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ORIGINAL ARTICLE

Causes of Blindness and Visual Impairment among Students in Integrated Schools for the Blind in Nepal

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ABSTRACT

Purpose: To identify the causes of blindness and visual impairment among students in integrated schools for the blind in Nepal.

Methods: A total of 778 students from all 67 integrated schools for the blind in Nepal were examined using the World Health Organization/Prevention of Blindness Eye Examination Record for Children with Blindness and Low Vision during the study period of 3 years.

Results: Among 831 students enrolled in the schools, 778 (93.6%) participated in the study. Mean age of students examined was 13.7 years, and the male to female ratio was 1.4:1. Among the students examined, 85.9% were blind, 10% had severe visual impairment and 4.1% were visually impaired. The cornea (22.8%) was the most common anatomical site of visual impairment, its most frequent cause being vitamin A deficiency, followed by the retina (18.4%) and lens (17.6%). Hereditary and childhood factors were responsible for visual loss in 27.9% and 22.0% of students, respectively. Etiology could not be determined in 46% of cases. Overall, 40.9% of students had avoidable causes of visual loss. Vision could be improved to a level better than 6/60 in 3.6% of students refracted.

Conclusion: More than one third of students were visually impaired for potentially avoidable reasons, indicating lack of eye health awareness and eye care services in the community. The cause of visual impairment remained unknown in a large number of students, which indicates the need for introduction of modern diagnostic tools.

KEYWORDS: Integrated school, Nepal, Visual impairment, Blind

INTRODUCTION

Of 45 million people who are blind worldwide, around 1.4 million are children under 16 years of age, 75% of whom live in developing countries.[1] Childhood blindness is important because these children have a lifetime of blindness ahead, with an estimated 75 million blind-years (number blind × length of life) second only to cataract.[2] It is also important because of its impact on the children's development, education, future work opportunities and quality of life. The prevalence of blindness in children varies from 0.3/1000 children in economically developed countries to 1.5/1000 in the poorest communities.[3] Many of the causes of childhood blindness are avoidable, being either preventable or treatable.[4] The control of blindness in children is one of the priority areas of Vision 2020: The Right to Sight, a joint initiative of the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (PBL).[3]

With an estimated population of 29 million in 2008, Nepal has 11.2 million children below 16 years of age.[5] Currently 30,240 children are estimated to be blind and another 90,000–120,000 have low vision (Mid Term Review of Vision 2020: The Right to Sight in Nepal, 2011). The Nepal Blindness Survey conducted in 1981 although focused primarily on blindness in adults and the elderly, reported ocular infections, xerophthalmia and congenital cataract as the major causes of childhood blindness.[6] Administratively Nepal is divided into 5 development regions, 14 zones

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and 75 districts. A total of 67 integrated schools are distributed in 58 districts for the education of blind and vision impaired (BVI) children.[7] The objective of this study was to identify the causes of blindness and visual impairment among BVI students studying in integrated schools for the blind in different parts of the country.

MATERIALS AND METHODS

From May 2008 to April 2011, comprehensive eye examinations were performed by a pediatric ophthalmologist and an optometrist in all BVI students present at school on the day of examination. A total of 778 students from all 67 integrated schools for blind children in Nepal were enrolled in the study.

Detailed information on the location of schools was obtained from the Department of Education. Preliminary contacts were made and the date of examination was fixed in each school by the survey team prior to school visits. Ethical approval to conduct the survey was obtained from the Institutional Review Board of Tribhuvan University Teaching Hospital, Nepal.

A brief history including age of onset of visual loss for the child, similar conditions in the family, consanguinity, and previous eye surgery performed, was obtained either from the student, resource teachers or parents, as available. Presence of additional disability was recorded from students' medical records. Visual acuity was defined as the ability of an eye to see details and the standard WHO definition of best corrected visual acuity < 3/60 or visual field <20° in the better eye was used as the criteria to label a student blind. Examinations were performed in a quiet room under ambient light conditions. Rooms with at least four windows and a door were chosen to allow control of light required for different testing procedures. Visual acuity for distance was tested with a Low Vision Resource Centre (LVRC) logarithm of the minimum angle of resolution (LogMAR) test chart. The chart was placed at a distance of 3m from the student undergoing the visual acuity testing. Distance visual acuity was recorded for an individual eye as a Snellen fraction. When the student could not make out any letters on the chart, the subject was asked to count fingers at 2 m (visual acuity recorded as 2/60) and if unable, at 1 m (recorded as 1/60). For inability to count fingers even at 1 m the student was asked to count fingers close to face (recorded as CFCF), and if unable, asked to appreciate movement of examiners hands close to face (recorded as HM). The failure to do all of the above was followed by projection of light (recorded as PLPR), perception of light (PL) or no perception of light (NPL). A reduced LVRC LogMAR test chart was used under ambient light conditions to test visual acuity of the students at near. Recording of near acuity was performed for both eyes together using "M" notations. Retinoscopy was not performed in cases where retinal reflex could not be seen (eg, disorganized eyes, or eyes with opaque cornea or dense media opacities). A low vision kit comprising telescopes, magnifiers and spectacle microscopes of different powers was used for low vision assessment. The anterior segment was examined using a portable slit lamp bio-microscope (Clement Clarke BA904, Essex, UK). Posterior segment examinations were carried out using a direct (Heine Beta 200, Herrsching, Germany) as well as an indirect (Appasamy associates IO wireless, Chennai, India) ophthalmoscope after dilating the pupil where possible. The WHO/PBL Eye Examination Record for Children with Blindness and Low Vision form was used and its manual followed to record data.[8,9] The etiology of an eye disease was categorized as hereditary when there was either a definite family history of the same condition, or if the condition was due to a well recognized or proven genetic or chromosomal abnormality; as a childhood factor if visual loss occurred as a result of events occurring after the first 28 days of life; as intrauterine when the abnormality had been there since birth, and was attributable to events occurring during the intrauterine period; and as perinatal or neonatal factors if the ocular abnormality was attributable to events occurring during the perinatal period (from 28 weeks of gestation up to 7 days after birth) or during the neonatal period (the first 28 days after birth).

At the end of the evaluation, optical correction was provided to those students who showed improvement in visual acuity on site whenever possible. Students requiring further assessment and treatment were referred to the nearest tertiary level eye hospital where arrangements were made for their services. Data entry was done in Epi-Info version 3.4.3 (Centers for Disease Control and Prevention, Atlanta, GA) and analyzed using SPSS version 15 software (SPSS Inc, Chicago, IL).

RESULTS

Among 831 students enrolled in 67 integrated schools, 778 students participated in the eye screening (participation rate 96.3%). Baseline characteristics of non-participants was not found to differ significantly from those included (Table 1). The number of BVI students in each school ranged from 6 to 32. The mean age of students was 13.7 years (SD 4.03), 68% of students were below 16 years of age, while the male to female ratio was 1.4:1. Additional disabilities, eg, hearing loss, mental retardation, epilepsy and physical handicap, were found in 22 (2.8%) cases. A positive family history of the same condition for visual impairment was found in 213 (27.4%) students. A history of visual loss since birth was found in 524 (67.4%) students while 203 (26.1%) had lost vision before their first birthday. Surgical intervention had been performed in 117 (15.0%) students, mostly for cataract 86 (73.0%) and glaucoma 23 (19.6%).

Of 778 students analyzed, 668 (85.9%) were blind, 78 (10.0%) had severe visual impairment and 32 (4.1%) were visually impaired (Table 2).

TABLE 1 Baseline characteristics of participants and non participants in blind and vision-impaired students in Nepal.

Baseline characteristics	Participants		Non participants		All
	n	%	n	%	n
Total students	778	93.6	53	6.4	831
Age, years					
0–10	181	93.8	12	6.2	193
11–15	349	93.1	26	6.9	375
Over 15	248	94.3	15	5.7	263
Sex					
Male	450	92.8	35	7.2	485
Female	328	94.8	18	5.2	346
Visual status of students					
Totally blind	163	91.1	16*	8.9	179
Low vision	615	94.3	37*	5.7	652
Time of onset of visual impairment					
By birth	524	95.8	23*	4.2	547
Acquired later	254	89.4	30*	10.6	284

*As described by resource teacher or parents of the student.

TABLE 2 World Health Organization (WHO) categories of presenting visual acuity among blind and vision-impaired students in Nepal.

WHO Category	Level of vision	Students, n (%)
1. No impairment	6/6–6/18	0 (0)
2. Visual impairment	<6/18–6/60	32 (4.1)
3. Severe visual impairment	<6/60–3/60	78 (10.0)
4. Blind	<3/60–PL	505 (64.9)
5. Blind	NPL	163 (21.0)
Total		778 (100)

PL, perception of light; NPL, no perception of light.

Corneal diseases caused visual impairment in 177 (22.8%) students. Retinal dystrophy was the most common abnormality observed among retinal disorders (18.4%), followed by albinism, retinoblastoma and retinal detachment. Disorders of the lens were found in 17.6% of students; untreated cataract in 5.9%, aphakia in 5.1%, and pseudophakia in 5.9% of students. Of the 130 (16.7%) students with whole globe abnormalities, 85 had congenital abnormalities such as microphthalmos and anophthalmos. Glaucoma was identified as the cause for visual impairment in 8.1% of students. Optic nerve and uveal disorders were seen in 8.7% and 5.0% of students, respectively. The globe appeared normal in 2.4% of students (Table 3).

In 46% of cases the underlying etiology of visual loss could not be determined (Table 4). Hereditary factors were found responsible in 27.9%, childhood factors in 22.0%, intrauterine factors in 2.6%, and perinatal factors in 1.5% of students. Mode of inheritance for hereditary factors was presumed to be autosomal recessive in 4.5%, autosomal dominant in 6.5%, and could not be ascertained in 16.8% of students. Retinal dystrophy (16.6%) was the leading genetic disease identified to cause visual loss. Childhood factors contributing to

TABLE 3 Anatomical site of abnormality leading to vision impairment in blind and vision-impaired students in Nepal.

Anatomical site	n (%), N = 778
Whole globe	130 (16.7)
Anophthalmos	18 (2.3)
Microphthalmos	69 (8.9)
Phthisis	29 (3.7)
Other	14 (1.8)
Cornea	177 (22.8)
Staphyloma	37 (4.8)
Scar	97 (12.5)
Opacity	39 (5.0)
Other	4 (0.5)
Lens	137 (17.6)
Cataract	46 (5.9)
Aphakia	40 (5.1)
Pseudophakia	46 (5.9)
Other	5 (0.6)
Retina	143 (18.4)
Dystrophy	129 (16.6)
Other	14 (1.8)
Uvea	39 (5.0)
Coloboma	37 (4.5)
Other	4 (0.5)
Glaucoma	63 (8.1)
Optic nerve	68 (8.7)
Atrophy	57 (7.3)
Hypoplasia	6 (0.8)
Others	5 (0.6)
Other	21 (2.7)
Refractive error	19 (2.4)
Cortical blindness	2 (0.25)

TABLE 4 Etiology of vision impairment in blind and vision-impaired students in Nepal.

Etiology	n (%), N = 778
Hereditary	217 (27.9)
Autosomal recessive	35 (4.5)
Congenital glaucoma (35)	
Autosomal dominant	51 (6.5)
Congenital cataract (23)	
Retinal dystrophy (22)	
Optic atrophy (6)	
Unspecified	131 (16.8)
Retinal dystrophy (107)	
Congenital cataract (11)	
Albinism (11)	
Retinoblastoma (2)	
Intrauterine factors	20 (2.6)
Rubella	16 (2.1)
Toxoplasmosis	4 (0.5)
Perinatal/neonatal factors	12 (1.5)
Ophthalmia neonatorum	12 (1.5)
Postnatal/childhood factors	171 (22.0)
Vitamin A deficiency	62 (8.0)
Measles	28 (3.6)
Trauma	12 (1.5)
Harmful traditional practice	46 (5.9)
Other	23 (3.0)
Unknown etiology	358 (46.0)
Cataract	87 (11.2)
Glaucoma	28 (3.6)
Abnormality since birth	213 (27.4)
Refractive error	19 (2.4)
Other	11 (1.4)

blindness included vitamin A deficiency (VAD, 8.0%), measles (3.6%), harmful traditional eye medication (5.9%), and others. The first was diagnosed based on age of onset and history of diarrhea, the second on the basis of skin rashes and fever at the time or before onset of visual loss. Visual loss due to harmful traditional eye medication was diagnosed on the basis of history of application of drugs not scientifically proven to have beneficial effect and prescribed by traditional healers or lay persons when the child had a problem in the eyes, which subsequently led to deterioration in ocular health and vision. Among 46 students who were blind following harmful traditional eye medication, 70% had a history of application of locally available herbs, 26% used human or cow milk, and 4% applied human urine in the diseased eye. Rubella was suspected to be responsible for blindness in 2.1% of students. Blindness due to retinopathy of prematurity was not observed.

TABLE 5 Avoidable causes of visual impairment in blind and vision-impaired students in Nepal.

Avoidable cause	n	%
Preventable	180	23.1
Vitamin A deficiency	62	8.0
Measles	28	3.6
Harmful traditional eye medication	46	5.9
TORCH	20	2.6
Ophthalmia neonatorum	12	1.5
Trauma	12	1.5
Treatable	139	17.8
Cataract	51	6.5
Glaucoma	63	8.1
Uveitis	4	0.5
Retinoblastoma	2	0.3
Refractive error	19	2.4

TORCH, infection from toxoplasmosis, other (Coxsackievirus, Syphilis, Varicella-Zoster Virus, HIV, and Parvovirus B19), rubella, cytomegalovirus, herpes simplex virus-2.

Distance vision could be improved in 166 (21.3%) students with refraction. A total of 5 (3.0%) students showed improvement to no impairment from the visual impairment category, 25 (15.1%) students improved from severe visual impairment to the visual impairment category, and 23 (13.8%) students from blind to the severe visual impairment category. The 28 (3.6%) students whose vision could be improved to a level 6/60 or better were provided with optical devices on site whenever possible.

Overall 40.9% of students had potentially avoidable causes of blindness (Table 5) with the cause preventable in 23.1%, and treatable in 17.8% of students. Corneal blindness due to VAD, measles and harmful traditional eye practices was the major preventable cause, while cataract and glaucoma were the major treatable causes identified. Older students were seen to be affected more frequently by preventable conditions than younger students ($P < 0.05$, Figure 1).

DISCUSSION

The large number of BVI students over 15 years studying in schools reflects their late start and the longer time taken to complete schooling. In the present study, only 2.9% of students had an additional disability. This could be a design effect because students with multiple and severe forms of disabilities are not admitted to schools for the blind in Nepal, thus the study sample may not reflect the true status of multiple disability. The study shows predominance of males over females (57.9% vs. 42.1%), which is not an unexpected finding in a society where boys are preferred over girls, also observed in other similar studies.[10–13]

Corneal blindness was the most common cause of visual impairment and the major preventable condition identified among students. This strongly

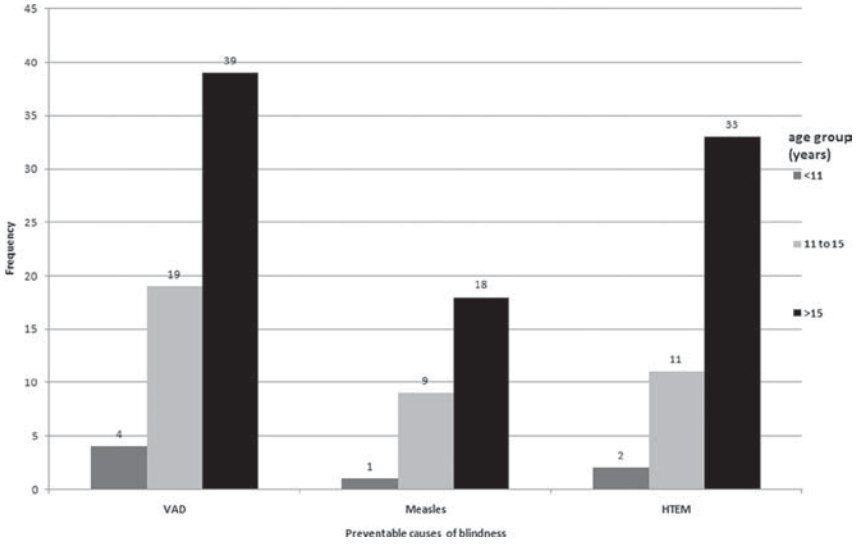

FIGURE 1 Relation between preventable causes of blindness and age. VAD, vitamin A deficiency; HTEM, harmful traditional eye medicine.

indicates the need for strengthening primary health care. The high prevalence of corneal blindness (23%) found in this study is consistent with reports from India (22.2–26.4%),[10,12,14] however much lower than that reported from other studies in Nepal (35.8%),[15] Myanmar (49.5%)[16] and rural Philippines (42.9–54.8%).[17] Closer analysis showed that corneal blindness due to VAD and measles was observed more frequently in older students, which may be taken as an indication that VAD- and measles-related corneal blindness is decreasing over the years due to improved distribution of vitamin A capsules and measles immunization coverage throughout the country. At the same time it is also a matter of concern that VAD is still responsible for blindness in students under 10 years of age despite 15 years of biannual distribution of 200,000IU vitamin A capsules. The current policy of biannual distribution of vitamin A capsules thus needs to be reviewed with regard to frequency of supplementation; eg, distribution 3 times a year, given the fact that over 60% of children in Nepal are undernourished.[17] This becomes even more important in view of the current food storage system which is bound to accentuate malnutrition. The policy of limiting distribution of capsules to children under 6 years of age would also need to be reviewed in view of the fact that VAD is still evident in older students. Long-term measures to increase dietary intake of vitamin A from fortified foods or locally available vitamin A also need to be implemented more vigorously.

Retinal disease, the majority being retinal dystrophy, was identified as the second most common (18.4%) cause of visual impairment in this study. This is comparable to similar studies from Nepal (20.4%),[15] India (13.1%),[11] Cambodia (16.1%)[19] and Sri Lanka (20.8%).[20] This proportion is likely to increase in future, as the proportion of avoidable conditions declines and improved care of neonates will result in more blindness due to retinopathy of prematurity. This was not seen in the present study, the reason being that survival of premature babies in Nepal is low due to a high infant mortality rate[5] and inadequate medical care for premature babies.

The proportion of lens pathology (17.6%) seen in this study is similar to that in reports from Thailand (16.9%),[17] Philippines (9.7–16.8%),[17] Indonesia (14.6%)[21] and Myanmar (14.4%),[16] but at slight variance from reports from Cambodia (27.4%),[19] Malaysia (22.3%),[22] Mongolia (34%)[23] and Bangladesh (32.5%).[24] Vision could be improved in 90.6% of students who had undergone cataract surgery by providing optical correction, while 9.4% remained blind even after surgery. Delayed presentation, surgical complications and poor visual rehabilitation after surgery could be responsible for visual impairment in these students. To address this unmet service need, training of grass root health workers to detect cataract early among children needs to be initiated. At the same time there is a need for specialist pediatric ophthalmic services for surgical as well as optical management of the condition.

The high proportion of undetermined cause (46.0%) for BVI is due to failure to establish the cause of known blinding conditions such as cataract, glaucoma and congenital ocular anomalies. In the absence of adequate facilities for diagnosis, a large number of cases will continue to be diagnosed as due to unknown etiology. Although a useful part of prevention programs, not much can be done for genetic diseases (27.9%) at present, these do indicate the need for introduction of modern diagnostic tools to accurately delineate inheritance patterns in developing countries. The proportion of hereditary disease seen in this study is similar to reports from China (30.7%),[13] Malaysia (29.5%)[22] and Mongolia (27%).[23] Avoidable causes of visual impairment were seen in 40.9% of students. This is lower than that found in a study conducted in Nepal (64.2%),[15] but is similar to the proportion seen in India (43.5%,[11] 47%[14]) Mynamar (43.6%)[16] and Sri Lanka (34.9%).[20]

Vision could be restored to a useful level in a significant number of students with refraction. This indicates the need for scaling up refraction services at health facilities and screening for visual potential at the time of school enrollment. Persistence of blindness due to corneal scarring from VAD despite a decade and a half of national vitamin A capsule distribution, calls for a serious strategy review of the program in Nepal. Blindness due to congenital cataract, a treatable condition, could also be avoided with timely intervention. Training of grass root health workers to detect cataract early among children will go a long way to prevent visual loss from childhood cataract. There is also a need for developing pediatric ophthalmology units in eye hospitals in the country to better manage pediatric eye health problems. This study provides much-needed data on the causes of childhood blindness, which is the basic requirement for developing strategies towards prevention and management. The significant improvement in vision possible among these children indicates an existing service gap that can be narrowed with simple refraction.

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