Effect of Walking to School on Myopia in Elementary School Students

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Abstract: Objective to investigate the effect of walking to and from school on the prevalence of myopia among elementary school students. Understanding the characteristics of the distribution of walking to school among different students. Methods Using a convenience sampling method, questionnaires were administered to second and third grade elementary school students in 11 schools where the National Public Health Program were conducted. The questionnaire includes students' myopia rate, students' walking time, daily visual screen time, daily chores time, sleep time and extracurricular classes. $\chi2$ test and Logestic regression analysis were used to analyze the impact of walking to school on the prevalence of myopia. Results Whether students walked to school was related to district, video screen time, time spent doing chores, and participation in extracurricular classes. The logestic regression analysis showed that walking to school ≥ 30 min per day was a protective factor for myopia (OR = 0.373, 95% CI = 0.152-0.918, P < 0.05).Conclusion Students walking to school has a protective effect on the occurrence of myopia.

1. Introduction

Myopia is a major public health problem that endangers the physical and mental health of children and adolescents. The overall myopia rate of children and adolescents in China has reached 52.7% in 2020, and the problem of low myopia is prominent, which has seriously affected the physical and mental health of children and adolescents in China [1]. Genetics and environment are the two major factors affecting myopia. The influence of environmental factors on myopia is mainly related to the time spent outdoors. Some studies have proven that adequate outdoor activity time has a protective effect on the development of myopia [2]. In recent years, the increased academic

burden of students, the diversification of indoor recreational activities and the regular prevention and control of the new coronavirus have led to an increase in children's time spent indoors and a decrease in time spent outdoors. The lack of time spent outdoors is becoming a major cause of myopia among children and adolescents [3]. Children walking to school can increase their exposure to sunlight and physical activity, and experts have suggested that walking to school as a form of outdoor activity could help prevent myopia [4]. The current studies have mainly focused on the effects of walking to school on physical health, cardiovascular system, obesity, and socialization, and there are almost no studies on the association between myopia and walking to school [5,6].This study adopted a cross-sectional study design method. From June to July 2021, a convenience sampling method was used to select second- to third-grade students in 11 elementary schools in Xi'an. A questionnaire survey was conducted to obtain information about myopia and the condition of walking to school. This study was conducted to analyze the association between walking to and from school and the occurrence of myopia.

2. Materials and Methods

2.1. Source of Information

In this study, data were collected by questionnaire. And in June and July 2022, a convenience sample was taken from 11 elementary school in Xi'an (5 urban schools and 6 suburban schools) where the national public health program was implemented. Students in one class of the second to third grade were selected for the study. The questionnaires were obtained from 513 students. We excluded 64 students who did not know whether they were nearsighted or had other visual impairments (farsightedness, strabismus), and finally identified 449 students as the final subjects (Figure 1).
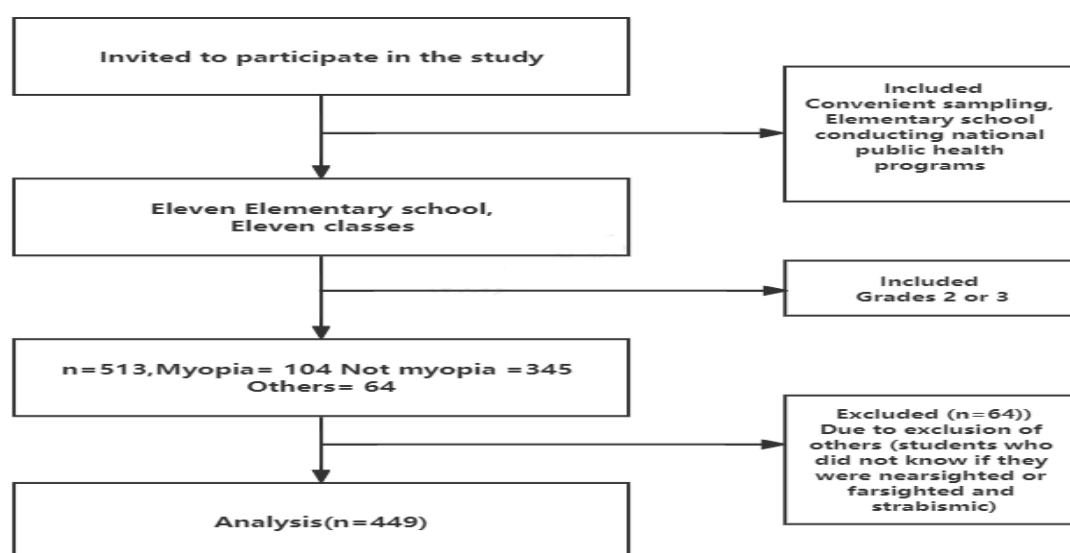

Figure 1. Flow chart

2.2. Methods

A self-administered questionnaire, "Myopia and walking to school among children and adolescents", was used. The questionnaire included students' basic information (district, gender, grade level), myopia, daily walking time to school, parents' myopia, use of electronic devices, daily

chores, sleep, and extracurricular classes. In order to ensure the authenticity of students' self-reported myopia, classes that had conducted vision screening within March and had students' feedback on the results were selected for the study.

2.3. Quality Control

A pre-survey was conducted before the formal survey, and on the basis of which the questionnaire was modified. In the formal survey, after the questionnaire were distributed, the investigator explained, and the students filled out the questionnaire independently. To ensure the accuracy and consistency of the questionnaire, after completing the questionnaire, the surveyor checked the logic and completeness of the content, and rewrote the questionnaires that did not meet the requirements.

2.4. Statistical Analyses

Data were double-entered with Epi data3.1 and statistically analyzed using SPSS 25.0.The statistical data were expressed as rates (%), and rates were compared using the $\chi 2$ test. The association and strength of the prevalence of myopia were analyzed using binary logestic regressions, and the levels of statistical tests were all two-sided $\alpha = 0.05$.

3. Result

3.1. Students' Self-Reported Myopia

The number of students in this survey was not very different in terms of area and gender, with 196 (43.7%) from urban elementary schools and 253 (56.3%) from suburban elementary schools. There were 220 (49.0%) female students and 229 (51.0%) male students. There were 364 students in the third grade and 85 in the second grade (Table 1). Among them, 104 (23.2%) students were myopic. The myopia rate of students was higher in urban areas (27.6%) than in suburban counties (19.8%), and higher in girls (24.5%) than in boys (21.8%),third grade (23.9%) was higher than second grade (20.0%), but the difference was not statistically significant(Figure 2).

Table 1. Basic characteristics of students in this study

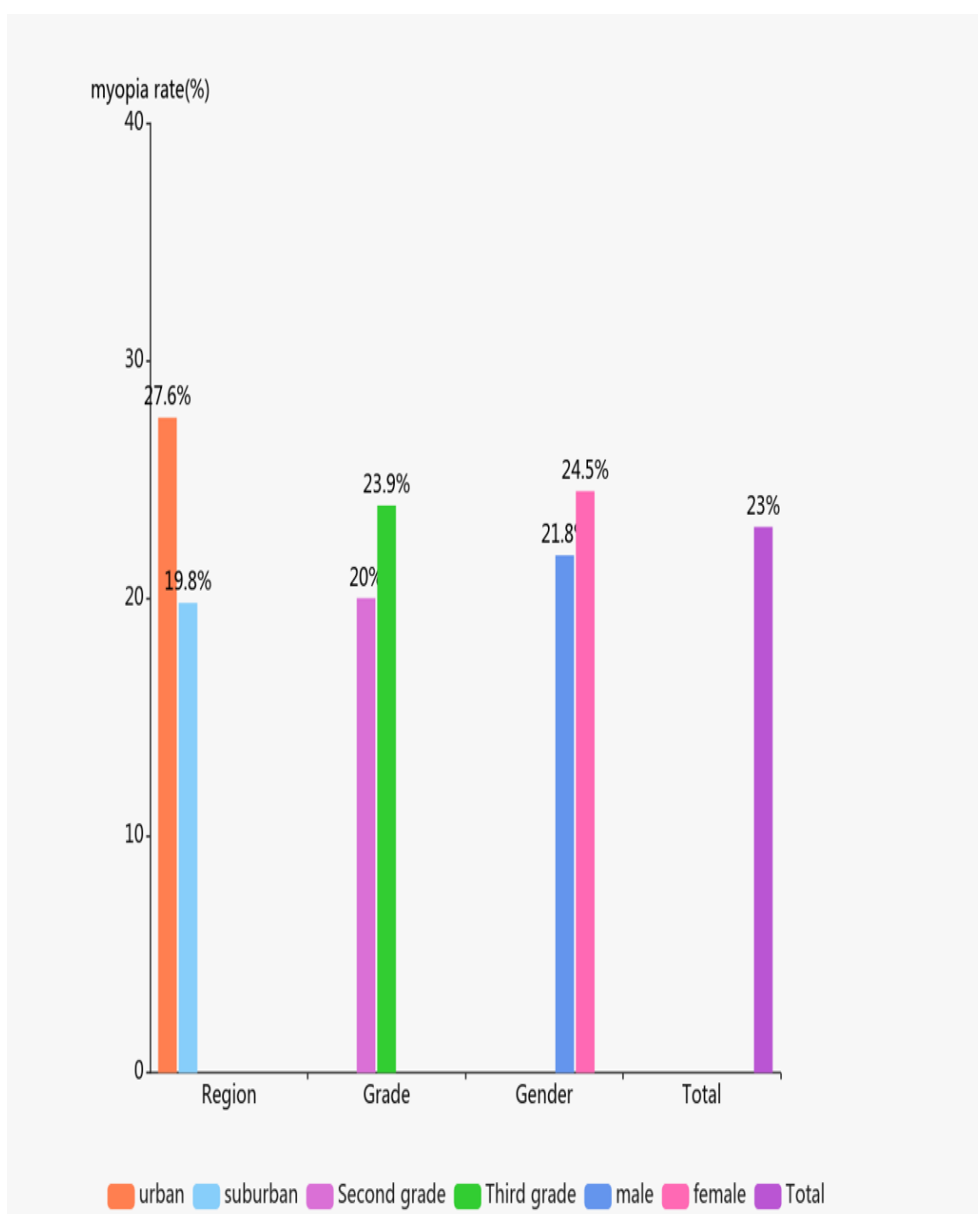| Variable	N(N%)	Myopia(N)	Myopia Rate
Region			
Urban	196(43.7%)	54	27.6%
Suburban	253(56.3%)	50	19.8%
Grade			
Second Grade	85(18.9%)	17	20.0%
Third Grade	364(81.1%)	87	23.9%
Gender			
Male	229(51.0)	50	21.8%
Female	220(49.0%)	54	24.5%
Total	449	104	23.2%

Figure 2. Comparison of myopia rates among people with different characteristics

3.2 Association between Walking to School and Myopia Prevalence

Myopia was found in 15.4% of students who walked to school for ⩾30min per day, 23.1% of students who walked to school for <30min per day, and 29.8% of students who did not walk to and from school per day. Students who walk longer to school have lower myopia rates. Using whether myopia was the dependent variable (0 = no myopia, 1 = myopia), a binary logestic regression analysis with an entry method to include walking to and from school time and other confounding factors that needed to be controlled, the results showed that after controlling for confounding factors such as region, grade, gender, myopia genetic background, participation in extracurricular classes, sleep time, and time spent doing housework, the daily walking time school was negatively associated with myopia occurrence and was a protective factor for myopia occurrence (OR < 1, P < 0.05) (Table 2).

Table 2. Logistic regression analysis of walking to and from school and prevalence of myopia

Variables	$Waldc^2$	P	OR	95%CI
Region				
urban			1	
suburban	0.009	0.926	0.974	0.561~1.692
Grade				
Second grade			1	
Third grade	4.416	0.036	2.122	1.052~4.281
Gender				
male			1	
female	0.362	0.547	1.173	0.698~1.970
Daily walking time to school	5.683	0.058		
0min			1	
<30min	3.319	0.068	0.538	0.276~1.048
≥30min	4.997	0.025	0.316	0.115~0.868
Myopia genetic background	30.781	<0.001		
Neither parent is nearsighted			1	
One parent is myopic	20.682	<0.001	4.010	2.204~7.297
Both parents are myopic	25.867	<0.001	6.692	3.217~13.922
Daily after-school reading and writing time	0.421	0.810		
0 or <1h				
1-2h	0.320	0.572	1.182	0.663~2.108
≥2h	0.233	0.629	1.187	0.591~2.385
Daily housework time				
0 or <20min			1	
≥20min	2.179	0.140	0.672	0.396~1.139
Daily sleep time during the week				
<10h			1	
≥10h	0.076	0.783	0.929	0.553~1.563
Attend cultural extracurricular classes				
No			1	
Yes	1.763	0.184	1.592	0.802~3.161
Daily use of mobile electronic devices time	0.935	0.627		
0				
<1h	0.416	0.519	1.197	0.694~2.064
≥1h	0.233	0.629	0.777	0.278~2.167
Constants	10.173	0.001	0.118	

3.3. Analysis of Students with Different Characteristics Walking to School

In this survey, 81.3% of the students walked to school every day, while 18.7% go to school by other means. The percentage of students walking to school was higher in urban areas (85.7%) than in suburban counties (77.9%) and higher in second grade (91.8%) than in third grade (78.8%). The percentage of students walking to school was lower for those who used mobile electronic devices for a longer period of time per day, with no use of mobile electronic devices (88.5%), using mobile electronic devices for <1h (78.8%), and using mobile electronic devices for ≥1h (59.0%).Whether

or not students walked to school differed by region, grade level, time spent using mobile electronic devices per day, and whether or not they attended extracurricular classes. The differences were statistically significant (P < 0.05) (Table 3).

Table 3. Analysis of students with different characteristics walking to school

	n	Walking (%)	No walking (%)	χ^2	P
Region				4.473	0.034
urban	196	168(85.7)	28(14.3)		
suburban	253	197(77.9)	56(22.1)		
Gender				0.273	0.601
male	229	184(80.3)	45(19.7)		
female	220	181(82.3)	39(17.7)		
Grade				7.562	0.006
Second grade	85	78(91.8)	7(8.2)		
Third grade	364	287(78.8)	77(21.2)		
Daily after-school reading and writing time*				0.531	0.769
0 or <1h	220	182(82.7)	38(17.3)		
1-2h	120	97(80.8)	23(19.2)		
≥2h	79	67(84.8)	12(15.2)		
Daily use of mobile electronic devices time*				20.257	<0.001
0	192	170(88.5)	22(11.5)		
<1h	217	171(78.8)	46(21.2)		
≥1h	39	23(59.0)	16(41.0)		
Daily housework time*				5.137	0.023
0 or <20min	253	197(77.9)	56(22.1)		
≥20min	190	164(86.3)	26(13.7)		
Daily sleep time during the week*				1.183	0.277
≥10h	189	158(83.6)	31(16.4)		
<10h	258	206(79.5)	53(20.5)		
Attend extracurricular classes				8.359	0.004
Yes	378	316(83.6)	62(16.4)		
No	71	49(69.0)	22(31.0)		
Total	449	365(81.3)	84(18.7)		

Note: Variables marked with * are missing data for that variable.

4. Conclusions

In this survey, the self-reported myopia rate of 23.2% for students compared with the national myopia rate (20.7%) in lower elementary grades in 2020, is basically at the same level [1]. It also has little difference in myopia rates compared to a region of Xi'an and other regions in 2021 [7-9]. The current myopia data was obtained through student reports, but the school had pre-measured and provided feedback to the students on the results. From this it seems that the myopia data in this study are real and reliable.

Studies have found that the longer the total time spent outdoors, the lower the prevalence of myopia [10]. In this study, walking to school is a protective factor for the occurrence of myopia. The longer students walk to school each day, the more time they have for corresponding outdoor activities, the better the myopia prevention and control. On the other hand, studies have found that outdoor activities can prevent myopia primarily by being outdoors rather than by being active. The prevalence of myopia was lower in students with moderate or high light intensity for the same amount of time outdoors [11]. The physical activity generated by walking is not high, but the outdoor environment has a wide view and can be exposed to high intensity light. In addition, outdoor neareye use is usually lower, and the outdoor environment is also conducive to reducing eye strain, which may be the reason for the low myopia rate among students walking to school. The regression analysis showed that only walking ≥30 min per day was a protective factor against myopia, probably because 2 h of outdoor activity per day for primary and secondary school students is the basic amount to prevent the occurrence of myopia [12,13]. Children and adolescents in China spend a serious lack of time outdoors[14]. Walking to school every day can increase the daily outdoor time base by 0-1/4, and students who walk to school for ≥30min per day accumulate more outdoor time, the likelihood of achieving the 2h outdoor activity standard was higher, and the prevention of myopia was better.

Walking is still the primary mode of travel for students to school [15,16]. Compared to suburban areas, urban areas have a higher density of population and roads, and more basic facilities, together with our policy of "schooling in close proximity", have somewhat shortened the distance to school [17]. This is the main reason why more students walk to school in urban areas than in suburban counties. There were no gender differences in whether students walked to school in this study, but other studies have found higher rates of walking to school among boys [18,19]. Third graders are more independent in their travels, and as walking is the primary mode of road traffic injury for students, parents are more inclined to choose a safe mode of travel for them [20]. Therefore, more students walked to school in grade 2 than in grade 3. The time spent on electronic products and the time spent on physical activity were negatively correlated [21]. Thus, students who do not use electronic devices also walk to school more, while students who do daily Students who perform daily chores tend to be more active in transportation and walk to school.

In summary, students walking to school has a protective effect on myopia. The effects of walking to school may also have other effects, such as improving students' cardiopulmonary function, improving the progression of diseases such as obesity, reducing the occurrence of psychological disorders, and even having an impact on students' cognitive ability and academic performance [5, 22-24].In addition, walking to school is a way to increase outdoor activity time while not taking time away from school. This is also more acceptable to schools and parents. Therefore, schools and parents can work together to eliminate safety hazards around schools, explore and designate safe and reliable routes, accompany students to school or encourage them to walk to school in pairs. Relevant departments should strengthen the construction of traffic facilities around schools to provide a good walking environment for students, and also encourage more children to participate in walking to school by holding activities such as "walking month". Activities to encourage more children to participate in walking to school.

The current study has some limitations. The study was a status study and the strength of the validation association was not sufficient; the presence of unincluded confounding factors in the questionnaire may have had an impact on the study outcomes. Future studies should expand the sample size and include more confounding factors to better examine the association between walking to school and myopia.

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If any, should be placed before the references section without numbering.

Data Availability

The datasets used during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] National Health and Wellness Commission of the People's Republic of China. 2020 Press Conference [EB / OL]. [2021-9-25].

[2] XU Ke, ZHANG Sheng, LU Ci-yong. (2022)Association of outdoor activity with myopia among lower-grade primary school students in Guangzhou city: a follow-up study. Chinese Journal of Public Health, 6, 686-688.

[3] LIU Zhonghui, XU Ke, HOU Changchun. (2022) Progress in studying the influence and mechanism of outdoor activities on myopia in children. Chinese Journal of Prevention and Control of Chronic Diseases, 7,537-540.

[4] TAO Fangbiao, PAN Chenwei, WU Xiaoyan, HE Xiangui, GUO Xin, ZHANG Xin.(2019) Expert recommendation for outdoors activities as myopia prevention and control in children and adolescents. Chinese Journal of School Health, 5,641-643.

[5] ZHANG Yuanyuan, MA Chuanwei, XI Bo.(2016) Association between commuting modes to school and blood pressure levels in children and adolescents. Chinese Journal of School Health,10,1453-1456.

[6] Martin Anne, Boyle Jessica,Corlett Fenella,Kelly Paul,Reilly John J. (2016) Contribution of Walking to School to Individual and Population Moderate-Vigorous Intensity Physical Activity: Systematic Review and Meta-Analysis. Pediatric Exercise Science,3, 353-363. https://doi.org/10.1123/pes.2015-0207

[7] CHEN Wei-wei, ZHOU Xi-yuan, LI Ya-fei, LIU Dan-ning. (2021) Survey on status of vision and refractive state of primary and secondary school, Nan'an district, Chongqing city, 2019.Preventive Medicine Tribune, 11,803-806+811.

[8] GUO Xianghui, LIU Jing, ZHAO Jin.(2021)Survey on prevalence of myopia among 4935 children and adolescents, Chaoyang district, Beijing city,2020.Preventive Medicine Tribune,8,616-618.

[9] ZHAO Xingxing, LU Xin, LI Jian, YU Lu, ZHANG Yiping, LIU Yingyao, WANG Yuan, WANG Tiantian, CHEN Wenjun, DU Zhaojiang.(2022) Differences and causes of myopia among students in different stages in the same region in Xi'an. International Eye Science,9,1587-1591.

[10] Kathryn A. Rose, Ian G. Morgan, Jenny Ip, Annette Kifley, Son Huynh, Wayne Smith, Paul Mitchell.(2007) Outdoor Activity Reduces the Prevalence of Myopia in Children. Ophthalmology,8, 1279-1285. https://doi.org/10.1016/j.ophtha.2007.12.019

[11] Galvis V, Tello A, Gómez LM, Camacho PA, Ortiz RG. Re: Wu et al.(2018) Myopia prevention and outdoor light intensity in a school-based cluster randomized trial (Ophthalmology,11,1239-1250. https://doi.org/10.1016/j.ophtha.2018.06.003

[12] TAO Fangbiao. (2020) Expert interpretation on appropriate technical guidelines for prevention and control of myopia in children and adolescents. Chinese Journal of School Health,2,166-168+172.

[13] ZHANG Kang, LUO Dong-mei, FU Yan, ZHAO Xing, QU Sha.(2019) Effect of outdoor activities on myopia in school-age children: a meta-analysis. Modern Preventive Medicine,22,4089-4093.

[14] HAN Xiao, CHEN Hui, MIAN Li-na, MA Li-rong, YANG Wei, JIAO Xin-ran. (,2021) Survey on daytime outdoor activities of students in Dongcheng district of Beijing. Chinese Preventive Medicine,2,151-155.

[15] WANG Xia, CHEN Xiaojian. (2018) spatial-temporal characteristics and constraint of primary school commuting in XI'AN City. City Planning Review, 11,142-150.

[16] Zhang Ru, Lin Lin, Yang Jing.(2014) School-age Children Travel Mode Characteristics and Affecting Factors. Urban Transport of China,2,78-83.

[17] TANG Yo, ZHANG Ru, YANG Jing, LIU Kan. (2017) A Study of Travel Patterns of the School-age Children in Beijing. Journal of Transportation Engineering,2,53-57+64.

[18] HE Ling-ling.(2017) Correlates of Transport Related Physical Activity of School-age Children in Shanghai. East China Teachers' University.

[19] LIN Tao-yu, XIAO Zuo-peng.(2017) The Varying School Travel Mode Choices and Its Influence Factors: the case of Shenzhen, China. Traffic & Transportation, 2,90-94.

[20] HOU Qingbo, LEI Ruoqian, JIANG Hong, HU Lin. (2020) Analysis of the status and influence factors of road traffic injuries in children of Shashi District, Jingzhou City. Journal of Public Health and Preventive Medicine, 6,121-124.

[21] LONG Xin, ZHANG Xianan, ZHANG Hongwe, JI Ying, XIE Lijing.(2020)Prevalence and associated factors of electronic products usage among primary school students of grade 4-6 in Beijing. Chinese Journal of School Health,5,673-675+679.

[22] Andreia Nogueira Pizarro et al. (2013) Is walking to school associated with improved metabolic health?. International Journal of Behavioral Nutrition and Physical Activity,1,12. https://doi.org/10.1186/1479-5868-10-12

[23] Ramanathan Subha et al.(2014) Happiness in motion: emotions, well-being, and active school travel. The Journal of school health, 8,516-523. https://doi.org/10.1111/josh.12172

[24] Garcá-Hermoso A, Saavedra JM, Olloquequi J, Ramírez-Vélez R. (2017) Associations between the duration of active commuting to school and academic achievement in rural Chilean adolescents. Environ Health Prev Med.,1,31 https://doi.org/10.1186/s12199-017-0628-5