

# Analysis of Related Influencing Factors and Prevention Strategies for Adolescent Scoliosis

Shuya Liu<sup>1</sup>, Huawei Zhang<sup>2\*</sup>

<sup>1</sup> Shandong Experimental High School International Department, Jinan250109, China

<sup>2</sup> Department of Rehabilitation, Children's Hospital Affiliated to Shandong University (Jinan Children's Hospital), Jinan250022, China

**Abstract:** Background: To explore the related influencing factors and related prevention strategies of adolescent scoliosis. Methods: 46 adolescent scoliosis patients who received medical treatment from June 2021 to August 2024 were selected as the study group, and 60 healthy adolescents (without scoliosis) who underwent physical examination during the same period were selected as the control group. SPSS21.0 software was used to analyze the general data of the two groups of subjects. Then multi-factor Logistics was used to analyze the influencing factors of adolescent scoliosis. Results: The self-requirements of sitting and standing posture, the weight of school bags, vision, daily sleep time, frequency of physical education classes per week, daily daytime outdoor activity time and daily indoor sedentary time were all independent risk factors for adolescent scoliosis. Conclusion: The results showed that the frequency of physical education classes per week, daily daytime outdoor activity time, daily sleep time, vision, the self-requirement of sitting and standing posture, the weight of school bag and daily indoor sedentary time are all independent risk factors for the occurrence of scoliosis in adolescents, which can provide effective intervention measures for the prevention of scoliosis in the future.

**Keywords:** Adolescent scoliosis, Influencing factors, Prevention strategies, Physical examination

## INTRODUCTION

Scoliosis is a kind of spinal deformity caused by lateral curvature of several or one segment of the spine without or accompanied by rotation of the corresponding vertebral body. It is one of the common types of spinal deformity in adolescents. Scoliosis affects the appearance of the patient, and also causes discomfort or pain to the patient's body, which in severe cases leads to abnormal cardiopulmonary function [Wu, et. al., 2021]. With the continuous improvement of people's living standards, scoliosis has received more and more attention in recent years. Survey data show that the detection rate of scoliosis in the Chinese population is relatively high, and the number of scoliosis patients is increasing at the rate of 300,000 / year. In addition, the proportion of adolescents in scoliosis patients is higher than 50%, and the number of scoliosis patients in primary and secondary school students in China is as high as 5 million, with a prevalence rate of 0.11% ~ 2.64% [Tung, et. al., 2018]. Scoliosis has become a serious public health problem faced by primary and secondary school students, which affects the physical beauty and motor function coordination of patients, and also affects the mental health of patients [Ren, et. al., 2024]. Primary and secondary school students are in a critical period of growth and development, and it is very important to have a healthy body. The cost of treatment for scoliosis patients is very high, which

can place a heavy financial burden on the patient's family. Early scoliosis screening of students in schools can not only significantly reduce the prevalence of local scoliosis, but also delay the progression of scoliosis and reduce the cost of treatment, so early scoliosis screening is indispensable [Liu, et. al., 2022]. In this study, 46 patients with scoliosis and 60 adolescents without scoliosis at the same period were selected as the study objects to explore the related influencing factors and related prevention strategies of adolescent scoliosis.

## MATERIALS AND METHODS

### General information

A total of 46 adolescent scoliosis patients treated in our hospital from June 2021 to August 2024 were selected as the study group, including 26 males and 20 females, aged from 11 to 18 years old, with an average age of  $14.14 \pm 1.38$  years old. Inclusion criteria: (1) All patients met the relevant diagnostic criteria for scoliosis in the 2016SOSORT guideline "Orthopedic and Rehabilitation Treatment of Idiopathic scoliosis during Growth"; (2) All patients were diagnosed with scoliosis after imaging examination of spinal curvature and rotation deformation with Cobb Angle  $> 10^\circ$ ; (3) The age of the selected patients ranged from 10 to 19 years old; (4) All patients were aware of the content of the study

**Corresponding Author:** Huawei Zhang, Department of Rehabilitation, Children's Hospital Affiliated to Shandong University (Jinan Children's Hospital), No. 23976, Jingshi Road, Jinan250022, China, E-mail: huawei\_612@126.com

and had signed informed consent. Exclusion criteria: (1) Patients with dysfunction of heart, liver, kidney and other important organs; (2) Patients with congenital scoliosis; (3) Patients with physical disability or motor dysfunction; (4) Patients with malignant tumors. Sixty adolescents (without scoliosis) who came to our hospital for physical examination in the same period were selected as the control group. The selected subjects included 34 males and 26 females, ranging in age from 11 to 19 years, with an average age of (14.09±1.91) years. The selected subjects were in good health and did not have any congenital diseases. This study was reviewed and approved by the Medical Ethics Committee of our hospital.

### Methods

According to the purpose of this study and the related references, our hospital developed a questionnaire on its own, which mainly included the gender, age, body mass index (BMI), only child or not, usual self-requirements for sitting and standing posture, nature of the school, vision, daily sleep time, frequency of physical education classes per week and daily outdoor activities. This study used an electronic questionnaire created through the Wenjuanxing website's web version. The selected research subjects in this study were collected face-to-face by trained and qualified medical staff.

### Statistical analysis

SPSS21.0 software was used to organize, analyze and compare the data in this study. The counting data were presented by rates or percentages, and comparison between groups were performed by chi-square tests. The measurement data were expressed by mean ± standard deviation, and comparison between groups were performed by t-test. The possible influencing factors of adolescent scoliosis were analyzed by one-way and multi-factor Logistics regression analysis.  $P < 0.05$  was considered as statistical difference

## RESULTS

### Univariate analysis results

The results of univariate analysis showed that there were no significant differences in gender, age and school nature between the two groups. There were statistically significant differences between the two groups in BMI, usual self-requirements for sitting and standing posture, weight of schoolbag, vision, daily sleep time, only child or not, nature of school, frequency of physical education classes per week, daily outdoor activity time and daily indoor sedentary time, as shown in Table 1.

Table 1 Univariate analysis

Factor	Control group (60)	Study group (46)	$t/\chi^2$	P
Gender (male/female, n)	34/26	26/20	2.794	0.096
Age (years)	14.09±1.91	14.14±1.38	1.508	0.147
BMI (overweight/total patients, kg/m <sup>2</sup> )	25/60	10/46	4.321	0.041
Usual self-requirements for sitting and standing posture (yes/no, n)	42/18	18/28	4.513	0.038
Weight of the bag (<15% body mass / > 15% body mass, n)	32/28	10/36	4.986	0.026
Vision (normal/abnormal, n)	36/24	12/34	6.194	0.019
Daily sleep time (<8h/≥8h, n)	8/52	30/16	6.318	0.016
Only child (yes/no, n)	19/41	20/26	4.018	0.045
Nature of school (public/private, n)	36/24	30/16	3.802	0.051
Frequency of physical education classes per week (< 4 classes / ≥4 classes, n)	18/42	24/22	4.726	0.031
Daily outdoor activity time (< 2h/≥2h, n)	12/48	20/26	4.612	0.035
Daily indoor sedentary time (< 6h/≥6h, n)	35/25	16/30	6.492	0.012

### MULTIVARIATE ANALYSIS OF RISK FACTORS FOR ADOLESCENT SCOLIOSIS

BMI, the usual self-requirements for sitting and standing posture, the weight of schoolbag, vision, daily sleep time, only child or not, the nature of the

school, frequency of physical education classes per week, the daily outdoor activity time and the daily indoor sedentary time were included in the independent variables and assigned values (Table 2). Whether scoliosis occurred in adolescents was taken as the dependent variable (1= occurrence, 0= non occurrence). The results of multi-factor Logistics

regression analysis found that self-requirements for sitting and standing posture, weight of schoolbag, vision, daily sleep time, frequency of physical education classes per week, daily outdoor activity

time and daily indoor sedentary time were all independent risk factors for adolescent scoliosis (Table 3).

Table 2 Independent variable assignment table

Independent variable	Variable assignment	
	1	0
BMI	Normal or underweight	Overweight
Self-requirements for sitting and standing posture	Yes	No
Weight of schoolbag	> 15% body mass	< 15% body mass
Vision	Abnormal	Normal
Daily sleep time	<8h	≥8h
Only child or not	No	Yes
Nature of school	Public	Private
Frequency of physical education classes per week	<4 classes	≥4 classes
Daily outdoor activity time	<2h	≥2h
Daily indoor sedentary time	<6h	≥6h

Table 3 Multivariate analysis of risk factors for adolescent scoliosis

Item	B	SE	Wald $\chi^2$	OR (95% CI)	P
BMI	0.287	0.618	0.015	6.891 (1.196,24.692)	0.081
Self-requirements for sitting and standing posture	0.994	1.009	4.181	7.601 (1.269,56.279)	0.028
Weight of schoolbag	0.998	0.786	3.512	7.580 (1.349,49.329)	0.032
Vision	0.979	0.220	5.047	1.781 (1.310,19.314)	0.018
Daily sleep time	0.898	1.009	4.851	6.819 (1.271,39.279)	0.021
Only child or not	0.299	0.299	0.476	1.432 (1.081,2.049)	0.077
Nature of school	1.038	0.339	0.517	1.401 (1.052,2.131)	0.069
Frequency of physical education classes per week	0.991	0.213	4.968	1.781 (1.310,19.301)	0.019
Daily outdoor activity time	0.879	1.009	4.851	6.821 (1.269,39.288)	0.022
Daily indoor sedentary time	0.401	0.169	5.089	1.509 (1.079,2.051)	0.015

## DISCUSSION

Scoliosis is a common disease that endangers the health of adolescents in China. It usually occurs in the early stage of adolescent development and progresses rapidly in the pubertal development period. Scoliosis usually causes various obstacles in the physiological function of patients, which will have a

certain impact on the daily life, study and work of patients in the future, and will also produce serious psychological burden. At present, the consensus of screening for scoliosis in adolescents has been formed in China, and early detection and effective corrective measures can restore the curvature of scoliosis to normal. In this study, 46 adolescents with scoliosis and 60 healthy adolescents without scoliosis were selected as subjects. The results showed that the

self-requirement of sitting and standing posture, overweight weight of schoolbag, abnormal vision, sleep time < 8h per day, frequency of physical education classes < 4 sessions per week, daily outdoor activity time < 2h and indoor sedentary time < 6h per day were all independent risk factors for adolescent scoliosis.

According to the results of this study, poor sitting and standing posture is an independent risk factor for adolescent scoliosis. This is because poor sitting and standing posture will lead to asymmetric pressure on the spine, which will increase paravertebral muscle fatigue and ligament pressure, and eventually lead to spinal deformation [Wang, et. al.,2021]. To address this risk factor, we can correct sitting posture by adjusting the height and comfort of the seat, while minimizing the time spent in the seat. The excessive weight of school bags is also an independent risk factor for adolescent scoliosis. This is because excessive school bags can compress the spine of teenagers, and long-term and excessive pressure will deform the spine of teenagers. In response to this risk factor, we can try to reduce the weight of the bag and the time to carry the bag. Myopia or strabismus is an independent risk factor for adolescent scoliosis, which may be due to poor vision adolescents in order to adapt to changes in visual spatial perception and maintain asymmetrical posture. Therefore, it is necessary to monitor the vision of adolescents for this risk factor and provide timely correction when abnormalities occur. Adequate sleep is a protective factor for scoliosis due to sleep's ability to relieve skeletal muscle fatigue, as well as the increased expression of glucocorticoid and interleukin-1, which reduces bone mineral density. Therefore, in order to prevent scoliosis, teenagers should try to ensure sufficient sleep. The results of this study showed that the frequency of physical education classes < 4 sessions per week, outdoor activity time < 2h per day and indoor sitting time < 6h per day were all independent risk factors for scoliosis in adolescents. Therefore, exercise is also a protective factor for scoliosis. This is because exercise can enhance the physique of teenagers, and functional exercise pays attention to adjusting the posture and function of the body, making the body symmetrical and postural coordination [Wu, et. al., 2022]. This reminds us to increase the amount of exercise for teenagers as much

as possible, especially outdoor activity time and intensity.

## CONCLUSION

In summary, the frequency of physical education classes per week, daily outdoor activity time, daily sleep time, visual acuity and usual self-requirements for sitting and standing posture, school bag weight and daily indoor sedentary time are all independent risk factors for adolescent scoliosis. In view of the above factors, teenagers should be screened every year, and the relevant knowledge of scoliosis should be publicized, so as to avoid the above risk factors and cultivate good living and learning habits of teenagers.

## REFERENCES

- Ren Q, An N, Huang J, Chen R, Zhang W and Wu Y. Current situation and health influencing factors of adolescent scoliosis among primary and middle school students aged 6 to 20 in Nantong City. *Chin J Child Health Care* 2024; 32: 868-874.
- Liu P, Jiang H, Sun J, Zhou L, Huang S and Qin Y. Current situation and related factors of adolescent idiopathic scoliosis in Zhuhai City. *South China J Prev Med* 2022;
- Sun Y, Liu W, Xiong L, Li M, Chen S, He W, Wu D and Lin R. Scoliosis and associated factors among middle school students in Guangzhou city. *Chin J Sch Health* 2021; 042.
- Tung R, Uvodich M, Anderson J, Carpenter K, Sherman A and Lozano R. Do Heavier Patients With Adolescent Idiopathic Scoliosis Have More Preserved Thoracic Kyphosis and Pulmonary Function? *Spine deformity* 2018; 6: 704-706.
- Wang F, Li Y, Guo X and Feng Q. Sedentary time, physical activity and abnormal body posture in adolescents. *China youth study* 2021; 9.
- Wu C, Li D and Zhang X. Status and influencing factors of scoliosis in children and adolescents in Zhengzhou City. *South China J Prev Med* 2021; 47: 3.
- Wu F, Li L and Liu Y. Study on prevention and correction of scoliosis in adolescents by physical exercise. *Journal of Jiamusi vocational institute* 2022; 38: 3.
- Ye H and Wang Z. Progress of Epidemiological Study on Adolescent Idiopathic Scoliosis. *SYSTEMS MEDICINE* 2022; 7: 192-196.