

Analysis of Visual Screening Status for Preschool Children Aged 5 to 6 Years in Linhai City

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Abstract

Objective: To survey the prevalence and main influencing factors of vision for preschool children aged 5 to 6 years in Linhai City, in order to provide a scientific basis for developing children's eye health care. **Methods:** A random cluster sampling method was used to investigate 1591 children aged 5 to 6 years from four kindergartens and their branches in the urban area of Linhai City. Record their vision screening results, and their parents are required to fill out relevant questionnaire. **Results:** A total of 1591 children aged 5 to 6 years who completed the visual acuity examination and questionnaire survey, the prevalence of low naked eye vision was 17.79% (283/1591), the prevalence of ametropia was 26.15% (416/1591), and the prevalence of visual abnormality was 27.47% (437/1591). Among ametropia, there were 199 cases of astigmatism (47.84%), 176 cases of myopia (42.31%), 15 cases of hyperopia (3.61%), 15 cases of hyperopia astigmatism (3.61%), and 11 cases of myopia astigmatism (2.64%). Multivariate logistic regression analysis showed that eating less vitamin A or carotene foods in daily diet, watching electronic screens those are too bright or too dark, spending less than 2 h outdoors, and watching electronic products for more than 30 minutes each time are risk factors for children with abnormal vision. **Conclusion:** In family life, it is necessary to pay attention to the balanced nutrition of children, take children to participate in outdoor activities frequently, and control the use of electronic products by preschool children strictly. At the same time, visual acuity screening should be applied to children aged 5 to 6 years old early so that problems can be identified as soon as possible, and intervention measures can be implemented timely.

Keywords

Preschool Children Aged 5 to 6 Years, Visual Acuity Screening, Visual

1. Introduction

Children aged 5 to 6 are in a sensitive stage of visual development and a critical period for the cultivation of eye hygiene habits [1]. With the advent of the Internet era, the incidence of visual abnormalities is increasingly occurring at younger ages, especially among preschool children aged 5 to 6. Excessive and frequent exposure to television and computer screens, coupled with insufficient outdoor activities, are significant factors contributing to visual development disorders [2]. This study aims to analyze the vision screening results and influencing factors among preschool children aged 5 to 6 in our city, providing a basis for implementing effective intervention measures.

2. Methods

2.1. Study Design and Sample

A random overall sampling method was used to select all 5 - 6 years old children from four kindergartens and their branches in our city in June 2023. A total of 1591 children were examined for vision (excluding children with strabismus and organic eye diseases), including 855 boys and 736 girls. At the same time, parents of the children filled out a questionnaire survey on factors related to visual abnormalities. This study was approved by the Medical Ethics Committee of Linhai Maternal and Child Health Hospital, and the survey was conducted voluntarily and anonymously.

We strictly follow the instructions of international standard visual acuity charts or standard logarithmic visual acuity charts. The monocular uncorrected visual acuity of children is used as a standard to determine whether their vision is abnormal. Weilun SureSight vision screening device is used to check refractive parameters. The survey on family situation is conducted in the form of a self-administered questionnaire, which is filled out by parents of children aged 5 - 6. The questionnaire mainly includes gender, age, nutritional feeding, electronic product use, etc.

2.2. Indicator Definition

According to the "Notice of the General Office of the National Health Commission on Issuing the Norms for Eye Health Care and Vision Examination Services for Children Aged 0 - 6 (Trial)" formulated in 2021, the judgment criteria for visual impairment and refractive abnormalities can be determined. If any of the following conditions occur in any one eye, the preliminary diagnosis can be determined: uncorrected visual acuity ≤ 4.9 (0.8) for children aged 5 and above, or visual acuity difference of two lines or more (standard logarithmic visual acuity chart), or visual acuity difference of 0.2 or more (international standard visual

acuity chart) between two eyes, it is considered low vision; ametropia: astigmatism > 1.50 D, hyperopia > +3.50 D, myopia < -1.50 D [3]. Children with low vision or ametropia are considered to have visual abnormalities [4].

2.3. Statistical Processing

SPSS 27.0 software was used for data analysis in this study. The count data is expressed as a percentage. Chi-squared test were used for analysis and Multivariate logistic regression analysis was used for multivariate analysis. $P < 0.05$ indicates a statistically significant difference.

3. Results

3.1. Test Results for Abnormal Vision

In Linhai City, Zhejiang Province, a total of 1591 preschool children aged 5 - 6 years underwent visual examinations and filled out questionnaires. The detection rate of abnormal vision was 27.47% (437/1591), including 17.79% (283/1591) of low naked eye vision and 26.15% (416/1591) of refractive abnormalities. Among individuals with refractive abnormalities, 199 people (47.84%) had astigmatism, 176 people (42.31%) had myopia, 15 people (3.61%) had hyperopia, 15 people (3.61%) had hyperopic astigmatism, and 11 people (2.64%) had myopic astigmatism.

3.2. Comparison of Detection Rates

The detection rate of abnormal vision in girls is higher than that in boys, but the results are not statistically significant. There is no statistically significant difference between genders ($P > 0.05$) in the detection rate of low vision and refractive abnormalities (myopia, hyperopia, astigmatism, myopic astigmatism, and hyperopic astigmatism), as shown in **Table 1**.

Table 1. Comparison of detection rates of abnormal vision in preschool children aged 5-6 years old of different genders (n, %).

| Factors | Abnormal vision (n = 437) | Low vision (n = 283) | Refractive abnormalities (n = 416) | | | | |
|----------|------------------------------|-------------------------|------------------------------------|-----------------------|--------------------------|-----------------------------------|--------------------------------------|
| | | | Myopia (n = 176) | Hyperopia (n = 15) | Astigmatism (n = 199) | Myopic astigmatism (n = 11) | Hyperopic astigmatism (n = 15) |
| Male | 222 (25.96) | 138 (16.14) | 93 (10.88) | 5 (0.58) | 99 (11.58) | 4 (0.47) | 9 (1.05) |
| Female | 215 (29.21) | 145 (19.70) | 83 (11.28) | 10 (1.36) | 100 (13.59) | 7 (0.95) | 6 (0.82) |
| χ^2 | 2.093 | 3.429 | 0.064 | 2.537 | 1.457 | 1.345 | 0.239 |
| P | 0.159 | 0.066 | 0.810 | 0.125 | 0.254 | 0.364 | 0.796 |

3.3. Univariate Analysis

Univariate analysis showed that the following Twelve factors were risk factors for abnormal vision in children, the mother spent 3 months before pregnancy watching electronic products every day, the mother's educational level, the first or second born Children, whether the child's daily diet consumed less vitamin A or ca-

rotenoid foods, whether the child's daily diet consumed less dark green fruits and vegetables, whether the child watched electronic products for more than 30 minutes each time, the child's cumulative time watching electronic products per day, whether the child's screen brightness was abnormal (the screen was too bright or too dark), whether the child watched electronic products too close, whether the child regularly paid attention to the child's eye discomfort symptoms (such as dry eyes, red eyes, itchy eyes, stinging, tears, etc.), the average daily outdoor activity time and the average daily sleep time of children ($P < 0.05$), as shown in **Table 2**.

Table 2. Univariate analysis of factors affecting visual abnormalities in preschool children aged 5 - 6 (n, %).

| Factors | Normal vision (n = 1154) | Abnormal vision (n = 437) | χ^2 | P |
|---|--------------------------|---------------------------|----------|--------|
| the mother spent 3 months before pregnancy watching electronic products every day | | | 12.753 | 0.002 |
| within 2hours | 565 (76.25) | 176 (23.75) | | |
| 2~6hours | 471 (70.72) | 195 (29.28) | | |
| more than 6hour | 118 (64.13) | 66 (35.87) | | |
| the mother's educational level | | | 8.824 | 0.032 |
| graduate degree and above | 53 (81.54) | 12 (18.46) | | |
| bachelor degree | 662 (72.11) | 256 (27.89) | | |
| associate degree | 251 (68.58) | 115 (31.42) | | |
| high school diploma and below | 188 (77.69) | 54 (22.31) | | |
| the first or second born Children | | | 8.308 | 0.005 |
| the first | 470 (68.81) | 213 (31.19) | | |
| the second and above | 684 (75.33) | 224 (24.67) | | |
| whether the child's daily diet consumed less vitamin A or carotenoid foods | | | 19.438 | <0.001 |
| yes | 405 (66.28) | 206 (33.72) | | |
| no | 749 (76.43) | 231 (23.57) | | |
| whether the child's daily diet consumed less dark green fruits and vegetables | | | 7.970 | 0.005 |
| yes | 503 (69.09) | 225 (30.91) | | |
| no | 651 (75.43) | 212 (24.57) | | |
| whether the child watched electronic products for more than 30 minutes each time | | | 7.200 | 0.008 |
| yes | 725 (70.32) | 306 (29.68) | | |
| no | 429 (76.61) | 131 (23.39) | | |
| the child's cumulative time watching electronic products per day | | | | |
| within half an hour | 236 (73.98) | 83 (26.02) | 18.257 | <0.001 |
| 0.5 - 1 hour | 422 (75.76) | 135 (24.24) | | |
| 1 - 2 hours | 333 (73.67) | 119 (26.33) | | |
| more than 2 hours | 163 (61.98) | 100 (38.02) | | |

Continued

| | | | |
|---|--------------|-------------|--------|
| whether the child's screen brightness was abnormal (the screen was too bright or too dark) | | 12.029 | <0.001 |
| yes | 111 (61.67) | 69 (38.33) | |
| no | 1043 (73.92) | 368 (26.08) | |
| whether the child watched electronic products too close (TV < 300 cm, computer/tablet < 50 cm, mobile phone < 30 cm) | | 9.017 | 0.003 |
| yes | 335 (67.54) | 161 (32.46) | |
| no | 819 (74.79) | 276 (25.21) | |
| whether the child regularly paid attention to the child's eye discomfort symptoms (such as dry eyes, red eyes, itchy eyes, stinging, tears, etc.) | | 4.761 | 0.037 |
| yes | 112 (65.50) | 59 (34.50) | |
| no | 1042 (73.38) | 378 (26.62) | |
| the average daily outdoor activity time | | 7.664 | 0.005 |
| within 2 hours | 841 (70.73) | 348 (29.27) | |
| more than 2 hours | 313 (77.86) | 89 (22.14) | |
| the average daily sleep time of children | | 10.202 | 0.006 |
| within 8 hours | 144 (64.29) | 80 (35.71) | |
| 8 - 10 hours | 888 (73.39) | 322 (26.61) | |
| more than 10 hours | 122 (77.71) | 35 (22.29) | |

3.4. Multi Factor Logistic Regression Analysis

The dependent variable was whether the preschool children aged 5 - 6 years old had visual abnormalities. In univariate analysis, $P < 0$. The influencing factors of 05 were used as independent variables, and multiple logistic regression analysis was conducted. The results showed that low intake of vitamin A or carotenoid foods in the diet, abnormal screen brightness of electronic products (too bright or too dark), average daily outdoor activity time of children < 2 hours, children watching electronic products for more than 30 minutes each time, and children using electronic products too close to each other would increase the risk of visual abnormalities in children to varying degrees. The factor assignment method is shown in **Table 3**, and the results of the multiple logistic regression analysis are shown in **Table 4**.

Table 3. Factor assignment method.

| Factors | Assignment and significance |
|---|---|
| Abnormal vision | yes = 0, no = 1 |
| during the first 3 months of pregnancy, the mother's daily time spent watching electronic devices | Within 2 hours = 1; 2 - 6 hours = 2; more than 6 hours = 3 |
| mother's educational level | set dummy variables (graduate degree and above; bachelor degree; associate degree; high school diploma and below) |

Continued

| | |
|---|--|
| the first or second born Children | the first = 1; the second and above = 2 |
| whether the child's daily diet consumed less vitamin A or carotenoid foods | yes = 0; no = 1 |
| whether the child's daily diet consumed less dark green fruits and vegetables | yes = 0; no = 1 |
| whether the child watched electronic products for more than 30 minutes each time | yes = 0; no = 1 |
| children's cumulative daily viewing time of electronic products | within half hour = 1; 0.5 - 1 hour = 2; 1 - 2 hours = 3; more than 2 hours = 4 |
| whether the child's screen brightness was abnormal (the screen was too bright or too dark) | yes = 0; no = 1 |
| whether the child watched electronic products too close (TV < 300 cm, computer/tablet < 50 cm, mobile phone < 30 cm) | yes = 0; no = 1 |
| whether the child regularly paid attention to the child's eye discomfort symptoms (such as dry eyes, red eyes, itchy eyes, stinging, tears, etc.) | yes = 0; no = 1 |
| The average daily outdoor activity time of children < 2 h | yes = 0; no = 1 |
| the average daily sleep time of children | within 8 hours = 1; 8 - 10 hours = 2; more than 10 hours = 3 |

Table 4. Multivariate logistic regression analysis of factors influencing visual abnormalities in preschool children aged 5 - 6 years old.

| Factors | B | Standard Error | Wald χ^2 | P | OR | 95% CI |
|---|-------|----------------|---------------|-------|-------|---------------|
| eat less vitamin A or carotenoid foods | 0.288 | 0.086 | 11.129 | 0.002 | 1.334 | 1.102 - 2.657 |
| abnormal brightness of electronic product screen | 0.509 | 0.263 | 9.528 | 0.011 | 1.664 | 1.125 - 2.460 |
| the average daily outdoor activity time of children < 2 h | 0.902 | 0.372 | 6.426 | 0.021 | 2.464 | 1.074 - 5.653 |
| children watch electronic products for more than 30 minutes each time | 0.758 | 0.426 | 4.539 | 0.037 | 2.134 | 1.423 - 3.795 |
| children using electronic products too close | 0.935 | 0.135 | 6.562 | 0.025 | 2.546 | 1.234 - 2.856 |

4. Discussion

This study shows that the detection rate of visual abnormalities in preschool children aged 5 - 6 in Linhai City is 27.47%, slightly higher than that in Quzhou City (26.8%), and significantly higher than that in Wenzhou City (14.73%). The rate of low visual acuity in naked eyes is 17.79%, which is lower than the low visual acuity rate of 6-year-old children newly enrolled in Jinshan District, Shanghai (27.78%), and significantly higher than that in Haidian District, Beijing (5.97% - 7.57%).

The detection rate of refractive abnormalities in preschool children aged 5-6 in Linhai City was 26.15% in this survey, with astigmatism (47.84%) accounting for the highest proportion of refractive abnormalities, followed by myopia (42.31%) [5]. Consistent with the research of Australia [6]. Astigmatism in children can

easily lead to refractive amblyopia, so the problem of astigmatism in children aged 5 - 6 deserves sufficient attention. Research [7] shows that approximately one-fifth of blindness worldwide is caused by refractive abnormalities, primarily myopia. Excessive screen time and a large amount of radiation stimulation can affect children's refractive development and easily lead to refractive abnormalities such as myopia and astigmatism.

There are many influencing factors for visual abnormalities in preschool children, and their occurrence is the result of a combination of genetic and environmental factors. This study used logistic regression to analyze the common influencing factors of visual abnormalities in preschool children aged 5 - 6 years old [8]. The results showed that low intake of vitamin A or carotenoid foods in diet, abnormal screen brightness of electronic products (too bright or too dark), average daily outdoor activity time of children < 2 hours, children watching electronic products for more than 30 minutes each time, and children using electronic products too close to each other were still associated with the occurrence of visual abnormalities in children [9]. The normal development of children's vision depends on comprehensive and balanced nutrition [10]. In this study, the results of multiple factor analysis showed that a lack of vitamin A and carotenoid foods in children's diet is a risk factor affecting their visual development. Carotenoids are converted into vitamin A in the body to promote normal secretion of mucosal epithelium and ensure normal visual development [11]. Approximately 250,000 to 500,000 children worldwide go blind each year due to a lack of vitamin A, with nearly half of them dying from blindness within a year. It can be seen that vitamin A and carotenoid foods provide sufficient nutritional support for visual development, which is crucial for children's visual development.

With the popularity of television, computers, and mobile phones, electronic products are being used more frequently in family life [12]. In this study, the results of multiple factor analysis showed that children who watch electronic products for more than 30 minutes each time have abnormal screen brightness, and children who use electronic products too close ($P < 0.05$) are risk factors for visual abnormalities in children [13]. When children use electronic devices too close, the screen is too bright or dark, and the viewing time is too long, the ciliary muscle will spasm due to long-term tension, causing blurred vision in the eyes, accompanied by a series of uncomfortable symptoms such as dryness, pain, and tears. Long term use of this can lead to abnormal vision [14].

This study also showed that an average daily outdoor activity time of less than 2 hours is a risk factor for visual abnormalities in children aged 5 - 6, which is consistent with the research of France [15]. When children participate in outdoor activities, light reduces the occurrence of myopia by promoting the release of dopamine from the retina [16], and outdoor light can also promote further development and maturity of vision [17]. Therefore, children's participation in outdoor activities can help protect their eyesight. Xu Lan's research also shows that the longer preschool children engage in outdoor activities, the lower their rate of vis-

ual impairment.

5. Conclusion

The situation of visual abnormalities in preschool children aged 5 - 6 in Linhai City is severe. Ensuring balanced nutrition for children, supplementing with vitamin A and carotenoid foods in their daily diet, strictly controlling the distance, time, and brightness of electronic products used by young children, and encouraging children to participate in outdoor activities when the weather is suitable are all measures to protect their vision. Strengthening education on reasonable eye use and early screening of the visual acuity of preschool children aged 5 - 6 can detect problems early and take corresponding intervention measures in a timely manner. By combining education, conservation, and medical care, we can jointly promote the healthy development of children's vision.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Wahl, M.D., Fishman, D., Block, S.S., Baldonado, K.N., Friedman, D.S., Repka, M.X., *et al.* (2021) A Comprehensive Review of State Vision Screening Mandates for Schoolchildren in the United States. *Optometry and Vision Science*, **98**, 490-499. <https://doi.org/10.1097/OPX.0000000000001686>
- [2] Reddy, R.S.P., Kiran, C., Gowthami, V., *et al.* (2013) A Study on Visual Status in Children with Autistic Spectral Disease at Shraddha Center in Hyderabad City. *Investigative Ophthalmology & Visual Science*, **54**, 1-5.
- [3] Gower, E.W., Silverman, E., Cassard, S.D., Williams, S.K., Baldonado, K. and Friedman, D.S. (2013) Barriers to Attending an Eye Examination after Vision Screening Referral within a Vulnerable Population. *Journal of Health Care for the Poor and Underserved*, **24**, 1042-1052. <https://doi.org/10.1353/hpu.2013.0134>
- [4] Laitinen, A., Koskinen, S., Rudanko, S., Martelin, T., Laatikainen, L. and Aromaa, A. (2008) Use of Eye Care Services and Need for Assistance in the Visually Impaired. *Optometry and Vision Science*, **85**, 341-349. <https://doi.org/10.1097/OPX.0b013e31816bea29>
- [5] Li, L., Su, Y., Chen, C., Feng, C., Zheng, H. and Xing, Y. (2011) Sweep Pattern Visual Evoked Potential Acuity in Children during Their Periods of Visual Development. *Ophthalmologica*, **226**, 220-227. <https://doi.org/10.1159/000329866>
- [6] Kapoor, V., Shah, S.P., Beckman, T. and Gole, G. (2021) Community Based Vision Screening in Preschool Children; Performance of the Spot Vision Screener and Optotype Testing. *Ophthalmic Epidemiology*, **29**, 417-425. <https://doi.org/10.1080/09286586.2021.1962918>
- [7] Marsh-Tootle Wendy, L., Russ Shirley, A., Repka Michael, X., *et al.* (2015) Vision and Eye Health in Children 36 to <72 Months: Proposed Data Definitions. *Optometry and Vision Science*, **92**, 17-23.
- [8] Altoaimi, B.H., Kollbaum, P., Meyer, D. and Bradley, A. (2018) Experimental Investigation of Accommodation in Eyes Fit with Multifocal Contact Lenses Using a Clinical Auto-Refractor. *Ophthalmic and Physiological Optics*, **38**, 152-163.

- <https://doi.org/10.1111/opo.12438>
- [9] Bourne, R.R.A., Flaxman, S.R., Braithwaite, T., Cicinelli, M.V., Das, A., Jonas, J.B., et al. (2017) Magnitude, Temporal Trends, and Projections of the Global Prevalence of Blindness and Distance and near Vision Impairment: A Systematic Review and Meta-Analysis. *The Lancet Global Health*, **5**, e888-e897. [https://doi.org/10.1016/s2214-109x\(17\)30293-0](https://doi.org/10.1016/s2214-109x(17)30293-0)
- [10] Huang, J., Dai, Y., Chen, X., et al. (2016) Analysis of Refractive State in 708 Children with Ametropic Amblyopia. *International Journal of Ophthalmology*, **16**, 185-187.
- [11] Yang, X., Jiang, H., Liao, M., Lin, M. and Wu, J. (2025) Construction of a Nomogram for Predicting Serum Vitamin D Deficiency in Children/Adolescents with New-Onset Type 1 Diabetes: A Single-Center Study in China. *Frontiers in Pediatrics*, **13**, Article ID: 1554833. <https://doi.org/10.3389/fped.2025.1554833>
- [12] Song, P., Wang, J., Wei, W., Chang, X., Wang, M. and An, L. (2017) The Prevalence of Vitamin a Deficiency in Chinese Children: A Systematic Review and Bayesian Meta-analysis. *Nutrients*, **9**, Article 1285. <https://doi.org/10.3390/nu9121285>
- [13] Liu, B., Jiang, S., Li, Z., Wang, Y., Zhou, D. and Chen, Z. (2022) Investigation and Analysis of Eye Discomfort Caused by Video Display Terminal Use among Medical Students Studying at High-Altitude Regions. *Frontiers in Public Health*, **10**, Article ID: 900539. <https://doi.org/10.3389/fpubh.2022.900539>
- [14] Saxena, R., Vashist, P., Tandon, R., Pandey, R.M., Bhardawaj, A., Gupta, V., et al. (2017) Incidence and Progression of Myopia and Associated Factors in Urban School Children in Delhi: The North India Myopia Study (NIM Study). *PLOS ONE*, **12**, e0189774. <https://doi.org/10.1371/journal.pone.0189774>
- [15] Ducrot, S. and Grainger, J. (2025) The Development of Letter Representations in Pre-school Children Is Affected by Visuomotor Integration Skills and Visual Field Asymmetries. *Journal of Experimental Child Psychology*, **257**, Article 106277. <https://doi.org/10.1016/j.jecp.2025.106277>
- [16] Ramamurthy, D., Lin chua, S.Y. and Saw, S. (2015) A Review of Environmental Risk Factors for Myopia during Early Life, Childhood and Adolescence. *Clinical and Experimental Optometry*, **98**, 497-506. <https://doi.org/10.1111/cxo.12346>
- [17] Foggia, E.D., Stoll, N., Meunier, H., et al. (2020) A New Visual Acuity Test on Touchpad for Vision Screening in Children. *International Journal of Ophthalmology*, **13**, 1436-1442. <https://doi.org/10.18240/ijo.2020.09.16>