Causes of Severe Visual Impairment and Blindness in Schools for the Blind

Hui-Yi Jin[1,2], Jiang-Nan He[1], Jian-Feng Zhu[1], Shan-Shan Li[1], Li-Na Lu[1], Xian-Gui He[1], Hong-Mei Xu[3], Xun-Jie Chen[3], Hai-Dong Zou[1,2]

[1]Department of Preventative Ophthalmology, Shanghai Eye Disease Prevention and Treatment Center, Shanghai 200040, China
[2]Department of Ophthalmology, Shanghai General Hospital, Shanghai Jiao Tong University, Shanghai 200080, China
[3]Department of Health Service, Shanghai Blind and Low Vision Children School, Shanghai 200336, China

To the Editor: Reduced vision impacts not only the individual but also the family, community, and public health. It leads to a significant economic burden, including increased education cost, reduced personal income, and loss of productivity for caregivers, and numerous intangible consequences, such as loss of independence, reduced quality of life, and excess morbidity for individuals. An estimated 19 million of the world's children are visually impaired, while 1.4 million are blind, according to the World Health Organization (WHO) criteria. Therefore, the control of visual impairment or blindness (VI/BL) in children is still one of the priority areas of the WHO's "Vision 2020: the Right to Sight" program.

As one of the most developed cities in China, Shanghai has adopted a policy that any person aged <16 years with BL or bilateral VI would be advised to attend Shanghai Blind Children School (SBCS) for special education. A medical team from the Shanghai Eye Disease Prevention and Treatment Center was put in place to provide periodic ocular examination and specialist support for all these children. Furthermore, since 2009, some children with severe or mild VI have been encouraged to integrate into mainstream schools with the support of teachers from SBCS to provide these children with more appropriate education and explore their individual potential.

It is important for each region to identify major preventable and treatable causes of childhood VI and to monitor the changing patterns of etiology over time so as to develop or fine-tune strategies for preventing childhood BL. Therefore, this study aimed to ascertain the preventable and treatable causes of BL and severe VI (SVI) in school-age children in Shanghai and try to evaluate the temporal trend.

The study was conducted in accordance with the *Declaration of Helsinki* and was approved by the Ethics Committee of Shanghai Eye Disease Prevention and Treatment Center and Shanghai General Hospital. All parents or guardians of the children gave their informed consents before inclusion in the study. All the school-age children registered in SBCS were included in the study. Most of them were attending SBCS, and the remaining children were integrated into mainstream schools in many districts of Shanghai on the days of the visit. All these school-age children with VI were recruited and examined in the vision rehabilitation room of SBCS in May 2015. Some low-vision children below school age or with multiple disabilities were not able to attend SBCS and therefore not included in the study.

The study team consisted of three optometrists, three ophthalmologists, and one ophthalmic nurse from the Shanghai Eye Disease Prevention and Treatment Center and one low-vision officer from the Education Commission. According to the WHO Prevention of Blindness (WHO/PBL) Examination Record for Children with Blindness and Low Vision, the data on personal/demographic details, brief family history, presence of other disabilities, medical history, previous eye surgery, and eye examination were collected from the children's medical records. Furthermore, more information was collected about the history of pregnancy, birth weight, and perinatal care of the children for etiological classification.

The best-corrected distance visual acuity was measured according to the coding instructions for the WHO/PBL eye examination record.[1] The ophthalmologists conducted comprehensive examinations of the eyelid, conjunctiva, cornea, anterior chamber, iris, pupil reflex, and lens using a slit-lamp biomicroscope (model YZ5F1, 66 Vision Tech Co., Ltd., China). The vitreous, retina, and optic nerve head were observed using a direct (model YZ6F, 66 Vision Tech Co., Ltd.) and an indirect ophthalmoscope (model YZ25B, 66 Vision Tech Co., Ltd.) after pupil dilation. The anatomical and etiological classification and the definitions of VI followed the coding instructions as well.[1] The ophthalmologists came to a consensus before addressing major ocular diseases and medical advice for the children.

Address for correspondence: Dr. Jiang-Nan He, Department of Preventative Ophthalmology, Shanghai Eye Disease Prevention and Treatment Center, No. 380, Kangding Road, Jingan, Shanghai 200040, China
E-Mail: hejiangnan85@126.com

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With the aim of exploring possible temporal trends, children with SVI/BL were divided into two groups (≤10 and >10 years).[2] Based on the results of refraction and their daily activities, low-vision aids (LVAs) were prescribed for the children for distance and near vision during the annual eye examination. The LVAs were freely provided by the Shanghai Disabled Persons' Federation. Additional interviews were conducted by the study team about the frequency and ease of using the LVAs.

Data were analyzed using the SPSS version 21.0 statistical software (SPSS Inc., Chicago, IL, USA). Statistical analyses were performed using the Pearson's Chi-square or Fisher's exact test for categorical variables. A $P < 0.05$ was considered statistically significant.

A total of 213 children (130 males and 83 females) in SBCS and mainstream schools were enrolled and examined, of whom 51 were studied in mainstream schools. Their ages ranged from 5 to 16 years, and the mean age was 12.8 ± 2.8 years. According to the WHO category of vision,[1] the 144 children were categorized into the SVI/BL group whose best-corrected visual acuity in the better eye was below 6/60 and the remaining 69 children into moderate VI (MVI) group. In this SVI/BL group, using anatomic classification, the retina (45.1%), lesions of the whole globe (17.4%), and optic nerve (17.4%) were found to be the major anatomical sites of abnormality. Meanwhile, retinopathy of prematurity (ROP) (19.4%) was the main cause of SVI/BL. A total of 46.5% of the causes were avoidable, of which 9.0% were preventable and 37.5% were treatable. In the treatable subgroup, ROP was the most common cause, followed by glaucoma and lens-related diseases [Table 1]. Furthermore, two age groups (>10 years and ≤10 years) were classified and compared to identify the changes in causes over time. Among 144 patients, 36 (25.0%) were aged ≤10 years and 108 (75.0%) were aged >10 years. The greatest change between the two age groups was the rate of ROP, showing that the rate of ROP cases was fewer in children aged ≤10 years (4 cases, 11.1%) than that in children aged >10 years (24 cases, 22.2%), which indicated that ROP was less frequent cause in children aged ≤10 years, although the difference was not statistically significant ($\chi^2 = 2.128$, $P = 0.145$).

This study on LVAs showed that commonly dispensed LVAs included hand magnifiers, electronic magnifiers, and handheld distance telescope. Sixty-two children with the perception of light or no perception of light could not use the LAVs, and 151 children were provided LVAs. Among these 151 children with LVAs, 67.5% (102/151) of the children had handheld distance telescope; 63.6% (96/151) had electronic magnifiers and hand magnifiers. Sixty-two children with light perception or worse could not use the LAVs. However, the acceptance rate for handheld telescope, electronic magnifier, and handheld magnifier was 31.0%, 26.0%, and 19.8%, respectively. Furthermore, the average use of LVAs was less than 1 h per day, mainly due to inconvenience, self-adaptation to the environment, clumsy appearance, unsatisfactory effects, and ignorance.

Table 1: Potentially avoidable causes in 144 children with severe visual impairment or blindness

Causes	*n* (%)
Avoidable	67 (46.5)
Preventable	13 (9.0)
Albinism	4 (2.8)
Cortical blindness	2 (1.4)
Amblyopia	1 (0.7)
Corneal ulcer/infection/scar	6 (4.2)
Treatable	54 (37.5)
Retinopathy of prematurity	28 (19.4)
Buphthalmos/glaucoma	11 (7.6)
Lens-related disease	9 (6.3)
Retinal detachment	5 (3.5)
Staphyloma	1 (0.7)

This cross-sectional study investigated school-aged children with VI in Shanghai and showed that retina was the major anatomical site of abnormality of SVI/BL and 46.5% of the causes of SVI/BL were avoidable. Furthermore, ROP was the first cause and the most common treatable cause of SVI/BL (19.4%). This was comparable to the study carried out in Mexico (18.8%).[3] These results might be due to the similar economic and health-care levels.

The trends of this study showed a reduction in the rate of ROP between the older and younger age groups, although no significant difference was observed. One explanation was that more attention paid to the therapeutic use of oxygen and prevention and treatment of retinopathy in premature infants in the last 10 years. Meanwhile, ROP management might have contributed to the decrease following the development of cryotherapy, panretinal photocoagulation, vascular endothelial growth factor inhibitors, and advanced surgical techniques. However, a study conducted in the tertiary care Neonatal Intensive Care Units (NICUs) in Shanghai indicated that more mature infants were at risk of developing severe ROP, and if the UK or US guidelines were applied to these populations, many infants would have missed the opportunity for treatment.[4] Therefore, the ROP screening criteria need to be wider in China than those in developed countries. Further population-based studies on premature infants in the broader NICUs are also essential.

This study also demonstrated that glaucoma and lens-related diseases were the predominant treatable diseases in the SVI/BL group. Only one of 11 glaucoma cases in the SVI/BL group received surgical treatment, but four of five glaucoma cases in the MVI group completed surgical treatment. Moreover, in all children with lens-related disorders (29/213), nearly two-thirds (18/29) underwent surgery, of which 83.3% (15/18) had MVI. Over 50% of the remaining untreated children (6/11) had SVI/BL. A previous study revealed that the critical period of surgery for unilateral congenital cataract is 6 weeks of age, and permanent sensory deprivation can occur if surgery is delayed beyond 4 months of age in bilateral dense cataract.[5] Thus, the key to preventing childhood cataract and glaucoma BL lies in early diagnosis and skilled management.

The availability of LVAs is necessary to optimize the residual vision of children. Although children in this study did not need to worry about the cost, the acceptance rates of LVAs were low (19.6–31.0%). Lack of cognitive ability and compliance, the inconvenience of LVAs, and gradually adapting to the environment made them discontinue the use of LVAs. Therefore, a multidisciplinary team of ophthalmologists, optometrists, rehabilitation therapists, teachers, and parents is required for childhood low-vision rehabilitation.

This study had some limitations. Although it included all the low-vision children registered continuously in SBCS, children below school age and those with multiple disabilities were not enrolled. Thus, the sample of children examined in this study must be viewed as a selected group having a bias. Despite its limitation, the study could provide an indication of major preventable and treatable causes of school-age children with SVI/BL in Shanghai by thorough screenings in preschoolers annually. In addition, the comparison of the causes of BL/SVI in different age groups and the

extension of the results need to be interpreted cautiously because the data are not population based and only a small proportion of blind children receive special education. The age at which children become blind due to different disorders varies. Future large-scale population-based studies should be conducted to provide more comprehensive information for making national or regional policies on BL prevention.

In summary, nearly half of the childhood BL in Shanghai could be avoided. The ROP, glaucoma, and lens-related disorders are the main treatable causes. The ROP screening program needs to be improved with wider criteria, and the awareness and treatment of ROP need to be strengthened. Early detection and treatment of congenital cataract and glaucoma are essential to reduce SVL/BL. Furthermore, public awareness about low-vision rehabilitation needs to be raised.

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Conflicts of interest

There are no conflicts of interest.

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