

# Causes of severe visual impairment and blindness in students in schools for the blind in Northwest Ethiopia

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## ABSTRACT

**Objectives** To determine the causes of severe visual impairment and blindness (SVI/BL) among students in schools for the blind in Northwest Ethiopia and to identify preventable and treatable causes.

**Method** Students attending nine schools for the blind in Northwest Ethiopia were examined and causes assigned using the standard WHO record form for children with blindness and low vision in May and June 2015.

**Results** 383 students were examined, 357 (93%) of whom were severely visually impaired or blind (<6/60 in their better eye). 253 (70.9%) were aged 16 years or above and 228 (63.9%) were males. 100 students aged <16 years were blind and four were SVI, total 104. The major anatomical site of visual loss among those 0-15 years was cornea/phthisis (47.1%), usually due to measles and vitamin A deficiency, followed by whole globe (22.1%), lens (9.6%) and uvea (8.7%). Among students aged 16 years and above, corneal/phthisis (76.3%) was the major anatomical cause, followed by lens (6.3%), whole globe (4.7%), uvea (3.6%) and optic nerve (3.2%). The leading underlying aetiology among students aged <16 years was childhood factors (39.4%) (13.5% measles, 10.6% vitamin A deficiency), followed by unknown aetiology (54.8%), perinatal (2.9%) and hereditary factors (2.9%). In the older group, childhood factors (72.3%) (25% measles, 15% vitamin A deficiency) were major causes, followed by unknown aetiology (24.1%), perinatal (2.4%) and hereditary factors (0.8%). Over 80% of the causes were avoidable with majority being potentially preventable (65%).

**Conclusion** Corneal blindness, mainly as the result of measles and vitamin A deficiency, is still a public health problem in Northwest Ethiopia, and this has not changed as observed in other low-income countries. More than three-fourth of causes of SVI/BL in students in schools for the blind are potentially avoidable, with measles/vitamin A deficiency and cataract being the leading causes.

## INTRODUCTION

The revised 2010 estimate showed that the number of blind children in the world has declined to 1.26 million compared with the previous estimate in 1999 of 1.4 million. However, in Sub-Saharan Africa, the number of blind children has increased by 31% to 419 000.<sup>1</sup> Children who are blind in this region

## Key questions

### What is already known about this subject?

- ▶ Corneal scarring has been the leading cause of childhood blindness in low-income countries. However, implementation of programmes to reduce vitamin A deficiency and measles has substantially reduced this cause of blindness with cataract now being the main avoidable cause of blindness in children in many developing countries.

### What are the new findings?

- ▶ Corneal scarring mainly due to measles and vitamin A deficiency is still the leading causes of blindness in children in schools for the blind in Northwest Ethiopia.

### Recommendations for policy

- ▶ Policy makers need to implement strategies to control childhood blindness from avoidable causes including measles, vitamin A deficiency, cataract and refractive errors.

are likely to have a high mortality, but those who survive contribute a disproportionate number of blind years of disability. Many of the causes of severe visual impairment and blindness (SVI/BL) in children are preventable or treatable, and therefore the control of blindness in children is a high priority in the WHO and the International Agency for the Prevention of Blindness (IAPB) VISION2020 initiative, the Right to Sight.<sup>2</sup>

There is a marked regional variation in the prevalence and major causes of childhood blindness in different parts of the world, reflecting varying socioeconomic development and under-5 mortality rates.<sup>3</sup> The prevalence ranges from 0.3/1000 children in high-income countries to 1.5/1000 children in low-income countries.<sup>3 4</sup> In the poorest countries, corneal scarring due to vitamin A deficiency, measles, ophthalmia neonatorum and the use of traditional practices have been a major cause of blindness, but have declined dramatically in many countries as a result of



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**Table 1** Presenting visual status of students attending nine schools for the blind in Northwest Ethiopia by sex and age group

WHO category of visual loss	Visual acuity in better eye	Sex		Age category in years				Total N (%)
		Male	Female	6-10	11-15	16-20	21-25	
No impairment	≥6/18	9	0	1	3	5	0	9 (2.3)
Visual impairment (VI)	<6/18-6/60	7	10	2	4	8	3	17 (4.4)
Severe visual impairment (SVI)	<6/60-3/60	10	3	0	4	8	1	13 (3.4)
Blind (BL)	<3/60-PL	133	63	11	55	82	48	196 (51.2)
Blind (BL)	NLP	85	63	8	26	79	35	148 (38.6)
Total		244	139	22	92	182	87	383 (100)

economic development and more extensive programmes of measles immunisation and better control of vitamin A deficiency. In these settings, cataract is now often the most common avoidable cause of blindness.<sup>5</sup> In many middle-income countries, retinopathy of prematurity has become the most common cause, whereas in high-income countries central nervous system disorders and retinal conditions are the most common causes.<sup>5</sup>

Population-based data on the causes of blindness in children are difficult to obtain, particularly in developing countries like Ethiopia, as registers of the blind do not exist and very large sample sizes are required for formal population-based cross-sectional surveys. Examination of children enrolled in schools for the blind offers the opportunity to examine a large number of children quickly in a standard manner by a few examiners. Over the past 20 years, the WHO classification system, which uses anatomical and aetiological categories of causes and standard recording form, has been increasingly used, which allows data to be compared between studies.<sup>6</sup>

## METHODS

The study was conducted in nine schools providing special education for blind students in North Gondar, South Gondar and Bahirdar City administrative zones, Amhara regional state in Northwest Ethiopia. Eight of the schools were integrated schools and one, in Gondar city, was a special school for the blind. The study was conducted during May and June 2015. All students under the age of 16 years at the time of the study and aged 16 years and above but who became visually impaired before the age of 16 years were included.

A team comprising a paediatric ophthalmologist and two trained optometrists undertook the examinations. A brief history of the eye condition, family history, and the presence of additional impairments (eg, cognitive, physical or hearing impairment and epilepsy) was recorded. Additional relevant information was collected from class teachers and family members. No medical records were available.

Distance visual acuity was measured by the optometrists using a Snellen E chart at 6 and 3 m, testing

each eye separately and then with both eyes open, with current spectacles, if available. Students with profound visual loss were assessed for light projection and perception of light. Visual loss was categorised according to the WHO categories of visual impairment.<sup>6</sup> Visual fields were assessed by confrontation, and intraocular pressures were measured using a Tonopen, a hand-held applanation tonometer. Anterior segments were examined using a handheld slit lamp microscope, and posterior segment examination was performed by direct and/or indirect ophthalmoscopy after dilating the pupils with tropicamide 1% eye drops, when possible. Students who needed refraction had retinoscopy after instillation of cyclopentolate 1% eye drops. The WHO classification system was used to categorise the cause of SVI/BL using definitions in the coding instructions. One major anatomical site and the relevant underlying cause of vision loss were selected for each eye and then for each student. The needs for optical, surgical or medical interventions were recorded and the visual prognosis assessed. Students requiring further investigations and treatment were referred to the Department of Ophthalmology, Gondar University Hospital. In addition to providing surgical intervention where indicated, low vision aids and spectacles were provided when required.

Data were entered into the WHO childhood blindness software V.1.2.75 and analysed with this software and Microsoft Excel. Data are presented on causes at the level of the child.

Ethical approval was obtained from the Institutional Review Board of the University of Gondar and London School of Hygiene & Tropical Medicine. Permission to conduct the research was obtained from appropriate government bodies including regional and zonal education offices and schools. Informed consent was obtained from school heads and parents or legal guardians of students in blind schools. Assent was also obtained from students.

## RESULTS

A total of 383 students were examined in the nine schools, 244 (63.7%) of whom were male. Their ages

**Table 2** Anatomical site of abnormality leading to vision impairment in 357 students with SVI/BL in schools for the blind in Northwest Ethiopia by age group

Anatomical site	Aged 0-15 years, n (%)	Aged 16 years and above, n (%)	Total, n (%)
<b>Whole globe</b>	<b>23 (22.1)</b>	<b>12 (4.7)</b>	<b>35 (9.8)</b>
Microphthalmos	10 (9.6)	8 (3.2)	18 (5.0)
Anophthalmos	11 (10.6)	4 (1.6)	15 (4.2)
Disorganised	2 (1.9)	0 (0)	2 (0.6)
<b>Glaucoma/buphthalmos</b>	<b>2 (1.9)</b>	<b>2 (0.8)</b>	<b>4 (1.1)</b>
Glaucoma	2 (1.9)	1 (0.4)	3 (0.8)
Buphthalmos	0 (0)	1 (0.4)	1 (0.3)
<b>Cornea/phthisis</b>	<b>49 (47.1)</b>	<b>193 (76.3)</b>	<b>242 (67.8)</b>
Scar	22 (21.1)	83 (32.8)	105 (29.4)
Staphyloma	19 (18.3)	55 (21.7)	74 (20.7)
Phthisis	7 (6.7)	54 (21.3)	61 (17.1)
Keratoconus	0 (0)	1 (0.4)	1 (0.3)
Other opacity	1 (0.9)	0 (0)	1 (0.3)
<b>Lens</b>	<b>10 (9.6)</b>	<b>16 (6.3)</b>	<b>26 (7.3)</b>
Cataract	7 (6.7)	13 (5.1)	20 (5.6)
Aphakia/pseudophakia	3 (2.9)	3 (1.2)	6 (1.7)
<b>Uvea</b>	<b>9 (8.7)</b>	<b>9 (3.6)</b>	<b>18 (5.1)</b>
Uveitis	3 (2.9)	5 (2.0)	8 (2.2)
Coloboma	17 (4.8)	2 (0.8)	7 (2.0)
Aniridia	1 (0.9)	1 (0.4)	1 (0.3)
Other	0 (0)	1 (0.4)	1 (0.3)
<b>Retina</b>	<b>1 (0.9)</b>	<b>1 (0.4)</b>	<b>2 (0.6)</b>
Dystrophy	1 (0.9)	0 (0)	1 (0.3)
Albinism	0 (0)	1 (0.4)	1 (0.3)
<b>Optic nerve</b>	<b>5 (4.8)</b>	<b>8 (3.2)</b>	<b>13 (3.6)</b>
Atrophy	5 (4.8)	8 (3.2)	13 (3.6)
<b>Globe appears normal</b>	<b>5 (4.8)</b>	<b>12 (4.7)</b>	<b>17 (4.8)</b>
Refractive error	2 (1.9)	4 (1.6)	6 (1.9)
Amblyopia	2 (1.9)	6 (2.4)	8 (2.2)
Cortical blindness	1 (0.9)	1 (0.4)	2 (0.6)
Idiopathic nystagmus	0 (0)	1 (0.4)	1 (0.3)
<b>TOTAL</b>	<b>104 (100)</b>	<b>253 (100)</b>	<b>357 (100)</b>

ranged from 6 years to 25 years (mean 17.6 years). One hundred and fourteen (30%) students were under the age of 16 years and 269 (70%) were 16 years or above. Additional impairments were identified in nine students (2.4%), which included hearing loss in four, cognitive impairment in two, physical handicap in two and epilepsy in one student. In 17 students, there was a positive family history of visual impairment.

Sixteen (6.7%) students were not visually impaired or had mild visual impairment and the remainder had severe visual impairment (SVI) (3.4%) or were blind (BL) (89.8%) (table 1). Among the 357 students who were SVI/BL, 104 were aged 0-15 years (mean 12.6; range 6-15 years) and 253 were 16 years or above (mean

19.8; range 16-25 years). Among students aged 0-15 years, there were equal numbers of males and females.

Previous surgical intervention had been performed in 22/383 (5.7%) students: cataract surgery (9), glaucoma surgery (3), enucleation (6), corneal graft (1), optical iridectomy (1) and tarsotomy (1).

The reported age of onset of visual loss was at birth in 36.5% of students aged 0-15 years and 5.9% among older students aged 16 years and above. Among younger students (under 16 years of age), 38.5% reported becoming blind before the age of 6 years compared with 34.3% of older students. Among younger students, 75% were born blind or became blind before the age of 6 years compared with 40.3% of older students.

**Table 3** Aetiological category of visual loss in 357 students with SVI/BL in schools for the blind in Northwest Ethiopia by age group

Aetiology	Aged 0-15 years, n (%)	Aged 16years and above, n (%)	Total, n (%)
<b>Hereditary</b>	<b>3 (2.9)</b>	<b>2 (0.8)</b>	<b>5 (1.4)</b>
Autosomal dominant	3 (2.9)	0 (0)	3 (0.8)
Autosomal recessive	0 (0)	1 (0.4)	1 (0.3)
Unspecified	0 (0)	1 (0.4)	1 (0.3)
<b>Intrauterinecongenital rubella syndrome</b>	<b>0 (0)</b>	<b>1 (0.4)</b>	<b>1 (0.3)</b>
<b>Perinatal/Neonatal factor</b>	<b>3 (2.9)</b>	<b>6 (2.4)</b>	<b>9 (2.5)</b>
Ophthalmia neonatorum	2 (1.9)	6 (2.4)	8 (2.2)
Cerebral hypoxia/injury	1 (0.9)	0 (0)	1 (0.3)
<b>Postnatal/childhood factor</b>	<b>41 (39.4)</b>	<b>183 (72.3)</b>	<b>224 (63)</b>
Measles	14 (13.5)	64 (25.3)	78 (21.8)
Vitamin A deficiency	11 (10.6)	39 (15.4)	50 (14.0)
Other acquired corneal infection/ulcer	11 (10.6)	69 (27)	79 (22)
Harmful traditional practice	1 (0.9)	1 (0.4)	2 (0.6)
Trauma	1 (0.9)	8 (3.2)	9 (2.5)
Neoplasm	1 (0.9)	0 (0)	1 (0.3)
Other	2 (12.5)	2 (0.8)	5 (1.2)
<b>Unknown aetiology</b>	<b>57 (54.8)</b>	<b>61 (24.1)</b>	<b>118 (33)</b>
Abnormality since birth	35 (33.6)	17 (6.7)	52 (14.6)
Cataract	8 (7.7)	14 (5.5)	22 (6.2)
Glaucoma/buphthalmos	2 (1.9)	2 (0.8)	4 (1.1)
Other	12 (11.5)	28 (11.1)	40 (11.2)
<b>Total</b>	<b>104 (100)</b>	<b>253 (100)</b>	<b>357 (100)</b>

### ANATOMICAL CAUSES OF SVI/BL

Overall, corneal disease, mainly scarring, staphyloma and phthisis, was the most frequent site leading to visual loss, accounting for 67.8% of SVI/BL (table 2). Corneal blindness was more common in older (aged 16 years and above) than younger (under 16 years) students (76.3% and 47.1%, respectively). Lesions of the whole globe, including anophthalmos and microphthalmos, were the second most frequent causes accounting for 9.8% overall, being a more important cause in younger than older students (22.1% and 4.7%, respectively). Twenty students (5.6%) were SVI/BL from unoperated cataract and six (1.7%) were still SVI/BL after cataract surgery, with little difference between age groups. Other sites of abnormality leading to visual loss were relatively uncommon, with little difference between age groups.

### AETIOLOGY OF SVI/BL

Among 357 students with SVI/BL, the aetiology was classified as 'childhood factors' in 63%, with measles, vitamin A deficiency and other corneal infection/ulcer being the leading underlying causes, accounting for 22%, 14% and 22%, respectively (table 3). Childhood factors were

more common causes in the older (16 years and above) than the younger (under 16 years) age group (72.3% and 39.4%, respectively). Perinatal factors, mainly ophthalmia neonatorum, were responsible for only 2.5% of cases and hereditary (1.4%) and intrauterine factors (0.3%) were also uncommon. No student was SVI/BL from retinopathy of prematurity. A third (33%) of cases were classified as being of unknown aetiology which included abnormalities present since birth (15%), cataract (6%), glaucoma (1%) and other (11%). The other category included optic atrophy (3.4%), refractive errors and amblyopia (3.1%). Unknown aetiology was recorded more commonly in younger than in older students (55% and 24%, respectively).

### AVOIDABLE CAUSES OF SVI/BL

Over 80% of students had potentially avoidable causes of vision loss, with a higher proportion being preventable (65%) than treatable (15.7%) (table 4). Corneal blindness due to scarring, measles and vitamin A deficiency were the major preventable causes, while cataract, refractive error/amblyopia and uveitis were the major treatable causes. Preventable causes were more common in older (16 years and above) than younger students (74.7% and 41.3%, respectively), whereas treatable causes were

**Table 4** Avoidable causes among 357 students with SVI/BL in schools for the blind in Northwest Ethiopia by age group

Aetiology	Aged 0-15years, n (%)	Aged 16 years and above, n (%)	Total, n (%)
<b>Preventable conditions</b>			
Corneal scarring	11 (10.6)	69 (27.3)	80 (22.4)
Measles	14 (13.5)	64 (25.3)	78 (21.8)
Vitamin A deficiency	11 (10.6)	39 (15.4)	50 (14)
Trauma	1 (1.0)	8 (3.2)	9 (2.5)
Ophthalmia neonatorum	2 (1.9)	6 (2.4)	8 (2.2)
Harmful traditional practice	1 (1.0)	1 (0.4)	2 (0.6)
Autosomal dominant	2 (1.9)	0 (0)	2 (0.6)
Rubella	0 (0)	1 (0.4)	1 (0.3)
Trachoma	0 (0)	1 (0.4)	1 (0.3)
Cerebral hypoxia/injury	1 (1.0)	0 (0)	1 (0.3)
<b>Subtotal</b>	<b>43 (41.3)</b>	<b>189 (74.7)</b>	<b>232 (65.0)</b>
<b>Treatable conditions</b>			
Cataract	8 (7.7)	14 (5.5)	22 (6.2)
Uveitis	3 (2.9)	5 (2.0)	8 (2.2)
Refractive error	2 (1.9)	4 (1.6)	6 (1.7)
Refractive amblyopia	2 (1.9)	6 (2.4)	8 (2.2)
Glaucoma	2 (1.9)	2 (0.9)	4 (1.1)
Corneal scar	2 (1.9)	2 (0.9)	4 (1.1)
Vernal keratoconjunctivitis	2 (1.9)	0 (0)	2 (0.6)
Keratoconus	0 (0)	1 (0.4)	1 (0.3)
Brain tumour	1 (1.0)	0 (0)	1 (0.3)
<b>Subtotal</b>	<b>22 (21.1)</b>	<b>34 (13.4)</b>	<b>56 (15.7)</b>
<b>Total avoidable</b>	<b>65 (62.5)</b>	<b>223 (88.1)</b>	<b>288 (80.7)</b>

relatively more common in younger students (under 16 years).

### TRENDS IN SVI/BL OVER TIME

To determine possible trends on the pattern of major causes of visual loss, students with SVI/BL were grouped into four age groups: (a) age 6-10 years (n=19), (b) 11-15 years (n=85), (c) 16-20 years (n=169) and (d) 21-25 years (n=84) (figure 1A and B). Corneal pathologies were the leading cause of SVI/BL in the oldest three groups (b, c, d), while whole globe was the leading cause in the youngest (a) (figure 1A). The change in aetiology with age reflects these differences with acquired conditions of childhood predominating in the older two age groups (c, d), with an unknown aetiology being more common in the younger two age groups (a, b) (figure 1B). Among childhood factors, measles and vitamin A deficiency were analysed separately. Vitamin A deficiency was responsible for visual loss in 9.5% in students aged 21-25 years, 18.3% in students aged 16-20 years, 11.8% in students aged 11-15 years and 5.3% in students aged 6-10 years, whereas measles was responsible in 23.8%, 26.0%, 15.3% and 5.3% in the same age groups.

The date of onset of visual loss, as recalled by students, was also recorded which allowed the approximate year of onset to be determined. Causes of vision loss were grouped as corneal and non-corneal (figure 2). Corneal blindness was responsible for approximately half of all vision loss for each estimated year of onset.

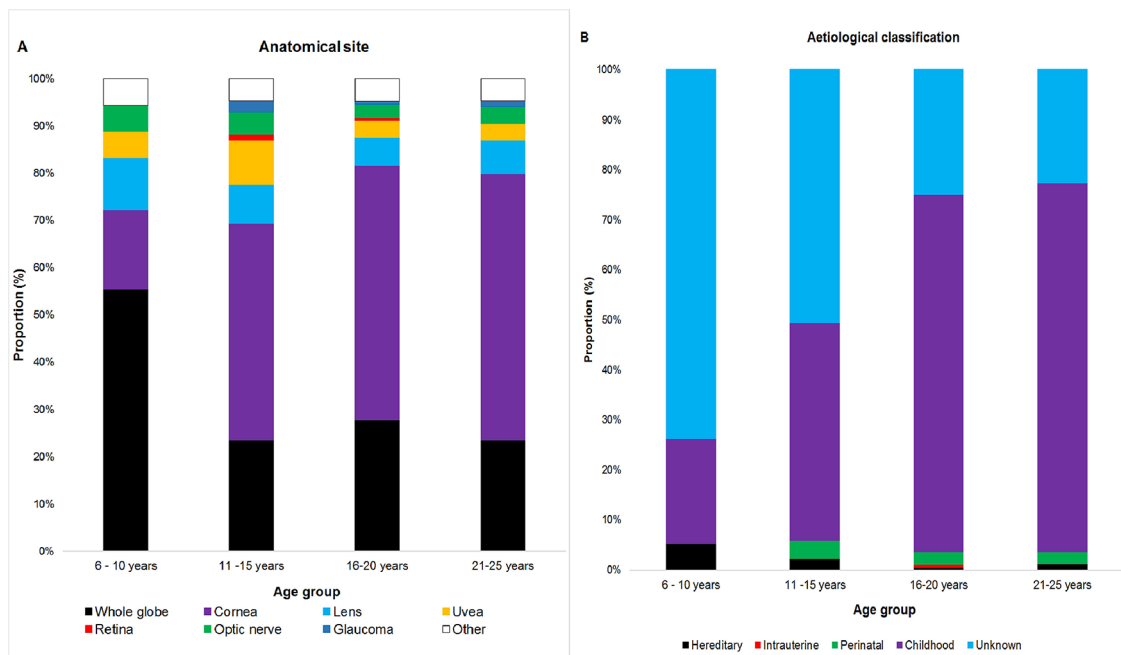
### TREATMENT AND PROGNOSIS

No intervention was needed for most students as they were irreversibly blind. Vision could be improved in 20 right eyes (5.2%) and in 29 left eyes (7.6%). Visual acuity was expected to deteriorate in 13 (3.4%) right eyes and 11 (2.9%) left eyes. Spectacle prescription was recommended in 22, low vision devices in 13 and surgical intervention, principally cataract surgery and corneal transplantation, was recommended in 33 students. A change in school was recommended for 10 students.

### DISCUSSION

In this study, the majority of students (93%) attending special education were SVI/BL, being similar to the previous study in Ethiopia<sup>7</sup> and in Burundi.<sup>8</sup> In our study,





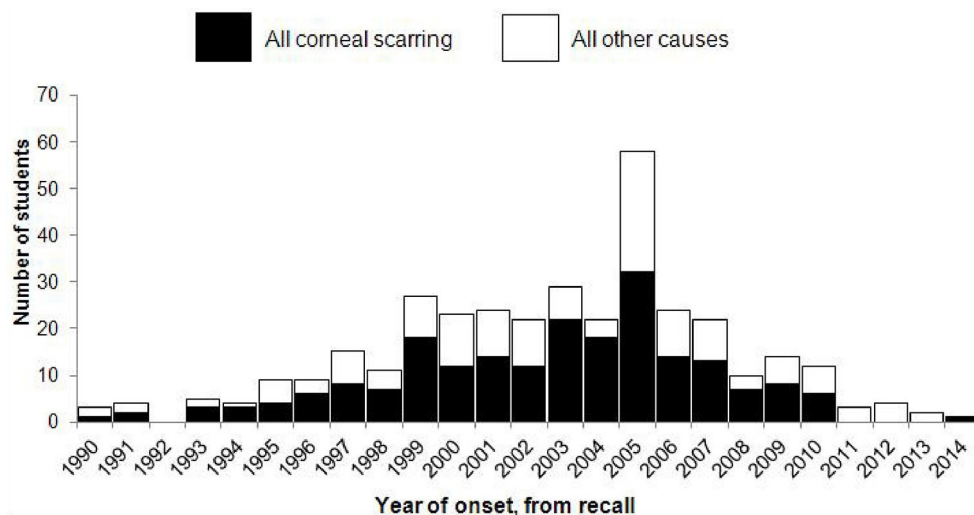
**Figure 1** Anatomical site (A) and aetiological category (B) of principal abnormality in students of different age groups.

there were nine students (2.3%) who had visual acuity of 6/18 or better who were inappropriately enrolled in schools for the blind, although the proportion of students with good visual acuity was lower than in some studies.<sup>9</sup>

In our study, only 30% of students were younger than 16 years, and similar findings have been reported in two studies in Nigeria<sup>10 11</sup> where 65% were 16 years or above, and one study in Burundi<sup>8</sup> where almost half the students were older than 15 years. The attendance of young adults in schools for the blind may indicate that once a child enters a blind school they tend to stay there, often because of poor academic attainment for several reasons: they often start school very late and miss a lot of schooling, Braille educational materials are often limited, and so students find it harder to learn and reach

the level required to progress. In addition, children with SVI/BL may be abandoned by their carers particularly if they are admitted to residential schools. Further studies on the role and impact of education in schools for the blind in Africa are needed.

Two-thirds of all students in our study had vision loss from corneal scarring or phthisis, which affected almost half of the students under the age of 16 years. This is essentially the same as in the study carried out in Ethiopian schools for the blind 15 years ago in which 62.4% of children aged less than 16 years were SVI/BL from corneal scarring or phthisis<sup>7</sup> but is considerably higher than in other studies in Africa for example, in Burundi (24%),<sup>8</sup> Oyo State in Nigeria (29%),<sup>10</sup> Cameroon (32%)<sup>12</sup> and East Africa (19%).<sup>13</sup> In contrast, corneal scarring/



**Figure 2** Recollected date of onset of visual loss of students with severe visual impairment and blindness.

phthisis was not the main anatomical site in South Eastern Nigeria<sup>11</sup> and Uganda,<sup>14</sup> being responsible for 21% of visual loss. Lens pathology was the leading anatomical site of vision loss in South Eastern Nigeria (31.4%) and globe pathology (27%) in Uganda. Our findings are similar to a study in 1993 in Zimbabwe in which 67% of children were blind from corneal pathology.<sup>15</sup>

Recent studies in poor countries in south east Asia have shown a lower proportion of SVI/BL due to corneal scarring than in Africa,<sup>16-18</sup> ranging from 5% in Bhutan<sup>16</sup> to 8% in South India.<sup>19</sup>

Data on the underlying aetiology need to be interpreted with caution, as medical records were not available and the diagnosis was made on the clinical appearance, or what students reported.

In our study, a quarter of students were identified as having had measles or vitamin A deficiency as the principal underlying cause of their vision loss, being similar to recent studies from Asia and Africa. However, a further 10.6% had corneal scarring where an underlying cause could not be determined, where vitamin A deficiency may have contributed to the corneal pathology, so underestimating the relative contribution. Despite an improvement in measles immunisation coverage from 59% in 2005 to 84% in 2014, the incidence of measles infection increased from 0.6 per 100,000 in 2005 to 11.1 per 100,000 in 2014.<sup>20</sup> According to the 2011 Ethiopian Demographic and Health Survey (DHS), measles immunisation coverage was only 56% overall, with significant variation between regions.<sup>21</sup> Vitamin A deficiency is also a serious public health problem in Ethiopia with a national prevalence of Bitot's spots of 1.7% among children aged 6-71 months, and 37.7% of children had deficient serum retinol levels. In this study, only 22.6% of children had received a vitamin A supplement in the previous 6 months.<sup>22</sup> Data from the 2011 DHS also showed that coverage of vitamin A supplementation in the previous 6 months among children aged 6-59 months was suboptimal (54.5% overall) with regional differences ranging from 28% to 83%.<sup>23</sup> Children in the poorest households, or whose mothers did not attend antenatal or postnatal care or where the mother had not worked during the previous year had the lowest coverage.

In our study, 7.7% of children under 16 years and 6.2% of all students had cataract as the principal diagnosis, but only one-third had undergone cataract surgery. Eighteen per cent of children attending schools for the blind in Kenya, Malawi, Tanzania and Uganda had cataract as the major cause of visual impairment, with 83% of these having had surgery in at least one eye.<sup>24</sup> The lower proportion of cataract blindness in our study almost certainly reflects the larger number of children with corneal pathology.

The number of students in our study, although large, represents only a small minority of the estimated number of young people with SVI/BL in Northwest Ethiopia, which is likely to be approximately 8749, assuming a prevalence of 1/1000 children. Children in schools for the

blind may, therefore, not be representative of blind children in the whole population as preschool age children and those with additional impairments, such as cerebral palsy, are likely to be under-represented. In addition, children from remote and underserved parts of the country may not attend a special school.

Data in this study were collected using the WHO classification and Coding Instructions. This has the advantage of allowing comparison to be made with other studies but major difficulties remain in identifying the underlying aetiology many years after the onset of disease. There were no medical records in any school and relying on the response of students is likely to lead to bias. This is one of the limitations of this study.

There is inconsistency in the literature regarding how to classify phthisis bulbi, which in low-income settings is often secondary to corneal perforation. In this study, the WHO guidelines were strictly followed and phthisis was classified under corneal pathology rather than whole globe.

It is difficult to assess trends over time in the aetiology of SVI/BL in this study for several reasons. First, student's recall of the age of onset of their visual loss is likely to be unreliable, and second, children who stay on at school may be different from those who leave at the usual age, so introducing bias. However, it was noted that there was a trend of reduction of measles as the cause of visual loss but there does not seem to be a change in pattern of vitamin A deficiency.

## CONCLUSIONS AND IMPLICATIONS

Corneal blindness, mainly as the result of measles and vitamin A deficiency, is still a public health problem in Northwest Ethiopia, and this has not changed over time as has been observed in other low-income countries. More than three-quarters of the causes of SVI/BL are potentially avoidable, with measles, vitamin A deficiency and cataract being the leading causes.

Concerted and integrated efforts are needed by the Ministry of Health and other authorities, primary health-care workers, eye care professionals and educators to implement primary healthcare to prevent corneal blindness from vitamin A deficiency and measles and to increase the detection, referral and management of cataract and refractive error. Initiatives to improve coverage of measles immunisation and enhance vitamin A supplementation are also urgently needed, both of which will reduce under-5 mortality rates as well as vision loss and blindness in children. The WHO recommends one tertiary level child eye health facility per 10 million population,<sup>2 4</sup> but currently there are only three for a population of over 90 million in Ethiopia. Strengthening existing facilities and establishing new centres so that there is one in each region of the country are highly recommended to address the treatable causes of childhood blindness.

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