OCULAR PROFILE OF VISUALLY IMPAIRED CHILDREN IN SCHOOLS FOR THE BLIND IN NORTH INDIA

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ABSTRACT

BACKGROUND
India shoulders the world's largest burden of childhood blindness. The pattern, causes and prevalence of blindness in children are changing in response to socioeconomic development. Examination of children in schools for blind provides data on the causes of blindness in children. In order to design effective prevention of blindness programs, information on major causes of blindness in children is required.

The aim of the study is to study the ocular profile of severe visual impairment and blindness in children from schools for the blind in North India.

MATERIALS AND METHODS
A total of 174 students in seven registered schools for the blind in Punjab, North India, were examined of which 172 were below 16 years of age and were included in the study. Visual loss was categorised according to WHO criteria for classification of blindness. The World Health Organizations program for the prevention of blindness (WHO/PBL) eye examination record for children with blindness was used to record the findings. The need for optical, surgical or medical interventions was recorded and the visual prognosis was assessed.

RESULTS
It was found that 36.74% children had potentially avoidable causes of blindness. Preventable causes of blindness were seen in 16.26% children and treatable causes in 20.48% children.

CONCLUSION
A wider availability of specialist ophthalmic services is needed for the treatable causes of childhood blindness. Optical and low vision services are also important in the management of children with otherwise untreatable causes of visual loss.

KEYWORDS


BACKGROUND
Childhood blindness refers to a group of diseases and conditions occurring in childhood or early adolescence (<16 years of age), which, if left untreated, result in blindness or severe visual impairment.1 Due to enormous loss of Disability Adjusted Life Years (DALys), childhood blindness is estimated to be the second leading cause of the burden due to blindness.2 Globally, the prevalence of blindness among children is estimated to be one tenth of that in adults at around 0.7 per 1000.3 India shoulders the world’s largest burden of childhood blindness. Fifty percent of these children could be cured if adequate facilities and trained staff were available.4 Prevalence, pattern and causes of blindness in children are dynamic, changing in response to socioeconomic development and the extent to which public health programs for child health are being implemented and accessed by communities.5

In India, the pattern of causes of blindness is likely to vary between state to state with poorer states having higher prevalence of blindness and a different pattern of causes than states with higher economic development and health indicators. Overall, the prevalence in India is estimated to be 0.81/1000 children ranging from 0.3/1000 in well-developed states (e.g. Kerala) to 1.5/1000 children in the poorest.6
Information on the major causes of blindness in children is required to design effective prevention of blindness programs. In order to provide data on the causes of blindness in children, examination of children in special institutions has increasingly been used.

No data on the pattern of childhood blindness and visual impairment was available from the state of Punjab in North India. Hence, the present study was undertaken with the primary objective of determining the ocular profile of severe visual impairment and blindness in children in schools for the blind in Punjab, North India.

AIMS AND OBJECTIVES
To study the ocular profile of severe visual impairment and blindness in children from schools for the blind in North India.

MATERIALS AND METHODS
This study was conducted in seven registered schools for the blind in the state of Punjab in North India after having obtained the required permission for the study from the school director/principal. The school authorities were briefed about the aims and objectives of the study and were requested to inform the parents of the children about the eye examination.

A total of 174 students in seven schools for the blind in Punjab, North India, were examined, of which, 172 were below 16 years of age and were included in the study.

Visual loss was categorised according to WHO criteria for classification of blindness (Table 1).

<table>
<thead>
<tr>
<th>Visual Acuity</th>
<th>WHO Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/6-6/18</td>
<td>NI</td>
</tr>
<tr>
<td>&lt;6/18-6/60</td>
<td>VI</td>
</tr>
<tr>
<td>&lt;6/60-3/60</td>
<td>SVI</td>
</tr>
<tr>
<td>&lt;3/60-PL</td>
<td>BL</td>
</tr>
<tr>
<td>No light perception</td>
<td>BL</td>
</tr>
</tbody>
</table>

Table 1. WHO Classification of Blindness

Demographic profile was recorded and a detailed history was obtained from the students and wherever possible from the parents and from the school records. History of ocular morbidity, birth history, family history and whether the parent’s marriage was consanguineous was taken and recorded as per protocol. History of comorbidities if any was obtained from the medical records of the child or from the parents/guardians.

Distance visual acuity was measured using a Snellen’s chart and Cardiff chart. Near vision was assessed using near vision charts. Functional vision was recorded by observing the ability to recognise the shape of three 2 cm symbols at any near distance, ability to recognise faces at a distance of 3 meters and ability to walk unaided around chairs set 2 meters apart. Torch and handheld slit lamp was used for anterior segment examination. Assessment of visual fields by confrontation method and refraction was also done. Intraocular pressure was recorded by digital tonometry and whenever indicated. Instrumental tonometry with Tono-Pen was done. The posterior segment was examined by direct ophthalmoscopy after dilating the pupils wherever required.

The World Health Organizations program for the prevention of blindness (WHO/PBL) eye examination record for children with blindness was used to record the findings using definitions in the coding instructions. A major anatomical site and aetiology of visual loss in WHO/PBL eye examination record was selected for each eye for the child.

The need for optical, surgical or medical interventions was recorded and the visual prognosis was assessed according to WHO/PBL eye examination record for children with blindness.

Statistical Analysis
All group comparisons involving quantitative variables were carried out using students “t” test or its nonparametric counterpart as applicable. Chi-square test was applied for comparing qualitative variables.

RESULTS
The highest numbers of children examined were from the District of Ludhiana 52 (29.88%) followed by Patiala 39 (22.41%), Amritsar 38 (21.83%), Faridkot 25 (14.36%) and Jalandhar 14 (8.04%).

Out of 172 children included in the study, 16 (9.31%), 49 (28.48%) and 107 (62.21%) were in the age group of 5-8 years, 9-12 years and 13-16 years, respectively. The mean age of children was 12.98±2.5 years and the age ranged from 6-16 years. There were 129 (75%) male children and 43 (25%) female children in our study.

About three quarters (75.59%) gave a history of being blind/visually impaired since birth, 23 (13.37%) lost vision in infancy and 19 (11.04%) became blind/visually impaired during childhood. Additional disabilities found in 8 (4.64%) children were epilepsy 3 (1.74%), physical handicap 3 (1.74%), hearing loss 1 (0.58%) and mental retardation 1 (0.58%).

Categories of Vision Loss
Out of the 172 subjects, 4 (2.32%) had visual acuity of 6/18 or more and so were classified as having No Visual Impairment (NVI), 2 (1.18%) had Visual Impairment (VI), 10 (5.81%) had Severe Visual Impairment (SVI), 156 (90.69%) were blind. Among the children with blindness, 76 (44.18%) had no perception of light, 80 (46.51%) were in visual category of <3/60 to light perception (Figure 1). There were 6 children whose visual acuity was >6/60 in the better eye and hence were excluded from our study population. Thus, out of 172 children examined, 166 had severe visual impairment or blindness.
Anatomical Sites of Visual Loss

In the 166 children who had severe visual impairment and blindness, the whole globe 72 (43.38%), optic nerve 44 (26.51%), cornea 26 (15.66%), lens 10 (6.02%), amblyopia 9 (5.42%) and retina 5 (3.01%) were found to be the most frequently affected sites of abnormality.

### Table 2. Main Anatomical Site of Abnormality in SVI/BL Children by Gender and Age

<table>
<thead>
<tr>
<th>Anatomical site</th>
<th>Male N=124</th>
<th>Female N=42</th>
<th>P value</th>
<th>5-8 yrs. N=16</th>
<th>9-12 yrs. N=48</th>
<th>13-16 yrs. N=102</th>
<th>P value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole globe</td>
<td>50 (40.32)</td>
<td>22 (52.39)</td>
<td>0.93</td>
<td>9 (56.25)</td>
<td>23 (47.91)</td>
<td>40 (39.01)</td>
<td>0.4</td>
<td>72</td>
</tr>
<tr>
<td>Cornea</td>
<td>23 (18.57)</td>
<td>3 (7.14)</td>
<td>0.8</td>
<td>4 (25)</td>
<td>7 (14.58)</td>
<td>15 (14.50)</td>
<td>0.8</td>
<td>26</td>
</tr>
<tr>
<td>Lens</td>
<td>9 (7.25)</td>
<td>1 (2.38)</td>
<td>0.6</td>
<td>0</td>
<td>3 (6.75)</td>
<td>7 (6.70)</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Retina</td>
<td>5 (4.03)</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>1 (2.08)</td>
<td>4 (3.52)</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Optic nerve</td>
<td>28 (22.58)</td>
<td>16 (38.09)</td>
<td>0.1</td>
<td>2 (12.5)</td>
<td>13 (27.48)</td>
<td>29 (28.43)</td>
<td>0.2</td>
<td>44</td>
</tr>
<tr>
<td>Other causes</td>
<td>9 (7.25)</td>
<td>0</td>
<td>-</td>
<td>1 (6.25)</td>
<td>0</td>
<td>8 (7.84)</td>
<td>-</td>
<td>9</td>
</tr>
</tbody>
</table>

Disorders of the whole globe and optic nerve were diagnosed more often in females whereas corneal pathologies and disorders of the lens were more common in males, however, the difference was not statistically significant (p value 0.93, p value 0.8) (Table 2).

The distribution of children into different age groups according to the main anatomical site of abnormality is shown in Table 2.

Blindness due to optic nerve pathology was highest in 13-16 years age group (28.43%), but the difference again was insignificant (p value 0.2).

### Aetiology of Visual Loss

Aetiological classification was based on the time of onset of insult leading to visual loss and the findings at the time of examination.

Aetiology was hereditary in 26 (15.66%) children, postnatal in 32 (19.27%) and undetermined/unknown in 108 (65.07%) children. No child was found to have intrauterine/perinatal aetiology. This could probably be due to lack of availability of proper medical records in the schools.

### Table 3. Underlying Aetiology in SVI/BL Children by Gender and Age

<table>
<thead>
<tr>
<th>Aetiology of SVI/Blindness</th>
<th>Male N=124</th>
<th>Female N=42</th>
<th>P value</th>
<th>5-8 yrs. N=16</th>
<th>9-12 yrs. N=48</th>
<th>13-16 yrs. N=102</th>
<th>P value</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereditary</td>
<td>22 (17.74)</td>
<td>4 (9.52)</td>
<td>0.4</td>
<td>2 (12.5)</td>
<td>7 (14.58)</td>
<td>17 (16.6)</td>
<td>0.9</td>
<td>26</td>
</tr>
<tr>
<td>Postnatal</td>
<td>26 (20.96)</td>
<td>6 (14.28)</td>
<td>0.5</td>
<td>4 (25)</td>
<td>8 (16.64)</td>
<td>20 (19.61)</td>
<td>0.6</td>
<td>32</td>
</tr>
<tr>
<td>Undetermined</td>
<td>76 (61.30)</td>
<td>32 (76.20)</td>
<td>0.07</td>
<td>10 (62.5)</td>
<td>33 (68.78)</td>
<td>65 (63.79)</td>
<td>0.2</td>
<td>108</td>
</tr>
</tbody>
</table>

There was no significant difference in the aetiology of SVI/BL among males and females (Table 3).
In all the age groups, maximum number of children had blindness due to undetermined aetiology and the difference between the groups was not significant (p value 0.2). Postnatal causes were more in 5-8 years age group and vitamin A deficiency was the leading cause (p value 0.6). There was no difference in the hereditary causes of blindness in all age groups (p value 0.9).

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Percentage (n=166)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereditary</td>
<td>26</td>
<td>15.66</td>
<td></td>
</tr>
<tr>
<td>Cannot specify</td>
<td>26</td>
<td>15.66</td>
<td></td>
</tr>
<tr>
<td>Intrauterine</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Perinatal/Neonatal</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Postnatal</td>
<td>32</td>
<td>19.27</td>
<td></td>
</tr>
<tr>
<td>Vitamin A deficiency</td>
<td>21</td>
<td>12.56</td>
<td></td>
</tr>
<tr>
<td>Measles</td>
<td>1</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>Neoplasm</td>
<td>4</td>
<td>2.44</td>
<td></td>
</tr>
<tr>
<td>Trauma</td>
<td>5</td>
<td>3.05</td>
<td></td>
</tr>
<tr>
<td>Harmful traditional practices</td>
<td>1</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>Undetermined/Unknown Aetiology</td>
<td>108</td>
<td>65.07</td>
<td></td>
</tr>
<tr>
<td>Cataract</td>
<td>19</td>
<td>11.44</td>
<td></td>
</tr>
<tr>
<td>Buphthalmos</td>
<td>14</td>
<td>8.45</td>
<td></td>
</tr>
<tr>
<td>Abnormality since birth</td>
<td>75</td>
<td>45.18</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>166</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4. Aetiology of Severe Visual Impairment and Blindness

Avoidable Causes of Severe Visual Impairment and Blindness

In our study, 61 (36.74%) children had potentially avoidable causes of blindness. Preventable causes of blindness were seen in 27 (16.26%) children and treatable causes in 34 (20.48%) children. Vitamin A deficiency and measles combined together were the major preventable cause of visual loss in 22 (13.25%). Visual loss due to trauma was seen in 5 (3.05%) children while harmful traditional practices was responsible for visual loss in only 1 (0.61%) child. Among the treatable causes buphthalmos, cataract and amblyopia accounted for 15 (9.04%), 10 (6.02%), 9 (5.42%) cases, respectively.

Out of the total 172 children, 2 (1.16%) improved on refraction and were recommended glasses and 17 (9.88%) children were advised surgery. Change of school and enrollment in a normal school was recommended to 6 (3.48%) children who had best corrected visual acuity of more than 6/60 in the best eye.

DISCUSSION

India shoulders the world’s largest burden of blindness. Of a total population exceeding 1 billion, as many as 15 million people are blind with an additional 52 million visually impaired among these are 3,20,000 children under the age of 16 constituting one fifth of the world’s blind children. Fifty percent of these children could be cured if adequate facilities and trained staff were available.4

Possible sources of data for childhood blindness include blind registers, population-based surveys and students based in blind schools or hospitals. There is currently no system of blindness registration in India. There are some biases inherent in any study of children in schools for the blind. Population-based studies for low prevalence conditions causing blindness in children have to be very large, which is expensive and time consuming to perform. In schools for blinds. The advantage of studies is that they are cheaper and quicker to perform. Also, they can use a single observer. Relative importance of different causes of blindness in children in a particular region is given as a result. However, they do not give information on the causes specific prevalence in that population. The children seen in this study mainly represent those with bilateral visual loss in whom this was the sole or major disability who had survived to school age and who had awareness of and access to a school for the blind.

In our study, a total of 174 children enrolled in seven schools for the blind in North India were examined and 172 children fulfilled the age eligibility criteria. Out of these, six children had a visual acuity of 6/60 or better and were excluded from the study.

The average age of children in our study was 12.98±2.5 years with the maximum number of children in 13-16 years age group (16.2%). In a similar study done by Titilay et al in 13 blind schools in Delhi, the maximum number of children were in the 13-16 years age group (45.7%).3

In our study, out of 172 children examined, 129 were males and 43 were females forming 75% and 25%, respectively. Titilay et al had also reported a male-female distribution of 61.5% and 38.5%.3 The higher number males as compared to females is probably due to the skewed male-female ratio in our country.

In our study, based on visual acuity at the time of examination, 5.81% were severely visually impaired and 90.69% children were blind, which is consistent with other studies. In a study conducted by Gogate et al in...
Maharashtra, 1985, children in 35 schools for blind were evaluated and percentage of children with SVI and BL were 3.4% and 95.4%, respectively.10

In the present study, only 4.65% of children had an additional disability, which is very low compared to Western surveys. This was however comparable to the study conducted in India by Titiyal et al and Bhattacharjee et al where additional disabilities were found to be 2.5% and 5%.6,11

In our study, congenital abnormalities of the globe (microphthalmos, anophthalmos, disorganised globe) accounted for 32.53% of SVI/BL in children. Congenital abnormalities may be due to genetic diseases or intrauterine factors, but in majority, the aetiology is unknown. This finding is consistent with other studies done in India. In a study by Krishnaiah et al in coastal districts of Andhra Pradesh in South India in 2009, congenital abnormalities of the globe were reported in 41.4% of children.12 In another study done by Bhattacharjee et al in north eastern states of India, congenital abnormalities accounted for 30.6% of cases of SVI/BL.11 It is important to realise that although congenital anomalies like anophthalmos and microphthalmos may not be treatable, many children benefit by low vision aids.

The second most common cause for SVI/BL in children in our study was optic nerve lesions that accounted for 26.50% of cases. This was slightly higher than the observations from other similar studies done in India. Titiyal et al in the year 2003 reported 10.6% of blindness due to optic nerve lesions whereas Rahi et al in 1995 reported only 5.9% lesions in their study.9

Corneal disorders (15.67%), principally corneal scarring was the third most common cause of SVI/BL in children in the schools for the blind in North India. Titiyal et al showed 21.7% blindness due to corneal pathologies in their studies.9 Vitamin A deficiency appears to be the major cause as the onset of blindness in most of these cases was in the postnatal period.

In our study, disorders of the lens were found in 11.44% of children; 6.03% had unoperated cataract and 5.42% had SVI/BL even after undergoing cataract surgery. In these pseudophakic children, visual loss was attributed to amblyopia. Titiyal et al also reported lenticular disorders as accounting for blindness in 10.9% of children. In this study, 50% of children with disorders of the lens had unoperated cataract.9

Glaucow/buphthalmos in the present study was responsible for 9.04% of childhood blindness. In the study done by Titiyal et al and by Krishnaiah et al, buphthalmos accounted for 4.9% and 8.1% cases of childhood blindness.9,12

In our study, retinal pathologies accounted for 3.02%. The retinal disorders were seen much less frequently in our study as compared to other Indian studies. However, if we consider the retinal and optic nerve lesions together, our numbers were comparable with other studies from India.

The underlying cause for SVI/BL could not be determined in 65.07% of children in the present study; amongst them, the abnormality had been present since birth in 45.18% children. The large proportion of children with visual loss of aetiology, which is undetermined is consistent with results of other studies and reflects limited scope for investigations and a lack of examination of family members in most cases.

In our study, 19.27% of children had acquired causes of blindness (trauma, vitamin A deficiency, corneal infections) of which vitamin A deficiency and measles accounted for 12.65%. Rahi et al found that in 28% of children postnatal factors acquired in infancy or childhood were the cause of visual loss of which vitamin A deficiency was reported in 18.6% of children.12 Similarly, in the study done by Titiyal et al in North India, childhood disorders were responsible for blindness in 28.0%.9 It is important to note that despite the vitamin A supplementation programs in our country, vitamin A deficiency still remains the single most important cause of acquired cause of blindness.

Hereditary factors were found in 15.66% of cases, in which, there was positive family history of another similarly affected individual in our study. In a study done by Titiyal et al, hereditary factors accounted for 13.4%, which is comparable to the present study.9

It is necessary to identify important avoidable causes of blindness in each country and monitor the changing patterns of blindness in different regions of the country over the time to develop control programs. In the present study, 37.34% of children were blind from potentially preventable and treatable conditions. High measles immunisation coverage, promotion of breastfeeding, health and education, nutrition and continued programs for the control of vitamin A deficiency through child survival programs are some measures, which can be beneficial.

Treatable causes of blindness were found in 20.48% of cases. These included cataract and glaucoma.

CONCLUSION
A wider availability of specialist ophthalmic services is needed for the treatable causes of childhood blindness such as cataract and glaucoma. Optical and low vision services are an essential element of such services and are also important in the management of children with otherwise untreatable causes of visual loss. Clinical genetic services are required to advise families with known risks of hereditary blinding diseases particularly those with dominantly inherited conditions.

Further work is however needed to elucidate the causes of microphthalmos and anophthalmos. Documentation of changing patterns in causes of childhood blindness in individual states would also be useful to allow early action against emerging avoidable causes.

REFERENCES