WORLD VIEW

Causes of severe visual impairment and blindness in children in schools for the blind in Ethiopia

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Aims: To determine the causes of severe visual impairment and blindness in children in schools for the blind in Ethiopia, to aid in planning for the prevention and management of avoidable causes.
Methods: Children attending three schools for the blind in Ethiopia were examined during April and May 2001 using the standard WHO/PBL eye examination record for children with blindness and low vision protocol. Data were analysed for those children aged less than 16 years using the EPI-INFO-6 programme.
Results: Among 360 pupils examined, 312 (96.7%) were aged <16 years. Of these children, 295 (94.5%) were blind or severely visually impaired. The major anatomical site of visual loss was cornea/phthisis (62.4%), followed by optic nerve lesions (9.8%), cataract/aphakia (9.2%), and lesions of the uvea (8.8%). The major aetiology was childhood factors (49.8%). The aetiology was unknown in 45.1% of cases. 68% of cases were considered to be potentially avoidable.
Conclusions: Vitamin A deficiency and measles were the major causes of severe visual impairment/blindness in children in schools for the blind in Ethiopia. The majority of causes acquired during childhood could be avoided through provision of basic primary healthcare services.

There are estimated to be 1.4 million blind children worldwide, of whom about 320 000 live in sub-Saharan Africa.[1] The prevalence of blindness in children varies according to socioeconomic development and under 5 years mortality rates, ranging from an estimated 0.3 per 1000 children in high income countries with low under 5 mortality rates to 1.5 per 1000 children in low income countries with high under 5 mortality rates.[1 2]

Although the actual number of blind children is much smaller than the number of adults who are blind, the number of "blind years" resulting from blindness in children is almost equal to the number of blind years due to age related cataract. Furthermore, many of the causes of blindness in children are either preventable or treatable, and are also related to child mortality. Therefore, the control of blindness in children is considered a high priority within the World Health Organization's Vision 2020 initiative: the right to sight.[1 3]

There is a wide regional variation in the causes of blindness and in the cause specific prevalence of blindness. Corneal scarring is the most important cause in the poorest countries of the world. In high income countries, lesions of the central nervous system predominate. In middle income countries the picture is mixed, with retinopathy of prematurity emerging as an important avoidable cause of blindness. In all regions of the world, cataract, retinal diseases, and congenital abnormalities affecting the whole globe are important causes of blindness.[4]

Ethiopia is a country with a very low socioeconomic status, and children make up almost 50% of its 65 million population. The under 5 years mortality rate is 176/1000 live births, which is unacceptably high even by sub-Saharan standards.[5]

There is a lack of accurate and reliable recent data on the prevalence of childhood blindness in Ethiopia, and the only reliable data on causes of childhood blindness come from a blind school study conducted in 1986.[6] As the causes of childhood blindness and their relative importance can change over time, one cannot rely on outdated data. Therefore, recent data are important for planning appropriate interventions for prevention and management of avoidable causes of blindness in children.

SUBJECTS AND METHODS

Three of the five schools for the blind in Ethiopia were selected for this study. Bako, which is located 250 kilometres west of Addis Ababa, and Shashemene located 250 kilometres south of the capital, represent the rural setting. Sebeta is near an urban centre, being located just 20 kilometres outside Addis Ababa. The study was conducted during April and May 2001. All pupils attending the schools for the blind and who were present during the study period were examined. A Snellen "illiterate" E optotype was used to measure visual acuity levels of 6/18, 6/60, and 3/60 with available correction (if any). If a child could not see the 3/60 optotype, he/she was checked for perception of light. The distance visual acuity was measured separately for each eye and then with both eyes together. Anterior segment examination was performed using a torch and a magnifying loupe. Posterior segment evaluation was done after dilating the pupil, where indicated, using a direct and/or indirect ophthalmoscope. Refraction was only performed in those cases where visual improvement was to be expected from the clinical findings. Low vision assessment, intraocular pressure, and visual field measurements were not undertaken.

The standard WHO/PBL eye examination record for children with blindness and low vision protocol was used to record the visual acuity, anatomical site of abnormality leading to visual loss, and underlying aetiology.[7] Data were analysed using software that accompanies the form. The anatomical site of abnormality and underlying aetiology were recorded for each eye, and one selected as the main site and cause for the child.

RESULTS

Personal details

A total of 360 pupils attending three schools for the blind in Ethiopia were examined. There were 71 pupils from Bako, 177 from Sebeta, and 112 from Shashemene. There were 232 males and 128 females in total, giving a female to male ratio of 1: 1.8 (Table 1). Although there were fewer females than males in each of the schools, there were strikingly fewer females in

Table 1 Distribution of pupils attending schools for the blind in Ethiopia by school and sex

School	Male	Female	Total	Percentage
Bako	64	7	71	19.7
Sebeta	106	71	177	49.2
Shashemene	62	50	112	31.1
Total	232	128	360	100

the school in Bako, which had a female to male ratio of 1:9.1. The age of the pupils ranged from 4 to 20 years. The mean age of the pupils was 12.3 years.

The pupils in these schools came from different regions of the country. Pupils mainly came from Oromiya (43.6%), Amhara (27.8%), and Southern Nations and Nationalities Peoples (15%) regions. In Bako, the majority of pupils came from Amhara region, while in Sebeta and Shashemene they came from Oromiya region. There were no children from Somali and Gambella regions (Table 2).

Categories of visual loss

Levels of WHO categories of vision and age group for the 360 pupils attending the schools for the blind are shown in Table 3. At presentation, 11 pupils (3.1%) had a visual acuity of 6/18 or better and therefore had no visual impairment. Seventeen pupils (4.7%) had visual impairment; 19 pupils (5.3%) had severe visual impairment, and 313 (86.9%) were blind. Among the blind pupils, 183 (50.8%) had a visual acuity in the range of less than 3/60 to light perception, whereas 130 (36.1%) had no light perception.

Among a total of 360 pupils attending the schools for the blind, 312 (86.7%) were children aged less than 16 years. Of these 312 children, seven pupils (2.2%) had no visual impairment, 10 pupils (3.2%) had visual impairment, 16 pupils (5.1%) had severe visual impairment, and 279 pupils (89.4%) were blind with a visual acuity ranging from less than 3/60 to no light perception.

Anatomical causes of severe visual impairment/ blindness in children aged <16 years

In the 295 pupils aged less than 16 years and who had severe visual impairment or blindness, corneal pathology/phthisis was the most frequent site of abnormality leading to visual loss, accounting for 62.4% of cases (Table 4).

Lesions of the optic nerve were the second most frequent and were responsible for 9.8% of cases. Of the 29 children with optic nerve lesions 24 had optic atrophy and five had optic nerve hypoplasia. Unoperated cataract and aphakia accounted for 9.2%, and lesions of the uvea for 8.8%. Among the 27 children with childhood cataract, 17 (63%) were operated and 10 (37%) were not operated. The age of unoperated children ranged from 9 to 13 years. In contrast, lesions of the retina were not that frequent and accounted only for 2.4% of cases. Lesions of the whole globe, such as anophthalmos, microphthalmos, removed eyes, and disorganised eyes were responsible for 4.7% of the cases. In this study, only five children (1.7%) had loss of vision due to buphthalmos.

Aetiological categories of severe visual impairment and blindness in children <16 years of age

Aetiological categories of severe visual impairment and blindness in children <16 years of age are shown in Table 5. Childhood factors, mainly attributable to vitamin A deficiency and measles, accounted for the majority of cases (49.8%). Hereditary diseases, such as retinal dystrophies and autosomal dominant cataract, were responsible for 3.4%. Three children (1.0%) were believed to have had visual loss due to ophthalmia neonatorum, which is one of the perinatal factors. Congenital rubella was responsible for two cases (0.7%). In a significant number of cases (45.1%), the underlying aetiology of visual loss could not be determined. These were mainly children with

Table 2 Regions of origin of the pupils attending the 3 schools for the blind in Ethiopia

Region	Population (millions)	Bako	Sebeta	Shashemene	Total	Percentage
Tigray	3.7	3	1	4	8	2.2
Afar	1.2	0	1	0	1	0.3
Amhara	16.3	34	51	15	100	27.8
Oromiya	22.4	23	98	36	157	43.6
Somali	3.7	0	0	0	0	0
Benshangul-Gumuz	0.5	1	0	0	1	0.3
SNNPR*	12.5	4	10	40	54	15
Gambella	0.2	0	0	0	0	0
Harari	0.2	0	6	0	6	1.7
Addis Ababa	3.5	5	9	16	30	8.3
Dire Dawa	0.3	1	1	1	3	0.8
Total	64.5	71	177	112	360	100

*SNNPR = Southern Nations and Nationalities Peoples Region.

Table 3 Visual status of 360 pupils attending the schools for the blind in Ethiopia by age group

		Age groups (years)				All	
Visual acuity	WHO categories	0–5	6–10	11–15	16–20	No	%
6/6–6/18	NI	1	2	4	4	11	3.1
<6/18–6/60	VI	0	4	6	7	17	4.7
<6/60–3/60	SVI	0	3	13	3	19	5.3
<3/60–PL	BL	0	52	118	13	183	50.8
NLP	BL	3	33	73	21	130	36.1
Total		4	94	214	48	360	
		1.1	26.1	59.5	13.3		100

NI = no impairment, VI = visual impairment, SVI = severe visual impairment, BL = blindness.

Table 4 Anatomical site of major causative pathology in children less than 16 years of age with severe visual impairment and blindness in schools for the blind in Ethiopia

Anatomical site		Frequency	Percentage
Whole globe		14	4.7
Anophthalmos	1		
Microphthalmos	6		
Removed	4		
Disorganised	3		
Cornea/phthisis		184	62.4
Phthisis	51		
Staphyloma	41		
Scar	89		
Other opacity	3		
Optic nerve		29	9.8
Optic atrophy	24		
Optic nerve hypoplasia	5		
Cataract/aphakia		27	9.2
Unoperated cataract	10		
Aphakia	17		
Uvea		26	8.8
Retina		7	2.4
Glaucoma/buphthalmos		5	1.7
Others		3	1.0
Total		295	100.0

Table 5 Aetiological categories of visual loss in children less than 16 years of age with severe visual impairment and blindness in schools for the blind in Ethiopia

Aetiology		Frequency	Percentage
Hereditary		10	3.4
Autosomal dominant	5		
Autosomal recessive	2		
Unspecified	3		
Intrauterine		2	0.7
Rubella	2		
Perinatal		3	1.0
ONN	3		
Childhood		147	49.8
VAD	91		
Measles	39		
Trauma	6		
HTEM	3		
Others	8		
Unknown		133	45.1
Cataract	20		
Buphthalmos	5		
Abnormality since birth	12		
Others	96		
Total		295	100.0

phthisis bulbi, uveitis, optic atrophy, microphthalmos, anophthalmos, and some cases of congenital cataract.

Avoidable causes of severe visual impairment/ blindness in children aged <16 years

In this study, 50.7% of the pupils aged less than 16 years attending schools for the blind had lost their vision as a result of preventable causes. The main preventable causes were vitamin A deficiency and measles. An additional 17.3% were blind from causes that were potentially treatable (Table 6). Over two thirds of children (68%) in the schools for the blind had severe visual impairment/blindness as a result of potentially avoidable causes.

DISCUSSION

Although blind school studies have the advantage of ease of examining a large number of children within a relatively short period of time by one examiner using standard methods, they are potentially biased. Children in the schools for the blind may not be representative of blind children in the whole population. It is believed that in most developing countries only about 10% of blind children are in blind schools.[8] Preschool children are not found in the schools for the blind and are thus excluded from the study. As observed from the admission criteria of the schools for the blind in Bako, Sebeta, and Shashemene, multiply handicapped children (especially those with mental retardation) are not admitted to the schools. Although most of the children in this study come from different regions of the country, blind children from remote and underserved parts of the country may not have access to blind schools. Furthermore, it is estimated that in poor countries 60–80% of blind children die within 1–2 years of becoming blind.[9] Despite these limitations, blind school studies do give valuable information on the causes of childhood blindness.

The children in this study came form different regions of the country, with a large proportion coming from three regions: Oromiya (43.6%), Amhara (27.8%), and SNNPR

Table 6 Avoidable causes of severe visual impairment/blindness in children less than 16 years of age attending schools for the blind in Ethiopia

	Number	Percentage
Preventable conditions:		
VAD	91	30.8
Measles	39	13.2
Trauma	6	2.0
Autosomal dominant	5	1.7
Ophthalmia neonatorum	3	1.0
HTEM	3	1.0
Rubella	2	0.7
Meningitis	1	0.3
Subtotal	150	50.7
Treatable conditions:		
Cataract	20	6.8
Glaucoma	5	1.7
Uveitis	26	8.8
Subtotal	51	17.3
Total avoidable	201	68

(15%), which is mainly a reflection of the size of the population of children in these regions. But there were no children from Somali and Gambella regions, indicating that these areas are underserved. One cannot classify the three schools for the blind as serving mainly rural or urban children as, for example, only 5.1% of children in Sebeta school for the blind came from Addis Ababa, which is just 20 km away.

There were more males than females in all three schools, particularly in the blind school in Bako. The preponderance of males in blind schools probably reflects the greater value accorded to male children in Ethiopian societies, rather than a real difference in incidence between the sexes.

Categories of visual loss

Among a total of 360 pupils examined, 332 (92.2%) had severe visual impairment/blindness. This proportion of children with SVI/BL is higher than the reports for Malawi (83.9%), Uganda (76.5%), and Kenya (66.3%).[10]

Nevertheless, there were 28 children (7.8%) who had visual acuity of 6/60 or better, despite the admission criteria requesting a medical certificate of blindness. Most of these children come from small towns near the blind schools. Parents might seek admission of their children even though they might not be blind, because blind schools offer free lodging and food, and often better education.

Anatomical site of major causative pathology: change over time

Foster reported on 195 children aged 7–18 years in Sebeta School for the blind in 1986.[6] The main cause of SVI/BL was corneal scarring/phthisis (72%), which was attributed mainly to vitamin A deficiency; measles accounted for 37% and smallpox 8%. Optic nerve lesions accounted for 10%, cataract/aphakia 6%, lesions of the uvea 4% of cases. In this study, corneal scarring/phthisis was also the main cause of severe visual impairment and blindness but the proportion is lower at 62.4%. A higher proportion of cataract/aphakia (9.2%) and lesions of the uvea (8.8%) were found. These results show that no significant progress seems to have been made in controlling corneal blindness in the country.

Corneal visual loss

In many developing countries corneal ulceration leading to corneal scarring and staphyloma or phthisis is a very important cause of visual loss.[10] In this study, corneal scarring/phthisis was the major cause of severe visual impairment and blindness. Corneal scarring/phthisis was also found to be the main anatomical cause in studies of children in schools for the blind in Malawi (48.9%),[10] west Africa (35.9%),[11] and India (26.4%).[12]

In contrast, in neighbouring Kenya and Uganda corneal scarring/phthisis is not the main anatomical cause, being responsible for 16.9% and 20.0% of visual loss respectively. In Kenya lesions of the whole globe and retina predominated, while in Uganda disorders of the lens and retina are now more common than corneal scarring. The reduction in corneal scarring in Uganda was attributed to the impact of improved measles immunisation coverage rates.[10]

Corneal scarring/phthisis often follows measles infection.[13] In this study vitamin A deficiency/measles accounted for 70.1% of corneal scarring/phthisis. However, because of unreliable histories and the absence of medical records, the role of harmful traditional eye medicine is likely to be underestimated in this study. The relatively high proportion of corneal scarring/phthisis found in this study is mainly a reflection of Ethiopia's poor socioeconomic status, which is associated with inadequate immunisation coverage (only 37% of 9 month olds were immunised against measles in 2000), poor nutrition and health services for children.[5 14]

Although the distribution of high dose vitamin A capsules has been carried out through the expanded programme of immunisation since 1996, vitamin A supplementation coverage in 6–59 month old children remains low in Ethiopia at 49%.[5] Vitamin A deficiency remains a significant public health problem, not only in preschool children but also in older children. A recent study in northern Ethiopia found a high prevalence of clinical vitamin A deficiency in children aged 6–9 years (5.8%), indicating the need for evaluating the practice of targeting vitamin A supplementation programmes only at preschool children in areas where vitamin A deficiency is endemic.[15]

Lesions of the optic nerve

Lesions of the optic nerve, which accounted for 9.8% of the cases, were the second most frequent cause in this study. Although most of the children gave a history of illness with fever before the onset of blindness, because of lack of reliable history and medical records, the aetiology of optic atrophy was unknown in the majority of the cases. The role of malaria, meningitis, and viral encephalitis needs further research in Ethiopia.

Childhood cataract

Childhood cataract was the third most frequent cause in this study. In contrast with this, cataract was the largest cause of visual impairment in Uganda.[16] In this study there were 10 unoperated cataract cases that were admitted to blind schools despite the admission criteria requiring them to be seen by an ophthalmologist. Although some of these children are likely to have poor visual prognosis because of late presentation, they were referred for surgery to a tertiary eye centre in Addis Ababa. Late presentation, poor surgical skills, complications of surgery, and non-existent visual rehabilitation postoperatively are likely to have contributed towards visual loss in those children who had had cataract surgery. A recent report about results of cataract surgery with IOL implantation in children in east Africa, which attained 44% corrected vision of 6/18 or better and 91.2% corrected vision of 6/60 or better in the operated eyes, is very encouraging.[17]

Uveal lesions

In this study, uveitis was responsible for 8.8% of visual loss. These were mainly cases of burnt out uveitis. In the majority of the cases the aetiology could not be determined with any degree of certainty.

Aetiological categories

As in many countries with poor socioeconomic status, childhood factors accounted for the majority of cases in this

study (49.8%). In a significant proportion of the cases (45.1%), the underlying aetiology could not be determined. In most children this was because it was not possible to determine the time of onset owing to lack of reliable history and medical records, or the pathological processes could not be elucidated. This finding is similar to other reported blind school studies—that is, Kenya 45.4%,[10] Uganda 43.4%,[10] and India 46%.[12]

Avoidable causes

In this study, 68% of children had avoidable causes of visual loss. This finding is similar to the findings in Malawi (67.2%) and Uganda (56.7%),[10] but higher than in Kenya (28.6%)[10] and South Africa (38.8%).[18] Vitamin A deficiency/measles contributed to the majority of the preventable causes. Childhood cataract was one of the main treatable conditions.

One of the main priorities of Vision 2020 is elimination of corneal scarring caused by vitamin A deficiency, measles, or ophthalmia neonatorum. This could be achieved through promotion of maternal and child health care, measles immunisation, vitamin A supplementation, and nutrition education.[3 4] Therefore, it is of paramount importance that the ministry of health in Ethiopia, in collaboration with other stakeholders, intensifies its efforts to increase measles immunisation coverage as well as vitamin A supplementation.

In order to tackle treatable conditions such as childhood cataract, there is a need to establish a network of specialist "child eye care" tertiary centres and to train more ophthalmologists in the skills required to run them. Currently, there are 63 ophthalmologists in Ethiopia and more than 70% of them work in the capital, Addis Ababa. There are no specialist tertiary centres for the treatment of childhood eye disorders, and only two recently trained paediatric oriented ophthalmologists for a population of about 65 million. If Vision 2020 targets for human resources development with regard to childhood blindness are to be met, Ethiopia needs at least 60 paediatric oriented ophthalmologists.[1 4]

This study has demonstrated that corneal scarring is the leading cause of blindness in children in schools for the blind in Ethiopia. Corneal scarring was mainly caused by vitamin A deficiency/measles, which could be prevented through provision of basic primary healthcare services. Almost 70% of the children in schools for the blind had preventable or treatable causes, indicating that a lot could be done for prevention of blindness in children in Ethiopia. Therefore, measures for prevention of childhood blindness in Ethiopia should mainly concentrate on corneal scarring and childhood cataract.

Concerted and integrated effort is needed by the ministry of health and other concerned authorities, eye care professionals, primary healthcare workers, traditional birth attendants, community and religious leaders, and educators to implement the elements of primary health care in prevention of corneal blindness.

Health education is needed to ensure improved intake of vitamin A in children and women of childbearing age through promotion of breast feeding, appropriate weaning foods, and home gardening. It should be aimed at increasing the rate of literacy in general and female literacy in particular, and adequate child spacing and family planning should be promoted.

One should also work towards improving clean water supply and sanitation to reduce the prevalence of diarrhoeal diseases. Additionally, all effort must be put into improving measles immunisation coverage through the expanded programme of immunisation from its current low level of 37%. Furthermore, vitamin A should be available in every measles ward, and vitamin A prophylaxis given for children with measles and severe diarrhoea.

Tackling the problem of childhood cataract would require capacity building in establishing tertiary eye care centres specialised in childhood blindness as well as increasing the number of paediatric oriented ophthalmologists in the country.

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