

Prevalence and risk factors of myopia and scoliosis in students in Binhu District, Wuxi, China

Chen Xing¹, Yu Jun², Xu Zihao², Shen Jian¹, Wu Yanbing¹, Sun Qingzhu¹

引用:陈星,俞君,徐梓豪,等. 中国无锡市滨湖区学生近视伴脊柱侧弯患病率及危险因素分析. 国际眼科杂志, 2026,26(11): 1872-1878.

Foundation item: Supported by Wuxi Binhu District Health Commission People's Livelihood Project Funding and Institutional Research Project(No.SC2301)

¹Department of Ophthalmology, Wuxi Ninth People's Hospital Affiliated to Soochow University, Wuxi 214062, Jiangsu Province, China; ²Department of Rehabilitation Medicine, Wuxi Ninth People's Hospital Affiliated to Soochow University, Wuxi 214062, Jiangsu Province, China

Correspondence to: Yu Jun. Department of Rehabilitation Medicine, Wuxi Ninth People's Hospital Affiliated to Soochow University, Wuxi 214062, Jiangsu Province, China. iampt@126.com

Received: 2026-02-13 Accepted: 2026-06-08

中国无锡市滨湖区学生近视伴脊柱侧弯患病率及危险因素分析

陈 星¹,俞 君²,徐梓豪²,沈 健¹,吴雁冰¹,孙庆祝¹
基金项目: 无锡市滨湖区民生实事项目和院内课题(No.SC2301)
作者单位: (214062) 中国江苏省无锡市,苏州大学附属无锡九院¹眼科;²康复科
作者简介: 陈星,毕业于苏州大学,博士,副主任医师,研究方向: 屈光不正。
通讯作者: 俞君,毕业于苏州大学,硕士,副主任治疗师,研究方向: 骨科康复与青少年体态调整. iampt@126.com

摘要

目的: 了解无锡市滨湖区中小學生近视伴脊柱侧弯患病率及影响因素。

方法: 采用分层整群随机抽样的方法,抽取滨湖区 10 所中小學生进行视力检测、脊柱侧弯检查及相关因素问卷调查。使用单变量分析检测脊柱侧弯和近视之间的关系。应用二元多变量 Logistic 回归模型分析近视和脊柱侧弯共患病相关危险因素。

结果: 共抽取 17 951 名學生,其中男生 8 948 名(49.85%),女生 9 003 名(50.15%);小学生 9 784 名(54.50%),初中生 8 167 名(45.50%)。近视、脊柱侧弯及共患病检出率分别为 68.30%、2.95%和 2.76%。女生的共患病率(3.78%)高于男生(1.74%)。共患病检出率初中生(7-9 年级为 3.67%)高于小学生(4-6 年级为 2.00%; $P<0.001$)。Logistic 回归分析显示,处于 7-9 年级(优势比[OR]=4.43,95%置信区间[CI]: 2.36-7.85)學生每天课后花费 2-3 h($OR=1.46$,95%CI: 1.02-2.16)或 ≥ 3 h

($OR=1.5$,95%CI: 1.21-2.55)进行家庭作业或每周 >6 d 且每次 >60 min 的中高强度体育活动($OR=1.39$,95%CI: 1.08-1.7),以及未根据學生身高调整书桌和椅子高度($OR=1.73$,95%CI: 1.2-2.25),均是近视与脊柱侧弯共患病的影响因素($P<0.05$)。

结论: 无锡市滨湖区小学及初中生中近视与脊柱侧弯共病的患病率逐渐受到关注。减少课后作业及读写时间,并每周至少 3 天进行 ≥ 60 min 的中高强度体育活动,或有助于降低该人群罹患近视与脊柱侧弯共患病的风险。

关键词: 近视;脊柱侧弯;共患病;小学生;初中生;患病率;危险因素

Abstract

• **AIM:** To investigate the prevalence and associated factors of comorbid myopia and scoliosis among primary and junior school students in Binhu District, Wuxi, China.

• **METHODS:** A stratified cluster random sampling method was used to select students from 10 primary and junior schools in Binhu District for visual acuity testing, scoliosis examination, and a questionnaire survey on related factors. The relationship between scoliosis and myopia was detected using univariate analysis. A binary multivariable logistic regression model was applied to analyze the risk factors associated with comorbid myopia and scoliosis.

• **RESULTS:** A total of 17 951 students were selected, including 8948 (49.85%) boys and 9003 (50.15%) girls; 9784 (54.50%) primary school students and 8167 (45.50%) junior school students. The detection rates of myopia, scoliosis, and comorbidity were 68.30%, 2.95%, and 2.76%, respectively. The comorbidity rate was higher in girls (3.78%) than in boys (1.74%). Junior school students (3.67% in Grade 7-9) had a higher total comorbidity detection rate than primary school students (2.00% in Grade 4-6; all $P<0.001$). Logistic regression analysis showed that being in Grade 7-9 [odds ratio (OR)=4.43, 95% confidence interval (CI): 2.36-7.85], spending 2-3 h ($OR=1.46$, 95%CI: 1.02-2.16) or ≥ 3 h ($OR=1.5$, 95%CI: 1.21-2.55) on homework or reading after school, engaging in >60 min of moderate-to-vigorous physical activity >6 days per week ($OR=1.39$, 95%CI: 1.08-1.7), and not adjusting desk and chair height to match the student's height ($OR=1.73$, 95%CI: 1.2-2.25) were positively associated with comorbidity (all $P<0.05$).

• **CONCLUSION:** The prevalence of comorbid myopia and scoliosis among primary and junior school students in Binhu District of Wuxi is concerning. Reducing the time of

homework or reading and writing after school and engaging in ≥ 60 min of moderate-to-vigorous physical activity at least three days per week may help lower the risk of comorbid myopia and scoliosis in this population.

• **KEYWORDS:** myopia; scoliosis; comorbidity; primary school students; junior school students; prevalence; risk factors

DOI:10.3980/j.issn.1672-5123.2026.11.02

Citation: Chen X, Yu J, Xu ZH, et al. Prevalence and risk factors of myopia and scoliosis in students in Binhu District, Wuxi, China. Guoji Yanke Zazhi (Int Eye Sci), 2026,26(11):1872-1878.

INTRODUCTION

Myopia is a global public health concern and one of the significant factors leading to visual impairment^[1]. It increases the incidence of ocular diseases such as cataract, glaucoma, and myopic retinopathy, and it also causes a severe social and economic burden^[2]. By 2050, an estimated 49.8% of the global population (approximately 4758 million) will be affected by myopia^[1,3]. Adolescent idiopathic scoliosis (AIS) is a complex rotational deformity of the spine in the three planes. Epidemiological surveys show that the incidence of AIS is about 2% to 3%, making it one of the three major health concerns for adolescents in China, along with myopia and mental health problems^[4-6].

In recent years, myopia and scoliosis have been recognized as two of the most common health problems affecting the healthy development of students in China. Myopia is the leading cause of visual impairment among adolescents, while scoliosis is a three-dimensional structural deformity of the spine^[7]. Previous studies have reported that students with myopia often have unequal visual acuity in both eyes, which can affect the adjustment of the central nervous system to the posture of adolescents and increase the risk of scoliosis^[8]; the risk of scoliosis in myopic students is 1.49 times that of without myopia^[9]. Furthermore, the prevalence of scoliosis is higher in students with myopia, and the prevalence of myopia is also higher in students with scoliosis, suggesting a bidirectional relationship between the two conditions^[5]. Recent data from the National Survey on the Health of Students in China show 22.9% of primary and junior school students have two or more common diseases, and these health problems often have common behavioral factors and susceptible environments. Investigating comorbidities among common health concerns and identifying their related factors is essential for developing targeted strategies to protect student health^[10].

So far, there are few studies on the myopia-scoliosis comorbidity in the Yangtze River Delta of China. The present study analyzed monitoring data on health conditions among primary and junior school students in Binhu District, Wuxi, from 2024 to 2025. Specifically, this study examined the factors associated with comorbid myopia and scoliosis to provide a reference for integrated prevention and management strategies for these conditions in school-aged populations.

PARTICIPANTS AND METHODS

Ethical approval This research was approved by the Ethics Committee of Wuxi Ninth People's Hospital Affiliated to Soochow University with the ethical review number LW20220045. This study was conducted in full accordance with the ethical principles of the Declaration of Helsinki. Informed consent was waived because of the retrospective and anonymous nature of this study.

Participants Using a stratified cluster random sampling method, students from primary and junior schools in the Binhu District of Wuxi were selected as participants for monitoring of common diseases among students in 2024-2025 (32 primary and junior schools). According to the method of random number table, 5 primary schools and 5 junior schools in Binhu District were selected as monitoring points, stratified by stage of education, and whole classes of students were included. The survey subjects were students from the Grade 4 of primary school to Grade 9 of junior school, stratified by grade, with two or more classes extracted from each grade, and all students in each class were taken as the research subjects. The sample size formula for the screening was as follows: $n = \frac{u_a^2 pq}{d^2}$, p is the prevalence of scoliosis in primary

and secondary school students, according to the literature, 3% is its value, d is the sensitivity value, $d = 0.15 p$, and we finally consider 6042 as the minimum sample size after increasing by 10%.

Clinical Examinations The clinical examinations included both visual acuity and refraction assessments. Distance visual acuity examination was measured using a 5 m standard logarithmic acuity chart, and refraction was assessed with an automatic desktop refractor under noncycloplegic conditions during school screening. Myopia is defined as uncorrected visual acuity < 5.0 (20/20) combined with a cycloplegic spherical equivalent refractive error of < -0.50 D, when undergoing further examination at the hospital. Students with unilateral myopia were classified as myopic, and those wearing orthokeratology lenses were also classified as myopic. The scoliosis screening method were 1) Students were examined in an upright standing position to observe head lean, shoulder asymmetries, unequal inferior angle of the scapula, scapular prominence, waist asymmetries, or pelvis lean. 2) Adams' forward bending test (FBT) was examined to observe thorax asymmetries, scapular asymmetries, waist asymmetries, pelvis lean, and spinous process line is not in the longitudinal midline. Students with at least one positive test were inspected angle of trunk rotation (ATR). 3) The inclusion criteria were that a curve progression of $\geq 3^\circ$ was used as ATR cut-off value and suspected of scoliosis. 4) conform to the Peking Union Medical College (PUMC) classification^[11]: Type I (Ia, Ib, Ic) left curves (diagnostic criteria: lateral curvature of the spine observed on a full-length standing position spinal anterior-posterior radiograph, with a measured Cobb angle $\geq 10^\circ$).

Questionnaire Survey A self-designed questionnaire was used to collect information on demographic characteristics (sex, age, grade, etc.), learning and lifestyle behaviors (reading and writing habits, physical activity, sleep, etc.), and behavior related to spinal abnormalities (backpack carrying, standing posture, back and waist pain)^[9]. The questionnaire had a Cronbach α coefficient of 0.90 and a validity coefficient of 0.86. Students from Grade 4 to Grade 9 participated in the questionnaire survey. All surveyors received professional training and distributed the questionnaires in a standardized manner. Students completed the questionnaires independently, and responses were checked for completeness and logical consistency at the time of collection. Adequate sleep was defined as ≥ 10 h per day for primary school students and ≥ 9 h per day for junior school students. Sedentary time referred to the total time spent sitting at a desk for study and screen each day. Desk and chair height were adjusted according to height means that the height of desks and chairs at home and school can be adjusted in a timely manner each year in accordance with one's height, avoiding a mismatch between height and the height of desks and chairs. Moderate-intensity physical activity was defined as activity requiring a moderate level of effort, feeling a little out of breath, sweating, or feeling a little tired. Vigorous-intensity physical activity was defined as activity requiring a high level of effort, feeling out of breath, sweating heavily, or being very tired.

Quality Control The project personnel consisted of qualified professionals who underwent strict training and assessment before implementation and demonstrated proficiency in the inspection procedures. All equipment met the required standards, was reviewed by professional institutions, and was calibrated before use. During the on-site survey, 5% of students were selected for reexamination to ensure the monitoring quality.

Statistical Analysis The database was established using EpiData 3.1, and after logical checks and data matching, statistical analysis was performed using SPSS 6.0. The current prevalence of myopia and scoliosis was expressed in terms of frequency and detection rate. The Chi-square (χ^2) test was used for univariate analysis with comorbidity as the dependent variable, and binary multivariable logistic regression was conducted on factors that were statistically significant in the univariate analysis. The significance level was set at $\alpha = 0.05$.

RESULTS

Myopia and Scoliosis in Primary and Junior Students and the Current Situation of Comorbidity A total of 17 951 primary and secondary school students were included in the 2-year survey, including 8948 boys (49.85%) and 9003 girls (50.15%); 9784 primary school students (54.50%) and 8167 junior school students (45.50%). The prevalence of myopia and scoliosis among primary and junior students in Binhu District in two years was 2.92% (2024) and 2.61%

(2025), respectively. The total detection rate and co-prevalence of myopia and scoliosis in two years were 68.30%, 2.95%, and 2.76%, respectively. Detection rates of myopia, scoliosis, and comorbidity were higher in girls than in boys, and higher in students from Grades 7–9 compared with those from Grades 4–6 (Table 1, Figure 1).

Univariate Analysis of Myopia and Scoliosis Co-morbidity The physical examination and questionnaire survey data were matched, and a total of 13 287 records were included in the analysis in 2024–2025. The results showed that the prevalence of comorbid myopia and scoliosis differed significantly by school stage, weekly duration of moderate-to-vigorous physical activity (≥ 1 h), after-school homework time, sleep condition, sedentary time, height-adjustment of the desks and chairs, and reminders from teachers and parents regarding proper reading and writing posture ($P < 0.05$; Table 2).

Table 1 The prevalence of myopia, scoliosis, and comorbidity in primary and junior students in Wuxi Binhu District in 2024–2025 n (%)

Variables	Participants (n)	Myopia	Scoliosis	Comorbidity
Year				
2024	9056	6257(69.09)	280(3.09)	264(2.92)
2025	8895	6004(67.50)	249(2.80)	232(2.61)
2024–2025 (total)	17951	12261(68.30)	529(2.95)	496(2.76)
Sex				
Male	8948	5915(66.10)	170(1.90)	156(1.74)
Female	9003	6346(70.49)	360(4.00)	340(3.78)
χ^2		39.82	68.99	69.04
P		<0.001	<0.001	<0.001
Grade				
4–6	9784	5890(60.20)	239(2.44)	196(2.00)
7–9	8167	6372(78.02)	290(3.55)	300(3.67)
χ^2		653.03	19.11	46.20
P		<0.001	<0.001	<0.001

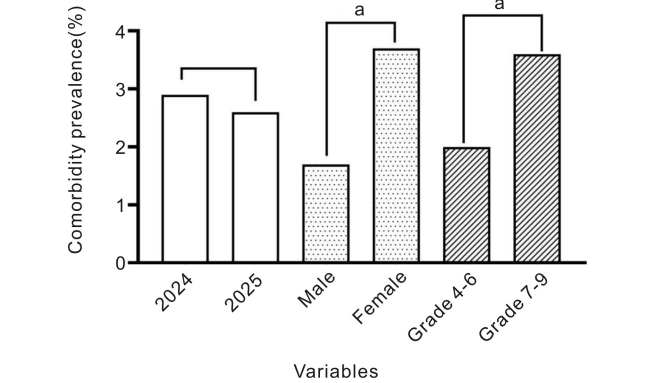


Figure 1 The prevalence of comorbid myopia and scoliosis was higher in girls than in boys and higher in students from Grades 7–9 than in those from Grades 4–6 (* $P < 0.001$).

Multifactorial Analysis of Myopia and Scoliosis Comorbidity Myopia and scoliosis co-morbidity (no = 0, yes = 1) as the dependent variable, the above single-factor variables as independent variables, and multi-category variables were included as dummy variables (Table 3), and binary logistic multi-factor regression analysis was performed. results showed that Grades 7-9 ($OR = 4.43$, $95\% CI: 2.36 - 7.85$), 2-3h ($OR = 1.46$, $95\% CI: 1.02 - 2.16$); $\geq 3h$ ($OR = 1.75$, $95\% CI: 1.21 - 2.55$) after school to write homework, no adjustment of desk and chair height according

to students'body size ($OR = 1.73$, $95\% CI: 1.32 - 2.25$; Table 4).

DISCUSSION

The detection rates for myopia, scoliosis, and thecomorbidity of myopia and scoliosis in students from grades 4 to 9 in Binhu District, Wuxi, during 2024-2025 were 68.30%, 2.95%, and 2.76%, respectively, which were all higher than the results of the study in Inner Mongolia from 2019 to 2022^[12]. The comorbidity detection rate of myopia and scoliosis was higher than the screening results of primary and secondary

Table 2 Univariate analysis of comorbidity of myopia and scoliosis in primary and junior students in Binhu district in 2024-2025

Variables	Participants (n)	Comorbidity (n,%)	χ^2	P
Grade			13.50	<0.001
4-6	6325	196 (3.10)		
7-9	6962	300 (4.31)		
More than 1 h of moderate-to-vigorous physical activity per week/day			74.17	<0.001
≥ 3	6806	160 (2.35)		
<3	6481	336 (5.18)		
Homework time after school/h			70.71	<0.001
<1	274	5 (1.82)		
1-2	2903	66 (2.27)		
2-3	5250	159 (3.03)		
≥ 3	4799	265 (5.52)		
Not clear	61	1 (1.64)		
Sleep			34.34	<0.001
Adequate	4043	92 (2.28)		
Inadequate	9244	404 (4.37)		
Sedentary time /h			38.33	<0.001
<10	10071	318 (3.16)		
≥ 10	3216	178 (5.53)		
Desk and chair height are adjusted according to height			26.41	<0.001
Yes	6243	177 (2.84)		
No	7044	319 (4.53)		
The teacher reminds attention to posture for reading and writing			12.89	<0.001
Occasionally/never	8277	347 (4.19)		
Always/often	5010	149 (2.97)		
Parents pay attention to posture for reading and writing			5.00	0.025
Occasionally/never	6178	255 (4.13)		
Always/often	7109	241 (3.39)		
Neck and shoulder pain			3.43	0.064
No	9439	334 (3.54)		
Yes	3848	162 (4.21)		

Table 3 Assignment of variable values in the logistic regression analysis

Encoding	Variable	Assignment
Y	Myopia and scoliosiscomorbidity	No = 0, yes = 1
X ₁	More than 1 h of moderate to vigorous physical activity per week	≥ 3 d = 1, <3 d = 2
X ₂	Homework time after school	<1 h = 1, 1-<2 h = 2, 2-<3 h = 3, ≥ 3 h = 4, Not clear = 5
X ₃	Sleep time	Adequate = 1, inadequate = 2
X ₄	Sedentary time	<10 h = 1, ≥ 10 h = 2
X ₅	Desk and chair height adjusted according to height	Yes = 1, no = 2
X ₆	The teacher reminds attention to posture for reading and writing	Occasionally/never = 1, always/often = 2
X ₇	Parents remind attention to posture for reading and writing	Occasionally/never = 1, always/often = 2

Table 4 Multivariate logistic regression analysis of the comorbidity of myopia and scoliosis in primary and junior students in Binhu in 2024–2025

Variables	Regression coefficient	Standard error	Wald χ^2	P	OR (95%CI)
Grade					1.00
4–6					
7–9	1.48	0.28	25.63	<0.001	4.43 (2.36, 7.85)
More than 1 h of moderate to vigorous physical activity per week/d					1.00
≥3					
<3	0.35	0.12	6.55	0.014	1.41 (1.07, 1.88)
Homework time after school/h					1.00
<1					
1–<2	0.31	0.32	0.89	0.099	1.36 (0.72, 2.57)
2–<3	0.37	0.18	4.11	0.044	1.46 (1.02, 2.16)
≥3	0.56	0.18	8.81	0.004	1.75 (1.21, 2.55)
Not clear	–0.03	0.77	0.01	0.958	0.96 (0.21, 3.46)
Desk and chair height adjusted according to height					1.00
Yes					
No	0.55	0.13	14.68	<0.001	1.73 (1.32, 2.25)

school students in Beijing from 2019 to 2022^[13]. This may be related to regional differences, suggesting that this area should pay attention to the comorbidity of myopia and scoliosis in primary and junior school students.

The prevalence of myopia, scoliosis, and their comorbidity was higher in females than in males, which aligns with previous studies on these conditions^[9,12–13]. This disparity may be attributed to several factors, including sex-specific susceptibilities. Female sex hormones can influence refractive power and contribute to the development of scoliosis by affecting the rapid structural changes and growth of the eyes. The age of menarche can also influence the onset of myopia and scoliosis^[14–15]. Furthermore, girls tend to be less physically active and are generally quieter than boys^[16]. The detection rates of myopia, scoliosis and co-morbidity increased with higher educational levels, and prolonged sitting and increased screen time due to increasing academic pressure. A lack of physical activity, poor visual habits, and improper posture can elevate the risk of these conditions' onset and progression. This is consistent with the growth curve of adolescence^[17–18]. These are potential explanations based on the previous literature.

After-school homework time was positively correlated with the co-occurrence of the two health concerns, which may be related to long periods of sitting and closer-range visual use. Some studies indicated that sedentary time ≥2 h increases the risk of myopia and scoliosis^[18–19]. In our country, primary and secondary school students spend a significant portion of their daily time sitting. In the survey, it was found that the reading and writing time of primary school students after school was mostly about 2h. Extended sitting can exacerbate muscle imbalances on both sides of the spine, alter spinal structure,

and contribute to the development of scoliosis^[20–21]. Prolonged close-range visual use or asymmetrical visual use during reading and writing can increase the risk of myopia. Daylight exposure is currently considered an effective and sustainable strategy for controlling the development and progression of myopia^[22]. Therefore, promoting outdoor activities in sunlight is essential.

The amount of moderate- and vigorous-intensity physical activity during the week was negatively correlated with the risk of scoliosis and myopia. It was found that the more sufficient the moderate- and vigorous-intensity physical activity, the lower the risk of scoliosis^[23–24]; some studies suggest that high levels of physical activity can offset the negative impact of long-term sedentary learning outside school on myopia^[17,25]. Currently, both parents and schools tend to prioritize academic learning over physical activity, yet the World Health Organization recommends that children and adolescents engage in at least 1 h of moderate- and vigorous-intensity physical activity every day. Some studies have confirmed that moderate- and vigorous-intensity exercise, particularly functional training, can strengthen the muscles around the spine, improve body flexibility, enhance the sustained contraction of the eye's ciliary muscle, increase accommodative sensitivity, promote blood circulation, and relieve both muscle and eye fatigue^[26–27]. These benefits have a preventive and therapeutic effect on the co-occurrence of scoliosis and myopia. Therefore, schools and parents should try to reduce the burden of students' studies and minimize extracurricular homework time; students should develop healthy behaviors such as 1 h of moderate-intensity physical activity every day (>3 d a week).

The height of desks and chairs should be adjusted according to

students' height. There is a correlation between shoulder and neck pain, scoliosis, and myopia. A mismatch between desk and chair heights and students' body sizes can lead to poor sitting posture. Poor sitting posture can lead to shoulder and neck pain. studies suggest that poor sitting posture is positively correlated with myopia and scoliosis^[28-29], and poor posture can cause back pain^[30]. Scientifically designed and standardized desks and chairs are essential for helping students adopt proper reading and writing postures. It is recommended that the education and health departments should strengthen awareness and configure desks and chairs matched with students' height. This survey reveals that the proportion of teachers or parents who remind students to pay attention to their reading and writing posture decreases as students' progress through school. Conversely, the proportion of students exhibiting poor posture increases with school progression. These suggest the importance of cultivating students' correct reading and writing posture, and teachers or parents should pay attention to correct students' poor posture at all stages.

To our knowledge, this investigation is the first report on the comorbidity of myopia and scoliosis among primary and secondary schools in Binhu District, Wuxi. However, there are some limitations in this study. The use of questionnaire surveys may have introduced recall and reporting biases. Additionally, the cross-sectional survey method used in this study can only identify associations between comorbidity and related factors. Nevertheless, this study provides a valuable reference for future research. Future investigations could explore the dose-response relationship between common student diseases and comorbidity-related factors, facilitate resource integration, and establish coprevention mechanisms. These efforts would contribute significantly to the prevention of myopia, scoliosis, and other related diseases in students.

Conflicts of Interest: Xu ZH, None; Yu J, None; Chen X, None; Shen J, None; Wu YB, None; Sun QZ, None.

Authors' contributions: Xu ZH and Yu J: Data Collection, formal analysis, investigation, project administration, writing-original draft (lead); Chen X: Data collection, formal analysis, project administration, writing-original draft; Shen J, Wu YB and Sun QZ: Data collection.

REFERENCES

[1] Liu GH, Rong H, Liu YP, et al. Effectiveness of repeated low-level red light in myopia prevention and myopia control. *Br J Ophthalmol*, 2024,108(9):1299-1305.

[2] Haarman AEG, Enthoven CA, Tideman JW, et al. The complications of myopia: a review and meta-analysis. *Invest Ophthalmol Vis Sci*, 2020,61(4):49.

[3] Holden BA, Fricke TR, Wilson DA, et al. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. *Ophthalmology*, 2016,123(5):1036-1042.

[4] Pei BQ, Lu D, Wu XQ, et al. Effects of growing rod technique with different surgical modes and growth phases on the treatment outcome of early onset scoliosis: a 3-D finite element analysis. *Int J Environ Res Public Health*, 2022,19(4):2057.

[5] Pan YS, Zhang HY, Ye X, et al. Study on the relationship between scoliosis and vision problems: a narrative review. *Medicine*, 2023, 102(42):e35178.

[6] Zale CL, McIntosh AL. Adolescent idiopathic scoliosis for pediatric providers. *Pediatr Ann*, 2022,51(9):e364-e369.

[7] Dabaghi - Richerand A, Santiago - Balmaseda E. Escoliosis de iniciotemprano: fisiopatología, diagnóstico y tratamiento. *Acta Ortopédica Mex*, 2023,37(2):99-105.

[8] Gallego - Siles JR, Siles - Fuentes MJ, Ibáñez - Vera AJ, et al. Idiopathic scoliosis in subjects with eye diseases: a systematic review with meta-analysis. *Ann N Y Acad Sci*, 2024,1533(1):81-88.

[9] Cai ZM, Wu RB, Zheng SK, et al. Morphology and epidemiological study of idiopathic scoliosis among primary school students in Chaozhou, China. *Environ Health Prev Med*, 2021,26(1):71.

[10] Song Y, Ma J. Correct the imbalance of growth and development and prevent important comorbidities of children and adolescents. *Zhonghua Yu Fang Yi Xue Za Zhi*, 2023,57:1-6.

[11] Zhuang QY, Qiu GX, Li QY, et al. Modified PUMC classification for adolescent idiopathic scoliosis. *Spine J*, 2019,19(9):1518-1528.

[12] Ma XY, Zhang XH, Song Yi, et al. Prevalence trend and related factors of scoliosis and myopia co-morbidities among primary and middle school students in Inner Mongolia Autonomous Region from 2019 to 2022. *Chin J Sch Health*, 2023,44(9):1289-1293.

[13] Gao RY, Sun BJ, Luo HJ, et al. Co-morbidity of screening myopia and scoliosis among primary and secondary school students in Beijing and associated factors. *Chi J Sch Health* 2024,45(8):1195-1198.

[14] Liang ZT, Guo CF, Li J, et al. The role of endocrine hormones in the pathogenesis of adolescent idiopathic scoliosis. *FASEB J*, 2021, 35(9):e21839.

[15] Zhang J, Li RL, Zhang Y, et al. Association between age at menarche and the risk of myopia at the age of 15 in Chongqing, China: a cross-sectional study. *Front Med (Lausanne)*, 2025,12:1590463.

[16] Jiang DD, Chen J, Thorn F, et al. Elementary school comprehensive intervention and myopia development: the Wenzhou Epidemiology of Refraction Error Study. *Int J Ophthalmol*, 2022,15(8):1363-1369.

[17] Huang PC, Hsiao YC, Tsai CY, et al. Protective behaviours of near work and time outdoors in myopia prevalence and progression in myopic children: a 2-year prospective population study. *Br J Ophthalmol*, 2020,104(7):956-961.

[18] Chen YH, Zhang ZD, Zhu QH. The effect of an exercise intervention on adolescent idiopathic scoliosis: a network meta-analysis. *J Orthop Surg Res*, 2023,18(1):655.

[19] Ding HM, Jiang LQ, Lin XQ, et al. Association of physical activity, sedentary behaviour, sleep and myopia in children and adolescents: a systematic review and dose-response meta-analysis. *BMC Public Heal*, 2025,25(1):1231.

[20] Chu LT, Yang DL, Zhang FY, et al. Association of physical activity and sedentary time with scoliosis screening positive in Chinese primary and secondary school students: a cohort study in Shanghai. *Front Public Heal*, 2025,13:1483007.

[21] Chopra S, Larson AN, Kaufman KR, et al. Accelerometer based assessment of daily physical activity and sedentary time in adolescents

with idiopathic scoliosis. PLoS One, 2020,15(9):e0238181.

[22] Ihesiulor CG, Rhadhakrishnan H. A review of mechanism of action of outdoor exposure in preventing myopia incidence and progression. Int J Ophthalmol, 2024,17(6):1144–1155.

[23] Qi X, Peng C, Fu PT, et al. Correlation between physical activity and adolescent idiopathic scoliosis: a systematic review. BMC Musculoskelet Disord, 2023,24(1):978.

[24] Wang C, Liu G, Lu Q, et al. Causal relationship between physical activity and scoliosis: a Mendelian randomization study. Medicine, 2024, 103(49):e40916.

[25] Li Y,Xu C, Liu ZH, et al. Effects of physical activity patterns on myopia among children and adolescents: a latent class analysis. Child Care Health Dev, 2024,50(4):e13296.

[26] Zhao MX, Zhang YJ, Herold F, et al. Associations between meeting 24–hour movement guidelines and myopia among school–aged

children: a cross–sectional study. Complement Ther Clin Pract, 2023, 53:101792.

[27] Zhu LW, Ru SH, Wang WX, et al. Associations of physical activity and screen time with adolescent idiopathic scoliosis. Environ Health Prev Med, 2023,28:55.

[28] Shi HN, Fu J, Liu XJ, et al. Influence of the interaction between parental myopia and poor eye habits when reading and writing and poor reading posture on prevalence of myopia in school students in Urumqi, China. BMC Ophthalmol, 2021,21(1):299.

[29] Dou QF, Zhu ZX, Zhu LW, et al. Academic–related factors and daily lifestyle habits associated with adolescent idiopathic scoliosis: a case–control study. Environ Health Prev Med, 2023,28:23.

[30] Saini Y, Rai A, Sen S. Relationship between sleep posture and low back pain: a systematic review. Musculoskelet Care, 2025, 23(2): e70114.