Prevalence and causes of blindness and visual impairment in Bangladeshi adults: results of the National Blindness and Low Vision Survey of Bangladesh

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Aim: To determine the age, sex, and cause specific prevalences of blindness and visual impairment in adults 30 years of age and older in Bangladesh.

Methods: A nationally representative sample of 12 782 adults 30 years of age and older was selected based on multistage, cluster random sampling with probability proportional to size procedures. The breakdown of the cluster sites was proportional to the rural/urban distribution of the national population. The examination protocol consisted of an interview, visual acuity (VA) testing, autorefration, and optic disc examination on all subjects. Corrected VA retesting, cataract grading, and a dilated fundal examination were performed on all visually impaired subjects. The definitions of blindness (≤3/60) and low vision (≤6/12 to ≥3/60) were based on the presenting visual acuity in the better eye. The World Health Organization/Prevention of Blindness proforma and its classification system for identifying the main cause of low vision and blindness for each examined subject was used.

Results: In total, 11 624 eligible subjects were examined (90.9% response rate) across the 154 cluster sites. A total of 162 people were bilaterally blind (1.53% age standardised prevalence) while a further 1608 subjects (13.8%) had low vision (≤6/12 VA) binocularly. Visual acuity was >6/12 in the “better eye” in the remaining 9854 subjects (84.8%); however, 748 of these people had low vision in the fellow eye. The main causes of low vision were cataract (74.2%), refractive error (18.7%), and macular degeneration (1.9%). Cataract was the predominant cause (79.6%) of bilateral blindness followed by uncorrected aphakia (6.2%) and macular degeneration (3.1%).

Conclusions: There are an estimated 650 000 blind adults (95% CI 552 175 to 740 736) aged 30 and over in Bangladesh, the large majority of whom are suffering from operable cataract. This survey indicates the need for the development and implementation of a national plan for the delivery of effective eye care services, aimed principally at resolving the large cataract backlog and the inordinate burden of refractive error.
allocation of the cluster sites for each of the six major administrative divisions in Bangladesh was taken into account based on the estimated numbers of people 30 years of age and older living in each division. The relative numbers of rural and urban clusters per division were proportional to census data regarding residence of inhabitants in each of the six divisions.

A total of 154 cluster sample sites were selected by PPS, of which 104 were rural villages while the remaining 50 were urban block areas. For logistical purposes, for example, working within a time frame for completing the survey between monsoon seasons, the rural clusters consisted of 100 subjects, while the urban study areas consisted of 50 subjects each (see Fig 1).

Before the examination of subjects, enumeration of eligible subjects in each cluster site was undertaken—that is 100 adults for each rural site and 50 for each urban cluster. Proceeding systematically from an identified reference point within the cluster—for example, a mosque or school, the names and ages of all habitual occupants of the households were listed until the requisite number of subjects of the target age group had been enumerated for each given cluster. All eligible subjects were informed that they would be asked to attend for an examination in their community in the near future.

Identification of the specific street blocks for subject enumeration within the 16 urban clusters of Dhaka City was based on comprehensive, digitised geographic information system (GIS) maps. According to these maps the Dhaka metropolitan area (population of approximately 10 million people) is divided into 90 administrative wards, providing details of all streets in the ward, including the slum areas of the city. Taking into account the urban wards that were selected via the PPS sampling strategy, each street block was assigned a number, one of which was then randomly chosen for enumeration purposes.

Three teams performed the survey. Each team included an ophthalmologist, a senior ophthalmic nurse, two technicians, two enumerators, two post-enumeration logisticians, an interviewer, and a driver.

**Ethical approval**

The Bangladesh Medical Research Council (BMRC) provided written ethical approval for this survey. Additionally, oral
informed consent was sought from each subject, following explanation of the procedures to be conducted, before examining the subject.

**Clinical examinations**

Detailed descriptions of the clinical examination carried out in the survey are provided in the published article referred to previously. The essential components of the examination protocol for all subjects were presenting visual acuity using a logMAR tumbling E chart for each eye separately with the subject’s current distance refractive correction, if any worn; automated refraction on all subjects (Topcon Corporation Model RM-8000B, Tokyo, Japan); cup:disc ratio assessment and an undilated fundal examination with direct ophthalmoscopy on those subjects with >6/12 visual acuity in both eyes (see Fig 2).

In those people with <6/12 vision in either (or both) eyes, an additional set of examinations was conducted. These included retesting of visual acuity with the autorefraction result placed in a frame using trial lenses followed by cataract grading according to the Mehra-Minassian central lens opacity grading system. This cataract classification system consists of six categories based on obscuration of the red reflex of an undilated normal pupil as a result of the presence of a lens opacity, as assessed using direct ophthalmoscopy. The grading ranges are: 0, clear red reflex/no opacity; 1, few small dot opacities which occupy <1 mm² maximum area; 2A, lens opacity obscuring red reflex with the area obscured smaller than area of clear reflex; 2B, area obscured is equal or greater than area of clear reflex; 3, lens opacity totally obscuring the red reflex; 4, (pseudo-) aphakia or displaced lens; 5, unable to assess red reflex owing to corneal opacity, for instance.

Additionally, all patients with a visual acuity of <6/12 in either eye were dilated after testing for relative afferent pupil defect and these people then received a complete funduscopic examination. Specific conditions such as age related macular degeneration and diabetic retinopathy were graded according to standardised classification systems, as described elsewhere. Intraocular pressure (IOP) was measured by Schiotz tonometry (Biro Gerhard, Hausen, Germany) if either of the following two conditions were met:

- IOP was measured in those subjects with a CDR of >0.7 at the time of the undilated optic disc examination that was carried out on all subjects.
- In the subjects with a visual acuity <6/12 in either or both eye(s), IOP was measured in those individuals whose optic disc could not be visualised despite pupil dilatation.

**Operational definitions**

The WHO categories of visual impairment were used for this study. **Blindness** was defined as a presenting visual acuity of less than 3/60 (20/400, 0.05) in the better eye. **Low vision** was defined as presenting visual acuity of less than 6/18 (20/60, 0.3) but equal to or better than 3/60 in the better eye (comprising visual acuity criteria for categories 1 and 2 in ICD-10). Category 1 is **visual impairment**, less than 6/18 to 6/30, and category 2 **severe visual impairment**, less than 6/30 to 3/60. Subjects with presenting visual acuity worse than 6/12 in either eye were targeted for further examination. However,
visual fields were not tested because of logistical and technical difficulties involved in conducting examinations in a primarily rural population. Therefore, field constriction was not considered in the definition of blindness, or in the identification of glaucoma as a cause of visual impairment.

Myopia was defined as a spherical equivalent refractive error of less than −0.50 dioptres. Myopia was further categorised as low myopia (≤−0.50 dioptres to >−5.00 dioptres), high myopia (≤−5.00 dioptres to >−10 dioptres), and extreme myopia (≤−10 dioptres). Hypermetropia was defined as a spherical equivalent refractive error of more than ≥+0.50 dioptres. Hypermetropia was further categorised as low hypermetropia (≥+0.50 dioptres to <+5.00 dioptres), high hypermetropia (≥+5.00 dioptres to <+10 dioptres), and extreme hypermetropia (≥+10 dioptres).

From a population based distribution of intraocular pressure (IOP) measured with the Schiotz tonometer on a randomly selected subsample during the main survey, the 95%, 97.5%, 99%, and 99.5% percentiles for IOP were calculated. For the purposes of this survey, a subject was recorded as a glaucoma case if the optic cup/disc ratio (CDR) was ≥0.7 in either eye in the presence of an IOP of ≥97.5%ile. Glaucoma suspects included those with a CDR of ≥0.7 and IOP <97.5%ile, and those where the optic discs were obscured but the IOP was ≥99.5%ile. Ocular hypertensives were defined as those subjects with a CDR (in either eye) of <0.7 and an IOP ≥97.5%ile.

**Statistical analysis**

The supervising ophthalmologist (RB) reviewed each of the record sheets for subjects with <6/12 vision in either eye with the examining Bangladeshi ophthalmologist, involving discussion with the other ophthalmologists and the survey epidemiologist (BD) concerning identification of the main cause of low vision or blindness for each subject.

Non-responders

Those enumerated subjects who did not attend the examination process following the initial verbal invitation by the postenumeration logisticians were repeatedly requested to attend if they were present in or near their home. Those subjects who agreed to participate but were unable (for example, infirmity) or unwilling to attend the temporary examination centre in the locality were instead examined at home. Visual acuity and a manual refraction were performed in all such people; in those with <6/12 VA, corrected visual acuity, cataract grading, and fundoscopic examination were also performed. People who either refused to attend for the eye examination or were not available were listed as “non-responders,” with the reason for non-attendance recorded by the logistical staff. All non-responders were recorded as “believed blind” or “not blind” in each eye separately, depending on the answer given by the non-responder themselves, if available, or by a close relative or neighbour of the enumerated individual if s/he was absent.

**RESULTS**

**Demographics**

A total of 12,782 eligible adults 30 years of age and older were enumerated, of whom 11,624 subjects were examined (90.9%...
response rate). There were 9371 (90.9%) and 2253 (91.0%) subjects examined within the rural and urban clusters, respectively. In sex terms, the overall response rate for being examined was higher for women (94.65%) than that for men (87.37%) in the study. Stratified analysis according to 10 year age groups identified that there were substantially more males (p<0.001) that did not participate in the survey than females, especially among individuals of ages ranging from 30 to 59 years. Upon analysing the reasons identified for non-participation in the survey—as provided by family members or neighbours of the non-respondents—it was found that “working at the time of the examination” was the principal reason reported for males not being examined. This was most especially the case among males of ages 30–59 years, which corresponds to being economically active in Bangladesh. There was no difference however in the proportions of male and female non-responders amongst older subjects—that is, aged 60 and above, which typically relates to a status of economic dependency rather than being in active employment in Bangladesh. There was no statistically significant difference was found in the proportion of responders and non-responders across the six administrative divisions of Bangladesh or according to rural versus urban residence of the subject.

Distribution of examined subjects into two broad visual acuity groups (≥6/12 and <6/12), according to sex and by 10 year age groups is presented in Table 1. Analysis of the relative proportions of females and males having ≥6/12 or <6/12 VA in the better eye according to the age bands indicates that there was a significant difference (p<0.001) between sexes. This difference demonstrates that with increasing age, there is a higher proportion of females that are visually impaired (VA <0.3) in the better eye. Of these, however, there were 748 subjects who had <6/12 vision in the fellow eye. A further 1770 (15.23%) people had <6/12 vision bilaterally. In total, therefore, there were 2518 subjects (21.66%, 95% CI 20.9 to 22.4) who had a presenting visual acuity of less than 6/12 in either one or both eyes. As described above, these individuals underwent a more comprehensive ocular examination that involved cataract grading and a dilated posterior segment examination, in order to identify the cause of low vision or blindness for these subjects. The distribution of all examined subjects by visual acuity category in the better eye is shown in Table 2.

A total of 162 subjects were found to be bilaterally blind on presentation (<3/60; >1.3 logMAR) in the study sample. This figure corresponds to a crude blindness prevalence of 1.39% (95% CI 1.17 to 1.62, design effect = 2.2), while the age standardised blindness prevalence was determined to be 1.53% (95% CI 1.31 to 1.75) in people over the age of 30 years, based on the most recent official population estimates available for Bangladesh.11

In relation to other grades of visual loss within the sample, 55 people (0.47%, 95% CI 0.33 to 0.61) had severe visual impairment upon presentation (<6/60 to >3/60) in the better eye, and 849 subjects (7.30%, 95% CI 6.72 to 7.89) who had moderate visual impairment (<6/18 to >6/60). Finally, a total of 704 people (6.06%, 95% CI 5.52 to 6.60) had “near normal” presenting visual acuity (<6/12 to ≥6/18) in the better eye.

Following trial lens correction based on the objective, autorefractometer result, these figures for blindness, severe visual impairment, moderate visual impairment, and near

<table>
<thead>
<tr>
<th>No of subjects examined (%)</th>
<th>Females</th>
<th></th>
<th>Males</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>≥6/12</td>
<td>2563 (95.7)</td>
<td>115 (4.3)</td>
<td>2080 (95.6)</td>
<td>95 (4.4)</td>
</tr>
<tr>
<td>&lt;6/12</td>
<td>1260 (86.3)</td>
<td>200 (13.7)</td>
<td>1374 (90.5)</td>
<td>144 (9.5)</td>
</tr>
<tr>
<td>≥6/12</td>
<td>511 (60.0)</td>
<td>340 (40.0)</td>
<td>628 (73.5)</td>
<td>226 (26.5)</td>
</tr>
<tr>
<td>&lt;6/12</td>
<td>212 (35.1)</td>
<td>392 (64.9)</td>
<td>338 (49.6)</td>
<td>343 (50.4)</td>
</tr>
<tr>
<td>≥6/12</td>
<td>51 (14.7)</td>
<td>295 (85.3)</td>
<td>89 (19.5)</td>
<td>368 (80.5)</td>
</tr>
<tr>
<td>&lt;6/12</td>
<td>4597 (77.4)</td>
<td>1342 (22.6)</td>
<td>4509 (79.3)</td>
<td>1176 (20.7)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Visual acuity</th>
<th>Snellen equivalent (logMAR)</th>
<th>Presenting vision</th>
<th>Corrected vision</th>
<th>Age standardised prevalence (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>≥6/12 (&lt;0.30)</td>
<td>9854/84.77</td>
<td>10759/92.56</td>
<td>8.37 (82.89 to 84.25)</td>
</tr>
<tr>
<td></td>
<td>&lt;6/12 to ≥6/18 (&lt;0.30 to 0.50)</td>
<td>704/6.06</td>
<td>329/2.83</td>
<td>6.46 (6.02 to 6.91)</td>
</tr>
<tr>
<td>Moderate visual impairment</td>
<td>&lt;6/18 to ≥6/60 (&lt;0.50 to &lt;1.00)</td>
<td>849/7.30</td>
<td>385/3.3</td>
<td>7.92 (7.43 to 8.41)</td>
</tr>
<tr>
<td>Severe visual impairment</td>
<td>&lt;6/60 to ≥3/60 (&lt;1.00 to &lt;1.30)</td>
<td>55/0.47</td>
<td>26/0.22</td>
<td>0.52 (0.39 to 0.65)</td>
</tr>
<tr>
<td>Blind</td>
<td>&lt;3/60 (&lt;1.30)</td>
<td>162/1.39</td>
<td>125/1.08</td>
<td>1.53 (1.31 to 1.75)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>11624/100.0</td>
<td>11624/100.0</td>
<td>11624/100.0</td>
</tr>
</tbody>
</table>

Table 1

Table 2

Table 2 Distribution of subjects according to presenting and corrected visual acuities in the better eye with age standardised prevalences based on presenting VA (n=11624)
normal vision changed, indicating a notable shift towards improvement in visual acuity status. These new figures became 125 (1.08%, 95% CI 0.86 to 1.29), 26 (0.22%, 95% CI 0.14 to 0.31), 385 (3.31%, 2.89 to 3.74), 329 (2.83%, 95% CI 2.47 to 3.20), respectively. The subtotal of 9854 subjects (84.77%, 95% CI 83.80 to 85.75) with a presenting visual acuity of $\geq 6/12$ in either one or both eyes, became 10759 (92.56%, 95% CI 91.88 to 93.23) with correction. The crude and age standardised prevalence results for presenting and corrected visual acuities are presented in Table 2, as are age standardised prevalence figures based on presenting VA. By combining the blindness and severe visual impairment categories, the age standardised prevalence for having a presenting visual acuity $< 6/60$ in the better eye was 2.05% (95% CI 1.79 to 2.31), while the age standardised prevalence for vision $< 6/12$ in the better eye was 16.43% (95% CI 15.76 to 17.10).

Unilateral blindness
In addition to the 162 binocularly blind people, there were a further 313 subjects who were found to be unilaterally blind; this corresponds to a unilateral blindness prevalence of 2.69% (95% CI 2.39 to 2.98). The majority of those subjects found to be uniconically blind (61.0%) had less than 6/12 vision in the other eye. The major causes of blindness in the affected eye were cataract (62.24%), central corneal opacity (9.18%), and phthisical/disorganised or absent globe (6.12%).

Visual acuity and age
Figure 3 illustrates the distribution of presenting visual acuity status according to age of the subject, in 10 year age groups. The proportion of subjects with normal vision ($\geq 6/12$) was shown to decrease significantly with increasing age. Overall, this trend difference across the five visual acuity categories, by age, was found to be statistically significant ($p < 0.001$). Moreover, there was a marked exponential increase in bilateral blindness prevalence according to increased age of the subject (Fig 4), culminating with a prevalence of 11.46% in people 70 years of age and older.

Visual acuity and rural/urban residence
There was a significant difference in terms of rural versus urban residence regarding presenting visual acuity, with a higher proportion of rural dwellers being less than 6/12 when compared with urban residents ($p < 0.001$, 95% CI OR 1.34 to 1.79). However, there was no statistically significant difference (95% CI OR 0.78 to 1.87) among those of rural or urban residence in relation to the proportion of blind subjects living in each area.

Visual acuity and sex
There was a marked difference in presenting visual acuity between women and men. There was a higher prevalence of blindness in women (1.72%) than men (1.06%). This difference was statistically highly significant ($p < 0.003$, 95% CI OR 1.18 to 2.29) as was the difference in the proportion of women with $< 6/18$ vision in the better eye when compared to men ($p < 0.02$, 95% CI OR 1.17 to 1.33).

Visual acuity and administrative division
In terms of the geographic and administrative regions within Bangladesh, higher blindness prevalences were found to exist in the divisions of Barisal (2.28%; 95% CI 1.24 to 3.32) and Khulna (1.97%; 95% CI 1.28 to 2.69) located in the primarily rural south and western areas of the country when compared with the remaining four divisions. Most notable was the relatively low blindness prevalence in Dhaka division (1.13%; 95% CI 0.80 to 1.46), the largest and most urbanised of the six administrative divisions of Bangladesh.

Visual acuity, literacy, and occupation
Occupational status was classified into three major categories: manual, non-manual, and inactive/unemployed. The prevalences of low vision and blindness among those who were occupationally inactive—that is, either unemployed or retired were significantly higher when this subgroup was compared with other groups ($p < 0.001$).

The type of work undertaken by male participants was found to be associated with a statistically significant difference in visual acuity status. There was a higher proportion of manual workers with VA $< 6/12$ in the better eye when compared with non-manual workers ($p < 0.001$; 95% CI OR 2.09 to 3.18) as there was also for VA $< 3/60$—that is, blind ($p < 0.02$; 95% CI OR 1.11 to 9.35).

A higher prevalence of visual impairment was identified among illiterate subjects when compared with those able to read, both in terms of low vision ($p < 0.001$; 95% CI OR 2.56 to 3.19) and for blindness ($p < 0.001$; 95% CI OR 5.86 to 9.20).

Causess of low vision and blindness
As described previously, the ophthalmologists recorded each ocular disorder that was diagnosed in eyes with $< 6/12$ visual acuity. In total, there were 4288 visually impaired eyes; this figure represents 18.44% of all the eyes examined, corresponding to 21.88% of the 11,624 examined subjects. Table 3 provides a breakdown of the lens opacity grading for all $< 6/12$ eyes, indicating that more than two thirds (68.59%) of eyes were graded 2A, 2B, or 3, while only approximately one quarter (25.28%) either had no cataract (grade 0) or minimal lens opacity present (grade 1).
Table 3 Distribution of all lens opacities in the 4288 eyes with <6/12 visual acuity

<table>
<thead>
<tr>
<th>Lens opacities</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades 0 or 1</td>
<td>1084</td>
<td>25.28</td>
</tr>
<tr>
<td>Grades 2A, 2B, or 3</td>
<td>2941</td>
<td>68.59</td>
</tr>
<tr>
<td>Grades 4, 5 and other (eg, phthisical globe)</td>
<td>263</td>
<td>6.13</td>
</tr>
</tbody>
</table>

Table 4 outlines in further detail all the ocular disorders, including lens opacities, which were diagnosed in eyes with <6/12 vision. The percentages for this table are calculated on the basis of the 4288 total eyes. Principal among the disorders is that of refractive error for which approximately 80% of all subjects examined with <6/12 VA were found to have a spherical equivalent ≥0.5 SE or, alternatively, ≤−0.5 SE. A subanalysis of those subjects with refractive error was conducted in which the lens opacity grading was taken into account in order to determine the level of refractive error in eyes with non-existent (grade 0) or minimal cataract (grade 1). Overall 13.46% of visually impaired eyes, without significant lens opacity, were somewhat hypermetropic (SE ≥+0.5 to < +5.0) whereas “low grade” myopia (SE ≤−0.5 to ≥−5.0) was far less common (7.53%) in visually impaired eyes. Less common were high hypermetropia (0.46%) and high (0.40%) and extreme myopia (0.21%) in eyes with minimal or non-existent lens opacity. The remainder of Table 4 indicates the extent to which other disorders were diagnosed in <6/12 eyes.

The presence of combined pathologies in the 4288 eyes with <6/12 visual acuity was a common finding, with the most frequently identified combinations being refractive error with cataract (52.3%), refractive error with AMD (9.0%), and cataract with AMD (8.6%).

As shown in Table 5, the main cause of <6/12 presenting visual acuity for subjects was cataract (73.39%), followed by refractive error (18.87%) and uncorrected aphakia (1.19%). In relation to the causes of bilateral blindness, cataract was also the principal disorder, having been identified for 129 of the 162 blind subjects (79.63%) followed by uncorrected aphakia (16.22%) and refractive error with AMD (9.0%).

Table 5 Distribution of the main cause of visual impairment in people with <6/12 presenting VA in the better eye

<table>
<thead>
<tr>
<th>Disorder</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td>1299</td>
<td>73.39</td>
</tr>
<tr>
<td>Refractive error</td>
<td>334</td>
<td>18.87</td>
</tr>
<tr>
<td>Macular degeneration</td>
<td>33</td>
<td>1.86</td>
</tr>
<tr>
<td>Uncorrected aphakia</td>
<td>21</td>
<td>1.19</td>
</tr>
<tr>
<td>Central corneal opacity</td>
<td>15</td>
<td>0.85</td>
</tr>
<tr>
<td>Other posterior segment disease</td>
<td>15</td>
<td>0.85</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>13</td>
<td>0.73</td>
</tr>
<tr>
<td>Other (including “incomplete examination”)</td>
<td>11</td>
<td>0.62</td>
</tr>
<tr>
<td>Optic atrophy</td>
<td>9</td>
<td>0.51</td>
</tr>
<tr>
<td>Phthisial eye</td>
<td>8</td>
<td>0.45</td>
</tr>
<tr>
<td>Chorioretinitis</td>
<td>6</td>
<td>0.34</td>
</tr>
<tr>
<td>Diabetic retinopathy</td>
<td>3</td>
<td>0.17</td>
</tr>
<tr>
<td>Pterygium</td>
<td>3</td>
<td>0.17</td>
</tr>
<tr>
<td>Total</td>
<td>1770</td>
<td>100.00</td>
</tr>
</tbody>
</table>

*Spherical equivalent ≥0.5 or ≤−0.5
†Refraction was not possible in 11 subjects with grades 0 or 1 lens opacity grading.
Thus, the principal finding arising from this survey is the very high level of blindness and low vision due to unoperated cataract and, to a lesser extent, uncorrected aphakia among the study subjects. The figure of 79.6% of blindness being attributed to unoperated lens opacities represents one of the highest ever reported from a population based study of this kind. One reasonable explanation for this finding deals with the relatively low cataract surgical output in Bangladesh.

In order to ameliorate this situation across Bangladesh, specific measures are in need of implementation. Such action is principally oriented towards increasing the currently inadequate cataract surgical coverage and resolution of uncorrected aphakic status. Included among these measures is the appointment of surgically trained ophthalmologists to staff one of the 64 district hospitals in the country, as by the year 2001 the large majority of these facilities did not have a practising ophthalmologist and/or cataract surgery is not performed there. This situation exists despite the fact that there are approximately 400 qualified ophthalmologists in Bangladesh, some of who are trained in microsurgery techniques.

Another measure that needs to be implemented is the purchase and provision of essential surgical equipment to the district hospitals (for example, operating microscopes) in order to provide fundamental logistical support to the district ophthalmologist. The development and integration of primary eye care services in the already well organised primary healthcare structures in Bangladesh is another intervention that would facilitate community based eye health education/promotion and in the referral of cases for treatment. Finally, the further training of more ophthalmologists in microsurgery techniques, of nurses in specialised ophthalmic nursing, and of paramedical assistants in the areas of basic eye disease recognition, treatment, and referral is required. Given the high rate of uncorrected aphakia as a cause of blindness, there is a need to ensure adequate provision (or maintenance and repair) of aphakic spectacles to those people in need of them. Alternatively, as part of the reorganisation of cataract surgical services, increased access to intraocular lenses placement should be countenanced, as a part of the overall strategy of high quality-high volume surgical services.

The absence of trachoma as a cause of blindness and low vision in Bangladesh, unlike that in neighbouring India, Pakistan, and Nepal also contributes to an increase of the relative proportion of cataract as the main cause. Moreover, data analysis regarding those study subjects who had been operated for cataract indicates that surgical coverage is disproportionately higher in male subjects than in females, resulting in a larger cataract burden for females.

As previously mentioned, all subjects with <6/12 visual acuity in either eye were dilated in order to allow for the identification of any posterior segment disease. The low level of diabetic retinopathy as the cause of visual impairment is quite notable within the examined subjects. Moreover, no subject was found to be blind due to diabetic retinopathy, similar to that found by Dandonna et al in neighbouring India. The main reasons for these findings may be the relatively short life expectancy of Bangladesh adults and the relatively low minimum age (30 years) as the main subject inclusion criteria for the study. The authors recognise, however, that subtle retinal pathology in subjects with good vision (>6/12 in both eyes) may have been less readily detected because the retinal examination was through undilated pupils.

Finally, despite a substantial reduction in the fertility rate in Bangladesh in recent years, overall population growth continues to rise. As such, there will be an estimated 180 million people in Bangladesh by the year 2025, with more than half of the population being over the age of 30 years, and one fifth (34 million) being 50 years of age and older. Based on the findings from this survey and future population dynamics, it is imperative that eye care service delivery be organised in Bangladesh in the near future, focusing principally on high

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**Table 6**

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th>No of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CDR &gt;0.7 and IOP &gt;97.5%ile</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>CDR &gt;0.7, IOP &lt;97.5%ile</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Disc obscured; IOP &gt;97.5%ile</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>CDR &lt;0.7, IOP &gt;97.5%ile</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Disc obscured; IOP &gt;97.5%ile</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>13</td>
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**Figure 5** Main cause of blindness for people with visual acuity <6/60 in the better eye.
quality and high quantity cataract surgical and refractive error correction services. This recommendation is consistent with the prioritised areas of action for the region as outlined by the WHO South East Asia policy document Vision 2020—the right to sight.24–27

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REFERENCES