Need for optical and low vision services for children in schools for the blind in North India

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Context: Children admitted in blind schools need low vision assessment for improving functional vision (useful residual vision).

Aim: To ascertain the need for spectacles and magnifiers as low vision devices (LVD) in children with useful residual vision, attending blind schools.

Setting and Design: Cross-sectional study conducted in 13 blind schools in Delhi, North India.

Materials and Methods: Of a total of 703 children (less than 16 years of age) examined, 133 (18.91%) with useful residual vision were refracted and analyzed. High addition plus lenses (range 5-30 diopters) were used as spectacle magnifiers for near LVD assessment. "World health organization (WHO)/ prevention of blindness (PBL) eye examination record for children with blindness and low vision", was used to collect data. SPSS (statistical package for the social science), version 10.0 was used for analysis.

Results: Based on the vision of 133 children at initial examination, 70.7% children were blind and 12.0% were severely visually impaired (SVI). 20.3% children improved by at least one WHO category of blindness after refraction. With best correction, 50.4% children were still blind and 13.5% were SVI. Visual acuity in the better eye after refraction in 47 children (35.3%), improved with spectacles. Children with aphakia (17), coloboma (5), refractive error (5) and microphthalmos (4) benefited from spectacles. Of 124 children with low vision but having useful residual vision, 51 (41.1%) were able to read N-10 unaided or with distance spectacles and 30 children (22.6%) improved to N-10 with spectacle magnifiers and were prescribed the same.

Conclusion: Visually impaired children with aphakia and congenital anomalies of the eye benefit from refraction and low vision services.

Key words: Childhood blindness, India, low vision, spectacles.

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Low vision was originally defined by world health organization (WHO) as a visual acuity, less than 20/60 to 10/120 in the better eye. However, many children who have a corrected visual acuity in the better eye of less than 10/200, have useful residual vision and may benefit from low-vision services. Therefore, a revised "working definition" of low vision was agreed upon at a WHO consultation meeting on management of low vision in children in 1992,[1] as someone who after full optical correction and surgical treatment, has a corrected visual acuity of 20/60 to light perception in the better eye or a visual field of less than 10º from the point of fixation, but who uses or has the potential to use vision for the planning and/or execution of the task.

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A significant proportion of children in schools for the blind, receive formal education using Braille. There is however, increasing awareness about the needs of children with low vision, to receive print education. Low-vision rehabilitation consists of providing the patient with assistive devices and training to improve the quality of life.[2]

Blind school studies have been done in various countries using the standard WHO proforma and have found a varied spectrum of childhood blindness.[3-6] The standard "WHO/ prevention of blindness" (PBL) eye examination record for children with blindness and low vision" was used[7] and categories were coded in accordance to the definitions given by the coding instructions of the standard WHO proforma.[8] "Functional vision" in these studies, was determined by the ability to perform the following[8] 1) test of independent mobility (ability to navigate without assistance between chairs set two meters apart, in a well lit room), 2) test of social contact (ability to recognize someone known to them, at a distance of 10 feet), 3) test of near vision (ability to recognize the shape of three 2 cm symbols at any near distance equivalent to N-60) and 4) believed to have useful residual vision (defined as sufficient vision for at least independent mobility, for making social contacts or for near vision, if formal testing of visual acuity is not possible).

The primary objectives of the present study were 1) to ascertain the need for spectacles and magnifiers as low vision devices (LVD) in these children with useful residual vision, attending blind schools in North India, 2) to determine causes of low vision and 3) to determine acceptance of magnifiers in relation to ocular pathology.

Materials and Methods

A cross-sectional study design was used to determine the causes of severe visual impairment and blindness in children attending all the 13 schools for the blind in Delhi, between July 2000 and May 2001; the detailed methodology and results of which have been published.[5] Being the national capital of India with a population of 13.8 million and situated in the central part of north India, most blind schools of north India are located in Delhi, admitting children from various north Indian states.[5]

History taking and eye examination, including anterior segment examination by torch and/or slit lamp biomicroscope, fundus examination by direct and indirect ophthalmoscope and intraocular pressure measurement, were performed to determine cause of visual impairment.

Distant visual acuity was assessed with directional Snellen E chart and categorized into WHO categories of blindness. Near vision was assessed by the ability to recognize symbols of 5 mm in size, equivalent to N10. Students with visual acuity less than 20/60 to perception of light in the better eye, underwent tests for assessment of "functional vision" (or useful residual vision), as defined earlier.

Refraction was performed under cycloplegia (Tropicamide 1%) in children with useful residual vision by a qualified optometrist. Post-mydriatic assessment for spectacles and magnifiers was performed after one week. No subjective verification was performed, as the directional Snellen E chart was used. Children with visual acuity greater than light perception and who had useful residual vision were assessed for magnifiers for near vision. The exceptions to this were those who were mentally retarded and those who were able to read N10 easily unaided. Addition of high plus lenses (range 5-30 diopters) were used as spectacle magnifiers for near LVD assessment. Children were assessed using the optimal illumination of a 40 watt halogen lamp, with the light source directed at an angle of 45° to the page, minimizing glare. The requirement for distance LVD, such as telescopes, were not assessed in this study, as these have more limited applications than those for near work and are expensive. In children with colobomas, microcornea/microphthalmos and/or nystagmus, direct retinoscopy was performed in the habitual fixating gaze of the child, without correcting an abnormal head posture if any. Full-aperture trial lenses were used to increase the field of view and high convex or concave lenses were tried first at a reduced working distance, if the retinoscopic reflex was difficult to appreciate.

Data were analyzed using SPSS (statistical package for the social sciences), version 10.0 statistical software. A report of the findings and recommendations at each school was given to the school principal. Children requiring further investigations and treatment were referred to the pediatric services of our tertiary care centre.

Results

A total of 703 students of less than or equal to 16 years of age (range= 5-16 years), were examined in 13 blind schools in Delhi, the results of which have been published earlier.[5]

Assessment of visual function: Functional vision (useful residual vision) was present in 133 children (18.91%) who were refracted and analyzed. Based on vision at initial examination, 70.7% children (94) were blind and 12.0% (16) were severely visually impaired [Figure 1]. After best correction, 50.4% children (67) continued to be blind and 13.5% (18) were severely visually impaired. After refraction, 20.3% (27) children improved by at least one WHO category of blindness. Using the revised working definition of low vision, 124 (17.63%) children had visual acuity in the better eye <20/60 to light perception, with useful residual vision; 310 (44.09%) had visual acuity in the better eye <20/60 to light perception, without useful residual vision; 260 (36.98%) had no light perception in both eyes and 9 (1.28%) had visual acuity in the better eye >20/60. After refraction, 5 (3.7%) children moved from the group with low vision, but having useful residual vision to the no impairment group.

Etiology of visual loss: Etiological classification as defined in the WHO/PBL form reflects time of insult leading to visual loss [Table 1]. The etiological factor for visual loss was undetermined in 85 (63.9%), hereditary factors were identified in 30 (22.6%) and childhood onset disorders were present in 16(10.5%).

Requirement for spectacles: At the time of examination, 28 children (21.0%) were already wearing glasses. After refraction, 47 children (35.3%) had an improvement in visual acuity in the better eye with spectacles and were prescribed the same. After refraction, 27 (20.3%) children improved by at least one WHO category. Among the main causes identified, 62.9% aphakes (17 of 25), 25% iridofundal colobomas (five of 20), 10.5% optic atrophies (two of 19) and 12.5% retinal dystrophies (two of 16), benefited from spectacles [Table 2].

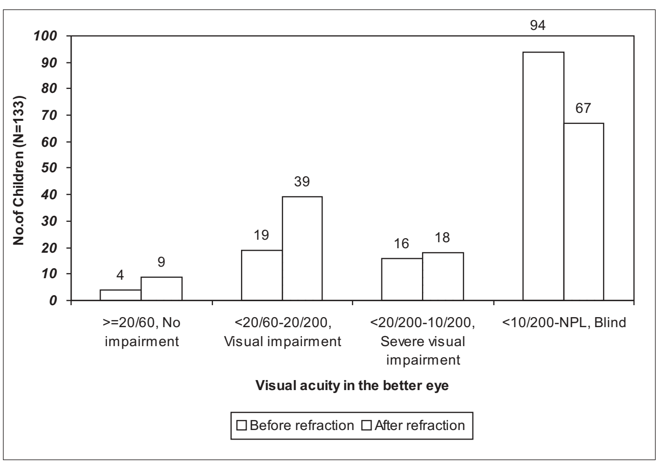

Figure 1: Change in distribution of cases according to WHO categories of visual impairment after refraction in children with useful residual vision

Table 1: Anatomical and etiological categories of visual impairment in children refracted

	N	%
Anatomical diagnosis		
Lens	41	30.8
Uvea	23	17.2
Optic nerve	22	16.5
Retina	21	15.7
Cornea	9	6.7
Whole globe	8	6.0
Others	9	6.7
Total	133	100
Etiologic diagnosis		
Hereditary	30	22.6
Childhood	16	10.5
Intrauterine	1	0.7
Perinatal	1	0.7
Undetermined	85	63.9
Total	133	100

Requirement for low vision devices (magnifiers): None of the children examined, were using a LVD at the time of examination. Of the 124 (17.63%) children with low vision but having useful residual vision, 51 were able to read N-10 unaided or with distance spectacles and were not assessed for magnifiers. Thirty (22.6%) children improved to N-10 with spectacle magnifiers and were prescribed magnifiers. Among the main causes identified, 56% aphakes (14 of 25), 25% iridofundal colobomas (five of 20), 21% optic atrophies (four of 19) and 11% corneal scars (one of 9) benefited from magnifiers [Table 2].

Types of refractive errors: The refractive error in the better eye was myopia in nine of the 47 children needing spectacles (19.1%) and hypermetropia in 38 (81.9%) [Table 3]. The mean spherical equivalent in the better eye was +5.24 D (range -4 to + 12 D).The refractive error varied according to the phenotype of the better eye. In children needing a myopic correction, the mean spherical equivalent was -2.3 D and in those needing a hypermetropic correction, the mean spherical equivalent was + 7.1D.

After complete examination, the long term visual prognosis in the better eye was considered to improve in 41 (30.8%), remain stable in 53 (39.8%) and deteriorate in 39 (29.3%).

Discussion

The redefinition of low vision has resulted in studies including more people with severe and profound low vision, who would be rehabilitated with intervention. Low vision patients can improve their residual vision and possibly relearn to perform lost functional vision, which often restores the ability to perform daily tasks like reading.[9] It has been estimated that the global prevalence of pediatric low vision is over 10 times that of pediatric blindness, with seven million children worldwide having low vision due to ocular disease and a further 10 million children worldwide, with low vision due to uncorrected refractive error.[10] A population- based cross-sectional study in India has found low vision to have a prevalence of 1.05% in the year 2000, with a burden of 10.6 (95% confidence interval, 8.4-12.8) million people requiring low vision services.[11]

Various studies have found low vision devices as an effective means of providing visual rehabilitation.[12-16] Sloan *et al*.[16] showed that children, compared to adults, have a very high rate of successful LVD use, when aids are properly prescribed. Faye *et al*.[12] found that children with congenital ocular defects can successfully use complex as well as simple LVD. A study of the need for low vision services in blind school students in East Africa showed that 63.9% of African blind school students had functional low vision. Forty six percent could read N5-N8 print unaided or with spectacles and a further 33% could read N5-N8 with LVD.[15] In this study, three simple tests for functional vision had a sensitivity of 96% in identifying students who could read N5-N8 print. LVD were

Table 2: Major causes of visual impairment in children prescribed spectacles or magnifiers

Anatomical diagnosis	Total number of children with the anatomical diagnosis	Number of children prescribed spectacles (N)	Percentage of children prescribed spectacles (%)	Number of children prescribed magnifiers (N)	Percentage of children prescribed magnifiers (%)
Aphakia	25	17	62.9	14	56
Iridofundal coloboma	20	5	25	5	25
Refractive error	7	5	71.4	0	0
Microphthalmos	8	4	50	4	50
Corneal scar	9	3	33.3	1	11.1
Pseudophakos	6	3	50	0	0
Cataract	8	2	25	0	0
Retinal dystrophy	16	2	12.5	0	0
Albinism	5	2	40	1	20
Optic atrophy	19	2	10.5	4	21
Optic hypoplasia	3	1	33.3	0	0
Aniridia	3	1	33.3	1	33.3
Total		47		30	

Table 3: Type of refractive error in the better eye by anatomical site in children prescribed spectacles

Anatomical cause	Total no.	Myopia N (Mean spherical equivalent-diopters)	Hypermetropia N (Mean spherical equivalent-diopters)	Range of spherical equivalent-diopters
Aphakia	17	0	17 (8.7)	+4.0 to +12.0
Iridofundal coloboma	5	2 (-2)	3 (7.6)	-3 to +8.0
Refractive error	5	2 (-2.5)	3 (8)	-3 to +9
Microphthalmos	4	2 (-1.5)	2 (7.5)	-2.0 to +8.0
Corneal scar	3	2 (-2.5)	1 (0.5)	-2.0 to +0.5
Pseudophakos	3	1 (-4)	2 (5.5)	-4.0 to +6.0
Cataract	2	0	2 (5)	+4.0 to +6.0
Retinal dystrophy	2	0	2 (5)	+4 to +6
Albinism	2	0	2 (4)	+3 to +5
Optic atrophy	2	0	2 (5)	+4 to +6
Optic hypoplasia	1	0	1 (4)	
Aniridia	1	0	1 (3)	
Total	47	9 (-2.3)	38 (7.0)	-4 to +12

indicated in 35.7% children.

In the present study, in the children refracted, lenticular conditions (primarily cataract and its surgery-related causes) comprised 30.8% of the cases. This was followed by uveal disorders (primarily iridofundal coloboma) in 17.2% and optic nerve (primarily optic atrophy) in 16.5%. The importance of hereditary factors (22.6%) contrasts the small contribution from perinatal and intrauterine factors. However, this study may underestimate the importance of both genetic and intrauterine factors, as in 42.3% cases, abnormality had presented at birth, but etiology could not be determined. Leat *et al.*[14] had examined 41 children using LVD in special schools for the visually impaired, wherein the common causes were congenital cataract (20%), nystagmus (14.6%), albinism (12%) and optic atrophy (12%). Gothwal *et al.*[10] did a pediatric low vision evaluation of 220 children in a private eye hospital in Hyderabad, India and found that the major causes of visual impairment were the hereditary / genetic conditions of hereditary macular degeneration (21%), congenital glaucoma (20%), retinitis pigmentosa (20%) and albinism (5%). The most commonly prescribed low vision devices were spectacles, probably because of the limited availability of devices in India.

The importance of the present study is highlighted by the fact, that low vision services or use of LVD were not available in any of the schools, emphasizing the need to improve awareness of low vision services among parents and teachers involved in special education in developing countries. Three tests of functional vision (useful residual vision) were used to identify those children who might benefit from spectacles and magnifiers. In the present study, 35.3% children were prescribed spectacles and 22.6% children were prescribed magnifiers. Though the need for low vision aids may have been underestimated in the present study (as only high addition plus lenses were used), which is the feasible option in an Indian setting where there is a poor availability of special LVD and near stand magnifiers, high powered near spectacles can be readily manufactured using conventional aspheric lenses. Monocular telescopes, non-optical aids such as fluorescent reading lamps, tinted lenses, as well as adaptive technology in the form of closed circuit television (CCTV), can also be made available in blind schools, especially in an urban area like Delhi.

The major anatomical causes for visual loss in children, who benefited from spectacles, were aphakia, iridofundal coloboma and microphthalmos. The major anatomical causes for visual loss in children who benefited from LVD were aphakia, iridofundal coloboma and optic atrophy. This is similar to the study conducted in 291 blind school children in Andhra Pradesh, India, wherein, 31.6% children with functional low vision improved with spectacles and 14.0% children with LVD. The main anatomical causes in children who were prescribed spectacles, were aphakia, coloboma, albinism and microphthalmos and the cases that were given magnifiers were of aphakia, microphthalmos / coloboma and retinal dystrophy / albinism.[4]

The type of refractive error in children who were prescribed spectacles, varied with the phenotype of the better eye. The mean spherical equivalent was hypermetropic due to the large number of aphakic children. Hornby *et al.* had done a clinical study of the requirement for optical services in 168 children with microphthalmos, coloboma and microcornea, in six special schools for the blind in Southern India and found that the refractive error varied with the anatomical cause.[13] Eyes with colobomatous microphthalmos were frequently hypermetropic, whereas those with coloboma and microcornea without microphthalmos and those with simple coloboma, were all myopic, except one. The refractive error in the better eye was myopic in 38 of 52 children (73%) needing spectacles and hypermetropic in 14 (27%), the mean spherical equivalent in the better eye being -2.0 D (range -14 D to + 16 D ± 6 D).

Prior to refraction, four children had a visual acuity >20/60, with five more children moving from the group with low vision, but having useful residual vision, improving to the no impairment group after refraction. The presence of these children with high refractive error, only with no other blinding factor in a blind school, was surprising, but additional social, psychological, economic and administrative factors could have accounted for it, that is out of the perspective of the present study.

Though Snellen distance visual acuity was used instead of logMAR visual acuity, which has been found to exaggerate the visual loss, logMAR acuity testing as well, is a form of visual psychophysics, in which refractive error, pathology or amblyopia reduces the patient's ability to discriminate the elements of the stimulus. The stimulus may be perceived incorrectly and the patient's response can be incorrect.[17,18]

The overall visual function of a child has four major components; communication, mobility, daily living activities and sustained near vision tasks like reading and writing, including color vision and contrast sensitivity assessment.[19] A more detailed evaluation of these parameters including psychological assessment, can aid in planning special education for visually impaired children.[20] Changes in environment that does not cost much, should be an integral part of the low vision care of these children. Depending on the educational need to use Braille or ability to use print as educational medium, additional wings of low vision care need to be setup within available rehabilitation services, in blind schools. Some of these children with low vision, studying in blind schools, after being trained once, can possibly be integrated in regular schools and thus the blind schools can be reclassified as schools for the visually impaired.

In conclusion, the ophthalmologists must be made aware of the potential value of spectacles and low vision devices in the "incurably blind children". The present study demonstrates the need for ophthalmic evaluation, refraction and assessment for low vision devices and spectacles, prior to admission to schools and the periodic review thereafter. In addition, training to use low vision devices with print education should be introduced in the blind schools, along with teaching Braille, keeping in mind both the short term visual outcome and the long term visual prognosis.

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