

Influence of age, gender, urban and rural environments as well as physical activity factors on the eyesight of students

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浙江省中小学学生视力影响因素的调查分析

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摘要

目的:通过对浙江省中小学学生视力状况及其影响因素的调查,为提供保护学生视力指南提出科学依据。

方法:抽取6600名7~17岁浙江省中小学学生,对其视力、身体活动态度和时间、看电脑电视时间等相关因素进行调查。视力测量采用对数视力表。

结果:浙江省中小学学生视力不良的比例为71.1%,超过同省2005年的水平,也超过同期全国的平均水平。7~17岁学生视力不良比例随年龄增长而增加,9岁儿童视力不良比例增速最快,女生视力不良比例高于男生。小学生和初中生的视力不具有城乡差异,城市高中生视力优于乡镇高中生。学生对体育运动的态度的、学生的体育运动时间等因素都与学生视力有正面的影响,看电视电脑的时间对视力的影响不具有显著性。

结论:年龄、性别、城市化发展因素都会影响学生视力发展,且身体活动因素对学生视力的正面作用值得关注。

关键词:身体活动;视力不良;人口统计学分析;学生视力

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Abstract

• **AIM:** To survey the eyesight status of students in the Zhejiang Province of China and its influencing factors, thereby providing a recommendation for eyesight protection of pupils.

• **METHODS:** Totally, 6600 school students aged from 7 to 17 in Zhejiang Province were included while their eyesight status in correlation with relevant factors such as physical activity attitude and duration spent with computer and TV were investigated. Visual inspection was performed by using standard logarithmic vision acuity charts.

• **RESULTS:** The prevalence of poor vision among high, middle and primary school students in China's Zhejiang Province has reached 71.1%, exceeding its level of 2005 and also the national average level in the same period. The rate of poor vision among 7-17 years old students increased with age, being fastest in children aged 9 years old and the rate of poor vision in girls is higher than in boys. The eyesight of primary and junior school students was not significant different between urban and rural areas, while the eyesight of urban was better than that of rural high school students. The students' attitude toward sports and time spending with sports in addition to other factors had a positive effect, whereas time spent in front of TV and computer did not significantly affected their eyesights.

• **CONCLUSION:** Age, sex and urbanization influence the development of students' eyesight and it is worth to pay close attention to the positive effects of physical activity.

• **KEYWORDS:** physical activity; poor vision; demographic analysis; student eyesight

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INTRODUCTION

The morbidity of poor vision among students is increasing worldwide, but particularly in China and some Southeast Asian countries the increase rate is dramatically^[1]. In 2010, Chinese student physical health investigation data showed, that the proportion of poor vision among Chinese students raised to a record and the detectable rate among primary students was already as high as 40.9%, raising to 67.3% among junior school students, 79.2% among high school students, while being 84.7% among college students^[2]. The morbidity of poor vision increases continuously, and the eyesight of students decreases continuously, thereby not only harming students health, but also influencing their study, daily life and employments. At present, most scholars believe that poor vision is related to both heredity and environmental factors, including degenerative changes, which resulted from complicated multiple factors^[3]. Since the model of monocular visual deprivation in monkeys has been first established by Wiesel and Raviola in 1977^[4], the establishment of experimental myopia animal models has become more and more mature and perfect, while various theories and mechanistic studies were proposed and undoubtedly^[1,3], the understanding of poor vision development and its treatment will be beneficially broadened eventually. However, there are various theories about impact mechanisms on eyesight at present and study subject pattern differ from humans, so that instructions cannot be provided for the public at present.

As a coastal province, the economy of the Zhejiang is high developed, but though the educational facilities, teacher preparation and medical conditions are at the forefront of the domestic counterparts, a previous survey revealed that the proportion of poor vision among students was at a higher level in this area^[5].

In order to make a deep survey of this poor vision causes among middle and primary school students in the Zhejiang province, a research group performed a statistical analysis of data from investigations on the relation between students' physical health and vision, thus picturing the characteristics and influencing factors of poor vision among middle and primary school students in order to provide a scientific basis for prevention and treatment of poor vision among pupils in the future.

SUBJECTS AND METHODS

In October 2010 we involved 6 primary schools, 6 junior schools, and 6 high schools from physical health monitoring sites in the cities of Hangzhou, Ningbo and Jinhua in the Zhejiang province. We used a stratified cluster sampling method and selected 50 rural boys, 50 rural girls, 50 urban boys and 50 rural girls in each age group resulting in 6600 participants included in this investigation. Sports teacher and Ophthalmologist checked the eyesight and

made a questionnaire survey on influencing factors of vision among the students beyond fourth grade. The investigators underwent rigorous training and quality control at the investigation sites met the requirements. The illumination intensity of the visual testing chart light boxes were 500lx, while visual inspection was performed by using standard logarithmic vision acuity charts. In the case of the eye sight score of both sides were more than 5.0, it was considered as normal vision; in the case that either the left or right eye sight was less than 5.0, it was considered as poor vision, while 4.9 was considered as mild impaired vision, 4.6–4.8 as moderate impaired vision, and ≤ 4.5 as severe impaired vision^[6]. Finally, we accumulated 6598 solid data as a result (some data were lost in the process of questionnaire) (Table 1). Chi-square tests were used for comparing the rates of poor vision among students of different grades, *t* tests were used to analyze the visual difference between gender, urban and rural environments, computer and TV spending time, physical activity duration times and attitude toward sports. Variance analyses were used to analyze the visual differences among different cities. The research was approved by the Ethical committee of Zhejiang Normal University and Zhejiang University of Technology. And informed consent was obtained from all participants.

RESULTS

Proportion Of Poor Vision Among Students At Different Ages The data in Table 2 show that the proportion of poor vision among primary and junior students increased with age, but in high school then (aged from 15y to 17y), the proportion remained above 90%. The rate of poor vision increases reached the highest level on a sequential basis at the age of 9, which resulted from the fast vision deterioration among 8–9 years old pupils, and therefore prevention of poor vision should be started in the early years of primary school. In addition to the group of city boys, the proportion of poor vision in the junior 3 students of other 3 groups (14 years old) was even higher than that in the high school 1st grade student group.

Poor Vision Status In Different School Grades In 2005, the rate of poor vision among students in Zhejiang province was: 37.35% in primary schools, 78.55% in junior schools, and 90.0% in high schools. As visible in Table 1 the rate of poor vision among each grade of primary and middle students in 2010 was 9–17.5% above the average level of the students in 2005^[6]. Compared with the data in 2005, the gap between the primary students was widened and narrowed between junior students.

A Chi-square test was used to analyze the rates of poor visions, and the results showed that there were significant differences among different grades of students. The rate of poor vision increased with grade.

Table 1 Vision status indifferent grades of students and its influencing factors n(%)

| | Primary school | Junior school | High school | Total |
|--|------------------|-----------------|-----------------|------------------|
| Vision level | | | | |
| Normal | 50.1 (1502) | 15.2 (273) | 7.3 (131) | 23.7 (2075) |
| Mild impaired vision | 10.1 (302) | 4.9 (89) | 2.9 (53) | 5.9 (519) |
| Moderate impaired vision | 18.1 (543) | 17.1 (308) | 10.5 (189) | 15.9 (1398) |
| Severe impaired vision | 21.7 (651) | 62.8 (1130) | 79.3 (1427) | 54.5 (4773) |
| Gender difference of visual acuity | | | | |
| Male | 4.86±0.31 (1498) | 4.54±0.38 (900) | 4.33±0.37 (900) | 4.63±0.41 (3298) |
| Female | 4.84±0.30 (1500) | 4.47±0.37 (900) | 4.29±0.37 (900) | 4.59±0.41 (3300) |
| <i>t</i> -test | <i>P</i> <0.05 | <i>P</i> <0.001 | <i>P</i> <0.05 | <i>P</i> <0.001 |
| Vision difference between students in urban and rural areas | | | | |
| Urban | 4.84±0.31 (1498) | 4.52±0.38 (900) | 4.35±0.37 (900) | 4.62±0.42 (3298) |
| Rural | 4.86±0.31 (1500) | 4.51±0.38 (900) | 4.29±0.37 (900) | 4.60±0.41 (3300) |
| <i>t</i> -test | <i>P</i> >0.05 | <i>P</i> >0.05 | <i>P</i> <0.001 | <i>P</i> <0.05 |
| Vision difference between students in different area | | | | |
| Hangzhou | 4.83±0.32(1000) | 4.50±0.39 (600) | 4.28±0.43 (600) | 4.59±0.44 (2200) |
| Ningbo | 4.86±0.31(1000) | 4.47±0.35 (600) | 4.29±0.30 (600) | 4.60±0.40 (2200) |
| Jinhua | 4.85±0.31(998) | 4.57±0.38 (600) | 4.38±0.37 (600) | 4.65±0.40 (2198) |
| <i>F</i> test | <i>P</i> >0.05 | <i>P</i> <0.001 | <i>P</i> <0.001 | <i>P</i> <0.001 |
| Computer and TV time per day | | | | |
| Half an hour and above | 4.81±0.34(621) | 4.53±0.38 (621) | 4.32±0.36(749) | 4.54±0.41 (1991) |
| Within half an hour | 4.77±0.34(1162) | 4.49±0.38(1138) | 4.31±0.38 (951) | 4.54±0.41 (3258) |
| | <i>P</i> >0.05 | <i>P</i> <0.05 | <i>P</i> >0.05 | <i>P</i> >0.05 |
| Attitude toward physical activity | | | | |
| Like and like very much | 4.79±0.34(968) | 4.55±0.37 (472) | 4.32±0.38(272) | 4.65±0.40(1712) |
| A little like and dislike | 4.78±0.34(819) | 4.50±0.38(1287) | 4.30±0.37(1430) | 4.49±0.41(3536) |
| | <i>P</i> >0.05 | <i>P</i> <0.05 | <i>P</i> >0.05 | <i>P</i> <0.001 |
| Physical activity time | | | | |
| An hour and above | 4.80±0.34 (907) | 4.51±0.37 (750) | 4.32±0.38(179) | 4.64±0.39(1836) |
| Less than an hour | 4.77±0.35 (884) | 4.51±0.38(1017) | 4.31±0.37(1537) | 4.48±0.41(3438) |
| | <i>P</i> <0.05 | <i>P</i> >0.05 | <i>P</i> >0.05 | <i>P</i> <0.001 |

Table 2 Number (Percentage) of impaired visions in students of different ages n(%)

| Age | Rural boy | Rural girl | City boy | City girl | Total | LRR(%) |
|-------|-------------|-------------|-------------|-------------|-------------|--------|
| 7 | 42 (28.0) | 42 (28.0) | 45 (30) | 57 (38.0) | 186 (31.0) | |
| 8 | 48 (32.0) | 60 (40.0) | 59 (39.3) | 63 (42.0) | 230 (38.3) | 123.6 |
| 9 | 72 (48.0) | 86 (57.3) | 70 (46.7) | 80 (53.3) | 308 (51.3) | 133.9 |
| 10 | 83 (55.3) | 93 (62.0) | 88 (59.5) | 91 (60.7) | 355 (59.4) | 115.6 |
| 11 | 104 (69.3) | 116 (77.3) | 95 (63.3) | 102 (68.0) | 417 (69.5) | 117.1 |
| 12 | 111 (74.0) | 117 (78.0) | 117 (78.0) | 118 (78.7) | 463 (77.2) | 111.0 |
| 13 | 127 (84.7) | 133 (88.7) | 127 (84.7) | 131 (87.3) | 518 (86.3) | 111.8 |
| 14 | 139 (92.7) | 141 (94.0) | 127 (84.7) | 139 (92.7) | 546 (91.0) | 105.4 |
| 15 | 134 (89.3) | 138 (92.0) | 134 (89.3) | 138 (92.0) | 544 (90.7) | 99.6 |
| 16 | 140 (93.3) | 145 (92.7) | 139 (92.7) | 143 (95.3) | 567 (94.5) | 104.2 |
| 17 | 142 (94.7) | 138 (92.0) | 137 (91.3) | 141 (94.0) | 558 (93.0) | 98.4 |
| Total | 1142 (69.2) | 1209 (79.3) | 1138 (69.1) | 1203 (72.9) | 4692 (71.1) | |

LRR: The rate of poor vision in the age group vs the rate of poor vision in the above age group.

Students' Visual Differences Between Gender In high school, the rate of poor vision reached 90%, however, as shown in Table 1, there were significant differences between gender in primary, junior and high school and the eyesight of

boys was generally better than that of girls.

Students' Visual Differences Between Urban And Rural Areas As shown in Table 1, rural primary students' eyesight was better than that of city primary students, but without

significant difference, whereas in high school the eyesight of city students were significantly better than that of rural students.

Students' Visual Differences Among Different Cities This physical health investigation was performed in Hangzhou, Ningbo and Jinhua, which represent three social and economical development levels of the Zhejiang Province (good, moderate and poor). In the investigation, no significant visual differences of primary students were found among the 3 cities, while there were significant differences among junior and high school students in the 3 cities. The eyesight of middle school students in Jinhua was significantly better than that in Hangzhou and Ningbo, but no significant visual differences were found between students in Hangzhou and Ningbo.

Influence of Other Factors On Students Vision In this investigation, we included students in the fourth grade and above and possible influencing factors on students vision fell into three categories: time spent with computer and TV; attitudes toward physical activity classes, after-class physical activities and long - distance running as well as physical activity times per day.

There was no influence of computer and TV usage time on eyesight of primary and high school students, but as far as junior students were concerned, the eyesight of students who spend more than half an hour with computer and TV were significantly better than those who spend less than half an hour, but the overall influence was not significant ($P>0.05$, Table 1).

Take together, students' acceptance of physical activity and physical activity time had a significantly impact on their vision, but there were no visual significant differences among each grades of students.

DISCUSSION

There are various researches about influencing factors on eyesight of students and most scholars thought that vision is a result of congenital hereditary and environment^[1,3]. In our study the eyesight of primary and middle school students decreased with increasing age^[7,8], and there were visual differences between urban and rural areas^[9], as well as between boys and girls^[1,10]. The major poor vision type is myopia, which is considered to be a result of visual axis extension during development of children^[7,11]; however, some others thought that myopia may be attributed to development of education and urbanization^[12,13], as well as repeated short - distance eye use for long times^[5].

According to a preliminary report, age may be an important factor leading to poor vision. With the increase of age, the proportion of poor vision among 7 - 17 years old students gradually increasing, with fastest changes on a sequential basis at the age of 9. In 1999, a myopia survey among 7-12

years old children in Hongkong showed that the rate of myopia grew fastest at the age of 9-11 and similar results were noted in a Japanese survey of 1999^[7,8], while the outcome of this study is in agreement with this previous reports.

Students' visual differences between urban and rural areas in Zhejiang province were: no significant visual difference existed among primary and junior pupils, while in high school, the eyesight of urban students was significantly better than that of rural students. Many previous studies have shown that eyesight of urban students was worse than that of rural students^[12-14], which is not consistent with our results, which might be attributed to advanced developed private economy and a narrowed gap between urban and rural areas in the Zhejiang province. Generally speaking, school facilities and teachers of urban areas are superior to that of rural areas, thereby providing better conditions for the protection of the eyesight. Compared with urban families, living conditions and incomes of rural people are worse and the primary and junior students return home directly every day, thus, these social and economic factors may be helpful for the protection of rural students vision^[15]. Therefore, as far as the factor of family is concerned, eyesight of rural students would be better protected, but when the factor of school is concerned, eyesight of urban students would be better protected, thereby offsetting each other, because no significant visual difference of primary and junior students was found between urban and rural areas. In high school, most of students board at school, thus school becomes a dominant factor, and eyesight of urban students is better than that of rural students. This survey revealed that there was little impact of time spent with computer and TV on students' visions and the traditional view of eye health may not be evident, particularly regarding time of watching a screen, as results of this research are consistent with that of other domestic and international researchers^[16-18] which showed that the impact of outdoor activity was more dramatic for students' vision.

Physical activity was significantly correlated with students' visions, because those who spend more than an hour on physical activity had a better vision. However, according to our survey, with increasing age, the vision still tended to become bad whether or not join in physical activity, but further research would be needed to illuminate the detailed associations between age, physical activity and vision.

In this investigation, the city of Hangzhou, Ningbo and Jinhua respectively represented three economic and cultural levels of the Zhejiang province, and number of population in the three cities was 4348000, 2234000 and 932000 at the end of 2010. The visual differences among the cities showed that eyesight of students in small cities was better than that in big cities, which coincided with the idea that development of education and urbanization leads to poor vision^[12,15]. Taken

together, the level of economic development and culture in Zhejiang province was higher than the average level of China and therefore, the rate of poor vision in Zhejiang province was also higher than the average level of China.

In conclusion, there are various factors, which might have an impact on students' vision, such as age, gender and urbanization and it is worth paying further attention to the probability of protecting the vision of students via physical activity.

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