1040-5488/12/8912-1752/0 VOL. 89, NO. 12, PP. 1752–1756
OPTOMETRY AND VISION SCIENCE

ORIGINAL ARTICLE

Optical Needs of Students with Low Vision in Integrated Schools of Nepal

Subodh Gnyawali*, Jyoti Baba Shrestha†, Dipesh Bhattarai‡, and Madan Upadhyay§

ABSTRACT

Purpose. To identify the optical needs of students with low vision studying in the integrated schools for the blind in Nepal.

Methods. A total of 779 blind and vision-impaired students studying in 67 integrated schools for the blind across Nepal were examined using the World Health Organization/Prevention of Blindness Eye Examination Record for Children with Blindness and Low Vision. Glasses and low-vision devices were provided to the students with low vision who showed improvement in visual acuity up to a level that was considered sufficient for classroom learning. Follow-up on the use and maintenance of device provided was done after a year.

Results. Almost 78% of students studying in the integrated schools for the blind were not actually blind; they had low vision. Five students were found to be wrongly enrolled. Avoidable causes of blindness were responsible for 41% of all blindness. Among 224 students who had visual acuity 1/60 or better, distance vision could be improved in 18.7% whereas near vision could be improved in 41.1% students. Optical intervention provided improved vision in 48.2% of students who were learning braille. Only 34.8% students were found to be using the devices regularly after assessment 1 year later; the most common causes for nonuse were damage or misplacement of the device.

Conclusions. A high proportion of students with low vision in integrated schools could benefit from optical intervention. A system of comprehensive eye examination at the time of school enrollment would allow students with low vision to use their available vision to the fullest, encourage print reading over braille, ensure appropriate placement, and promote timely adoption and proper usage of optical device.

(Optom Vis Sci 2012;89:1752–1756)

Key Words: braille, children, integrated schools, low vision, low-vision device

More than 161 million people in the world were reported in 2002 by the World Health Organization (WHO) to be visually impaired, of whom 37 million were blind.[1] An estimated 68 million people require low-vision care and are likely to benefit from such care.[2] Currently, it is estimated that there are 1.5 million blind children in the world, of whom 1.0 million live in Asia. Blindness in more than one-half of children is preventable or curable.[3] Although visual impairment globally is age dependent and much less prevalent in children, a study in the eastern region of Nepal has reported that one-third of all visual impairment occurred in children younger than 15 years.[4] The government of Nepal estimates that there are 30,240 blind children in Nepal, and three times as many children have low vision in 2010.[5] Sadly, of the estimated 120,000 blind and low-vision children, fewer than 7000 are enrolled in schools.[5]

Various studies[6–8] have reported that 50 to 83% of students enrolled in special or integrated schools have functional low vision and that almost 90% of the so-called blind students retain a degree of usable residual vision.[9] Reading is a first step in education and is a predictor of good academic success.[10] Being able to read ink print allows a child much greater access to information and a wider range of educational, recreational, and employment opportunities.[11]

Vision impairment in children has profound psychological, educational, and economic effects not only for the individuals and their families but also for the community and country.[12] Uncorrected visual impairment in children can cause disability by significantly interfering with their ability to function independently, learn, or move safely in the environment.[13] Furthermore, it results in a great loss of productivity for the country. Additional funds are needed to provide rehabilitation services to assist these children to be independent citizens in the future.[12] This is a further strain on the fragile economy of developing countries.

*OD, MPH
†MD
‡BOptom
§MD, FRCS

B. P. Eye Foundation, Maharajgunj (SG, DB, MU); and B. P. Koirala Lions Centre for Ophthalmic Studies, Institute of Medicine, Maharajgunj (JBS), Kathmandu, Nepal.

In view of these facts, the national plan of action for Vision 2020 has accorded high priority to low-vision services in Nepal.[14] At present, low-vision services are available in 11 eye hospitals and 14 primary eye care centers of the country.[15] Several studies have shown a high rate of successful low-vision device use among children compared with adults.[16,17] The failure to provide appropriate low-vision services prevents many individuals from achieving full social inclusion and optimal quality of life, increases cost to society, and deprives society of the social and economic contributions of these individuals.

This study was therefore designed to determine the optical needs of students with low vision enrolled in integrated schools for the blind and to assess use of the devices by the students. We also looked at factors that constituted barriers for continued use of devices provided. To the best of our knowledge, such a study has not been reported earlier from Nepal. Information thus generated is critical for formulating a user-sensitive national plan of action for low-vision children in Nepal.

METHODS

According to a revised "working definition," a "low-vision person" is someone who after full optical correction and surgical treatment has a corrected visual acuity between 6/18 and light perception in the better eye or a visual field of less than 10 degrees from the point of fixation but who uses or has the potential to use vision for the planning and/or execution of the task.[18] We used this definition for the present study.

A pediatric ophthalmologist and an optometrist conducted a comprehensive eye examination of all students enrolled as blind who were available on a prearranged day of examination in 67 integrated schools for the blind from May 2008 to April 2011. The WHO/Prevention of Blindness Eye Examination Record for Children with Blindness and Low Vision form was used and the accompanying manual was followed to record data. Visual acuity was recorded as per the WHO working definition of low vision. Ethical approval to conduct the survey was obtained from the institutional review board of the Tribhuvan University Teaching Hospital. Written permission from the Department of Education was obtained to conduct the survey in each district where blind children were enrolled into schools. Verbal consent for eye examination of the students was obtained from the school administration and parents of the students whenever present. The *Declaration of Helsinki* was followed during eye examination and for any intervention provided to the student. Ocular and medical history on systemic illness was obtained from the resource teacher and review of medical records when available.

Examination was performed under natural light conditions in a quiet room with three windows and a door which could be closed or opened as needed. Visual acuity was tested using Low Vision Resource Centre LogMAR test charts for distance and near vision. Distance visual acuity and near visual acuity were recorded in Snellen fraction and M notation, respectively, using the MNREAD Acuity Chart (Lighthouse Low Vision Products, Long Island City, NY). Refraction was done using a Heine streak retinoscope in students who had presenting distance visual acuity of 1/60 or better. A low-vision kit composed of telescopes, magnifiers, and spectacle microscopes of different powers was used for low-vision assessment. Distance visual acuity in the better eye was taken to categorize the level of visual impairment of the student. The anterior segment was examined using a portable slit lamp biomicroscope (Clement Clarke BA904). Posterior segment examination was carried out using a direct (Heine Beta-2000) and an indirect (Appasamy associates IO wireless) ophthalmoscope after dilating the pupil when indicated. At the end of the evaluation, students who either obtained distance visual acuity of 6/60 or better or near visual acuity of 4M or better were provided with glasses and/or low-vision devices free of cost. Instructions on the use and maintenance of devices were provided to the students in the presence of resource teachers and parents when available. Causes of visual impairment were categorized as preventable and treatable, which together constitute avoidable causes of visual impairment. The cause for visual loss with age of onset at birth was labeled as congenital, whereas the onset later in life was labeled as acquired.

Continuous usage of the optical device by the student during learning activities at school was assessed by a telephone interview 1 year after providing the device. For students younger than 10 years, the resource teachers were interviewed, whereas for students 10 years or older, both students and their resource teachers were interviewed separately. Data entry was done on Epi-Info version 3.4.3 and analyzed using SPSS version 15 software. Study results were shared with the Ministry of Education, Ministry of Health, Ministry of Women, Children and Social Welfare, and other concerned stakeholders.

RESULTS

Seven hundred seventy-nine students from 67 integrated schools for the blind, covering 38 of 75 districts, all 14 zones, and all five development regions of Nepal, had comprehensive eye examination. Age of the students ranged from 6 to 24 years. Mean age of the students was 13.7 years (SD, 4.03 years); 32% of students were older than 16 years and the male-to-female ratio was 1.4:1. Anatomically, the cornea (22.7%) was the commonest site of visual impairment (Fig. 1), followed by retinal problems (18.4%) and lens pathology (17.6%). Whole globe lesions, optic nerve diseases, glaucoma, and uveal lesions occurred in declining frequency.

Xerophthalmia was found to be the most common cause of corneal blindness, whereas corneal ulcers after use of traditional harmful medications contributed to the rest. Lens pathology consisted of unoperated cataract, aphakia, and pseudophakia. Retinal problems consisted mainly of retinal dystrophy manifesting at or soon after birth. Overall, 40.9% of the students had a potentially avoidable cause of blindness: preventable in 23.1% and treatable in 17.8% of the students. History of visual loss since birth was found in 524 (67.3%) students, whereas 203 (26.1%) had lost vision before their first birthday. This indicates that most (93.4%) children are either born blind or acquire blindness during infancy.

Five students achieved normal vision after refraction (category 0). Of the remaining 774 students, 611 (78.9%) fell into different categories of low vision whereas 163 (21.1%) were totally blind (Table 1). There were only 224 (28.7%) students who had presenting visual acuity of 1/60 or better in the better eye and were available for refraction. Among these, distance visual acuity could

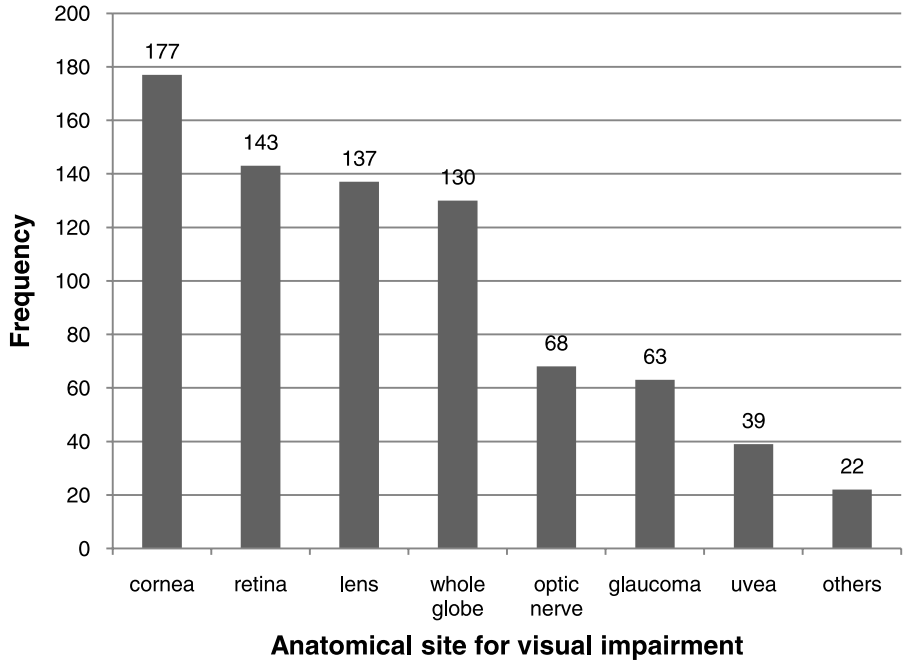

FIGURE 1.
Anatomical site for the cause of visual impairment among students.

be improved to 6/60 or better in 24 (10.7%) students with simple refraction. Eighteen (8.0%) additional students could attain a visual acuity of 6/60 or better with the use of low-vision devices. Visual acuity of this level is considered sufficient for seeing and copying letters from the blackboard—if the student is seated at the first row (~2 m from the blackboard) in a classroom.[19] Glasses and low-vision devices for distance visual acuity were provided to 42 (18.7%) students whose visual acuity could be improved to 6/60 or better. Among 224 refracted, 116 (51.8%) students were hyperopic, 69 (30.8%) were myopic, and 39 (17.4%) were astigmatic. Just more than 30% of hyperopia cases were caused by inadequately corrected aphakia and pseudophakia. The magnification provided for telescopes was in the range of three times to six times, and the most common magnification prescribed was four times (40%).

Of 224 students who had distance visual acuity 1/60 or better, five (2.2%) had near visual acuity better than 1.25M at the time of presentation. Of the 219 remaining, 105 (47.9%) students had presenting near visual acuity 2M or better, whereas 114 (52.1%) students had visual acuity between 2.5 and 4M (Table 2). Among 224 students refracted, the near visual acuity of 26 (11.6%) students improved to a level 2M or better. Twenty-eight (12.5%) additional students showed improvement in near visual acuity of 2M or better with low-vision devices. Near visual acuity of this level is considered sufficient to read the print used in school books.[19] Another 38 students whose near visual acuity improved to a level better than 4M were also provided with low-vision devices for near visual acuity as they could be helpful for reading large-font textbooks. A total of 92 (41.1%) students were provided low-vision devices for near visual acuity. Spectacle microscopes were the most common type of low-vision device prescribed followed by handheld magnifiers and stand magnifiers (Table 3).

Of the 164 (21.1%) students who attained near visual acuity of 2M or better, 110 (67.1%) were learning braille at the time of eye examination (Table 4). Five (3.0%) students were found to be learning braille with their eyes! This could have been avoided easily by assessment of visual status and its appropriate correction at the time of school enrollment. Thirteen (7.9%) students,

TABLE 1.
Presenting and best corrected visual acuity of students according to the working category of visual impairment given by the WHO

Working category of visual impairment	Visual acuity	Presenting		After refraction		Use of LVD	
		Frequency	%	Frequency	%	Frequency	%
0. Normal	6/6–6/18	1	0.1	5	0.6	6	0.8
1. Low vision	<6/18–6/60	32	4.1	52	6.7	69	8.9
2. Low vision	<6/60–3/60	78	10.0	76	9.8	61	7.8
3. Low vision	<3/60–1/60	113	14.5	91	11.7	88	11.3
4. Low vision (near blindness)	<1/60–PL	392	50.3	392	50.3	392	50.3
5. Total blindness	NPL	163	20.9	163	20.9	163	20.9
Total		779	100	779	100	779	100

LVD, low vision device; PL, perception of light; NPL, no perception of light.

TABLE 2.
Presenting and best corrected near visual acuity of students having distance visual acuity 1/60 or better

	Presenting		After refraction		Use of LVD	
Near visual acuity	Frequency	%	Frequency	%	Frequency	%
Better than 1.25M	28	12.5	32	14.3	58	25.9
1.25M–2M	82	36.6	104	46.4	106	47.3
2.5M–4M	114	50.8	88	39.3	60	26.8
Total	224	100	224	100	224	100

despite having good vision, were advised to take up braille and print reading side by side, fearing that their eye condition would worsen in the future.

After 1 year of the prescription of optical devices, 58 resource teachers (response rate, 86.5%) and 34 students aged 10 years or older (response rate, 74%) were interviewed by telephone to find out the status of the use of devices by the students. Among 134 students provided with optical devices, only 48 (35.8%) students were reported to be using the device continuously for 1 year. Compliance with the use of the device was reported to be lower in students of younger ages compared with students 10 years or older ($p = 0.03$ at 95% confidence interval). Damage or misplacement of the device was the most common (64%) response obtained for discontinuation. Feeling of discomfort while using the optical device (32%), inadequate instructions given for use of the device (18%), and inappropriate lighting and sitting arrangement (14%) were other reasons for discontinuing the use of devices.

DISCUSSION

More than 700 children in 38 districts examined during the course of this study represent all three ecological terrains and geographic regions of Nepal. From a demographic perspective, our study shows a larger number of older students and more male students than female students. The age range of students in this study varied from 6 to 24 years (mean, 13.7 years; SD, 4.03 years); one-third of the students were older than 16 years. This could be caused by a constellation of factors, such as late enrollment and repeated failures because of cognitive defects with or without other global development defects. The poor quality of education provided could possibly be another contributory factor. Age at enrollment for blind children was higher than that for sighted children (7 years vs 4 years). The higher enrollment of male students over female students in schools seen in this study is not unexpected in a Nepali society, where male children are preferred over female children for various cultural reasons. This finding is particularly disturbing in view of the fact that women represent two-thirds of blindness and visual impairment in Nepal,[5] yet there are fewer girls studying in schools for the blind.

The prevalence of avoidable causes (40.9%) of vision impairment among school students is similar to that of other developing countries, such as India[20] (43.5%) and Myanmar[8] (43.6%). This indicates an urgent need for strengthening primary health care. The high proportion of cases with retinal problems (18%) seen in this study is likely to increase in the future with improved newborn care facilities and decreasing neonatal mortality rates in Nepal. Similarly, a high prevalence of cataract blindness (17.6%) reflects the unmet need for eye health services in the country and hopefully would decline now that rubella immunization has been introduced as a component of the National Immunization Program. Establishment of a National Children's Eye hospital and pediatric units in some of the existing eye hospitals is likely to improve services to children with eye problems.

More than two-thirds (78.4%) of the students enrolled in the integrated schools had low vision. As available vision is decisive in the learning of a vision-impaired student, a system of comprehensive eye examination by eye health professionals at the time of school enrollment should be put into place. Without this, five (0.6%) students in this study, who could have gone to regular schools, were needlessly provided the benefits of scholarship by the government. These funds could have been used for those who were genuinely visually impaired.

An interesting finding of this study is that a significant number of students achieved useful vision with refraction and prescription of glasses and low-vision devices. This indicates an unmet need of assessment of visual potential at the time of school enrollment as well as an urgent need to scale up refraction services. Assistance provided at the time of eye examination potentially enabled 48.2% students who were learning braille despite having good enough vision to use print media for learning. A similar study in Nigeria has reported that with best refraction and low-vision

TABLE 3.
Type of low-vision device prescribed for near visual acuity

Type of LVD	Frequency	%
Spectacle microscope	49	53.3
Handheld magnifier	36	39.1
Stand magnifier	7	7.6
Total	92	100

TABLE 4.
Medium used by students with near visual acuity better than 2M for learning

	Before intervention		After intervention	
Medium for learning	Frequency	%	Frequency	%
Braille	110	67.1	37	22.6
Print	35	21.3	114	69.5
Both braille and print	19	11.6	13	7.9
Total	164	100	164	100

assessment, 22% of braille readers could attend regular school.[21] Producing textbooks in print media instead of braille can result in a substantial saving to the national education budget. Sensitization of school administration and parents about the benefits of print reading over braille reading is necessary to bring a tangible change. A low-vision device should be considered as an essential learning tool for students with low vision.

This study also brings out the limitations of providing a low-vision device without a thorough assessment of every possible difficulty in using the device. As seen in this study, almost two-thirds of the students provided with optical devices were not using their device after a year. As the devices are fragile, their safe upkeep and attention to lighting and sitting arrangements are important factors likely to increase their use. Periodic evaluation of the eyes and accompanying change in refraction should be done to assess the changing needs of students. Print sizes of textbooks usually get smaller with increasing grades. The increasing vision demand may need to be met by higher magnification devices. Although compliance with regard to use of low-vision devices has been reported to be higher among children than in adults[16,17]; in this study, however, we found compliance to be better in older than in younger children. This could be caused by the inability of younger children to handle the devices. Definite reasons would need to be explored in future surveys.

The fact that vision could be improved to enable students to see letters on the blackboard and read text in smaller font sizes after refractive correction strongly indicates the need of collaboration and networking between the eye care team, school management, and educational and rehabilitation programs so that children are not forced to learn braille. This is also necessary for sustainable care and consequent cognitive development of students with vision impairment. This study provides much needed data on the eye health needs of students admitted to integrated schools with low vision. It enables the development of strategies appropriate for education of vision-impaired children in Nepal. The findings of this study could help develop a more inclusive eye care system in Nepal.

ACKNOWLEDGMENTS

Supported by the Department of Education, Government of Nepal.
Received January 4, 2012; accepted July 30, 2012.

REFERENCES

1. Resnikoff S, Pascolini D, Etya'ale D, Kocur I, Pararajasegaram R, Pokharel GP, Mariotti SP. Global data on visual impairment in the year 2002. Bull World Health Organ 2004;82:844–51.
2. Arditi A, Corn A, Goodrich G, Inde K, , Oslo Workshop on Low Vision. Toward a Reduction in the Global Impact of Low Vision. New York, NY: International Society for Low-Vision Research and Rehabilitation; 2005.
3. Gilbert C, Foster A. Childhood blindness in the context of VISION 2020—the right to sight. Bull World Health Organ 2001; 79:227–32.
4. Thakur AK, Joshi P, Kandel H, Bhatta S. Profile of low vision clinics in eastern region of Nepal a retrospective study. Br J Visual Impair 2011;29:215–26.
5. National Public Health Research Apex Body for Eye Health. Report of Mid-Term Review of Vision 2020: The Right to Sight, Nepal. Kathmandu, Nepal: Ministry of Health and Population, Government of Nepal; 2011.
6. Hornby SJ, Adolph S, Gothwal VK, Gilbert CE, Dandona L, Foster A. Evaluation of children in six blind schools of Andhra Pradesh. Indian J Ophthalmol 2000;48:195–200.
7. Omar R, Mohammed Z, Knight VF, Basrul MH. Profile of low vision children in the special education schools in Malaysia. Med J Malaysia 2009;64:289–93.
8. Muecke J, Hammerton M, Aung YY, Warrier S, Kong A, Morse A, Holmes M, Yapp M, Hamilton C, Selva D. A survey of visual impairment and blindness in children attending seven schools for the blind in Myanmar. Ophthalmic Epidemiol 2009;16:370–7.
9. National Society for the Prevention of Blindness. Vision Problems in the US. New York, NY: National Society for the Prevention of Blindness; 1980.
10. Stelmack JA, Tang XC, Reda DJ, Rinne S, Mancil RM, Massof RW. Outcomes of the Veterans Affairs Low Vision Intervention Trial (LOVIT). Arch Ophthalmol 2008;126:608–17.
11. Silver J, Gilbert CE, Spoerer P, Foster A. Low vision in east African blind school students: need for optical low vision services. Br J Ophthalmol 1995;79:814–20.
12. Reddy SC, Tan BC. Causes of childhood blindness in Malaysia: results from a national study of blind school students. Int Ophthalmol 2001;24:53–9.
13. Warren DH. Blindness and Early Childhood Development, 2nd rev. ed. New York, NY: American Foundation for the Blind; 1984.
14. National Public Health Research Apex Body for Eye Health. National Plan of Action for Eye Care Services in Nepal (Strategic Plans for 2002–2019). Kathmandu, Nepal: Ministry of Health and Population, Government of Nepal; 2001.
15. Nepal Netra Jyoti Sangh: National Society for Comprehensive Eye Care. National Low Vision Program Report (2002). Available at: http://www.nnjs.org.np/programs/national_low_vision_programs.php. Accessed December 10, 2011.
16. Fonda G, Gardner LR. Characteristics and low vision corrections in Stargardt's disease. Educational and vocational achievements enhanced by low vision corrections. Ophthalmology 1985;92:1084–91.
17. Leat SJ, Karadsheh S. Use and non-use of low vision aids by visually impaired children. Ophthalmic Physiol Opt 1991;11:10–5.
18. World Health Organization. The Management of Low Vision of Childhood. Proceedings of the WHO/PBL Consultation, Bangkok, July 1992. Geneva, Switzerland: World Health Organization; 1993.
19. van Dijk K. Providing care for children with low vision. Commun Eye Health 2007;20:24–5.
20. Titiyal JS, Pal N, Murthy GV, Gupta SK, Tandon R, Vajpayee RB, Gilbert CE. Causes and temporal trends of blindness and severe visual impairment in children in schools for the blind in north India. Br J Ophthalmol 2003;87:941–5.
21. Ejukonemu BO. Magnitude of refractive errors and low vision among braille-reading children in Nigeria. Visual Impair Res 2001; 3:31–40.

Subodh Gnyawali
B. P. Eye Foundation
Tribhuvan University Teaching Hospital Complex
P.O. Box 8750
Maharajgunj, Kathmandu
Nepal
e-mail: subodh_neh@yahoo.com