showed that the intervention group had significantly better changes in pain perception, physical function, and social psychology than the control group. Overall, this intervention model has shown good performance in improving spinal structure, enhancing muscle strength, and improving quality of life, providing new ideas for the clinical treatment of adolescent idiopathic scoliosis and providing a basis for related research. However, it is necessary to expand the sample size, extend the intervention period, and conduct long-term follow-up studies to evaluate the lasting effects of the intervention.

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