**WORLD VIEW**

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

A B Kello, C Gilbert

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 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 aetiology was childhood factors (49.8%). The aetiology was unknown in 94.5% 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.

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. 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 male to female 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...
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 1 Distribution of pupils attending schools for the blind in Ethiopia by school and sex

<table>
<thead>
<tr>
<th>School</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bako</td>
<td>64</td>
<td>7</td>
<td>71</td>
<td>19.7</td>
</tr>
<tr>
<td>Sebeta</td>
<td>106</td>
<td>71</td>
<td>177</td>
<td>49.2</td>
</tr>
<tr>
<td>Shashemene</td>
<td>62</td>
<td>50</td>
<td>112</td>
<td>31.1</td>
</tr>
<tr>
<td>Total</td>
<td>232</td>
<td>128</td>
<td>360</td>
<td>100</td>
</tr>
</tbody>
</table>

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

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

* 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

<table>
<thead>
<tr>
<th>Visual acuity</th>
<th>WHO categories</th>
<th>Age groups (years)</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/6-6/18</td>
<td>NI</td>
<td>0-5</td>
<td>6-10</td>
</tr>
<tr>
<td>&lt;6/18-6/60</td>
<td>VI</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>&lt;6/60-3/60</td>
<td>SVI</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>&lt;3/60-PL</td>
<td>BL</td>
<td>0</td>
<td>52</td>
</tr>
<tr>
<td>NLP</td>
<td>BL</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>4</td>
<td>94</td>
</tr>
</tbody>
</table>

NI = no impairment; VI = visual impairment; SVI = severe visual impairment; BL = blindness.
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. 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. Despite these limitations, blind school studies do give valuable information on the causes of childhood blindness.

The children in this study came from different regions of the country, with a large proportion coming from three regions: Oromiya (43.6%), Amhara (27.8%), and SNNPR.
Corneal scarring and phthisis or phthisis is a very common cause of severe visual loss in many developing countries, and in Africa,Backdrop.

In this study 70.1% of the children have corneal scarring/phthisis as the main cause of severe visual loss, 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, cataract/aphakia was the third most frequent cause in this study. Childhood cataract was the third most frequent cause in this study. In contrast with this, cataract was the largest cause of visual loss.

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 was not in Ethiopia at 49%. Vitamin A deficiency remains a significant public health problem, not only in preschool children but also in older children.

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

<table>
<thead>
<tr>
<th>Preventable conditions:</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A deficiency (VAD)</td>
<td>91</td>
<td>30.8</td>
</tr>
<tr>
<td>Measles</td>
<td>39</td>
<td>13.2</td>
</tr>
<tr>
<td>Trauma</td>
<td>6</td>
<td>2.0</td>
</tr>
<tr>
<td>Autoimmune dominant</td>
<td>5</td>
<td>1.7</td>
</tr>
<tr>
<td>Ophthalmia neonatorum</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>HTDM</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Rubella</td>
<td>2</td>
<td>0.7</td>
</tr>
<tr>
<td>Meningitis</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Subtotal</td>
<td>150</td>
<td>50.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatable conditions:</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td>20</td>
<td>6.8</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>5</td>
<td>1.7</td>
</tr>
<tr>
<td>Uveitis</td>
<td>26</td>
<td>8.8</td>
</tr>
<tr>
<td>Subtotal</td>
<td>51</td>
<td>17.3</td>
</tr>
<tr>
<td>Total avoidable</td>
<td>201</td>
<td>68</td>
</tr>
</tbody>
</table>

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.

Although 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. 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. 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%), west Africa (35.9%), and India (26.4%).

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.

Corneal scarring/phthisis often follows measles infection. 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.

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%. 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.

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.

Although 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 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.

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%)8 and
South Africa (38.8%).13 Vitamin A deficiency/measles contrib-
uted 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 pro-
motion of maternal and child health care, measles immunisa-
tion, vitamin A supplementation, and nutrition education.1,4
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 cover-
age 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 ophthal-
mologists 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 ophthal-
mologists 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.14

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 provi-
sion 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 pre-
vention 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 sup-
ply and sanitation to reduce the prevalence of diarrhoeal dis-
eases. Additionally, all effort must be put into improving mea-
sles 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 mea-
sles and severe diarrhoea.

Tackling the problem of childhood cataract would require
capacity building in establishing tertiary eye care centres spe-
cialised in childhood blindness as well as increasing the
number of paediatric oriented ophthalmologists in the coun-
ty.

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