WORLD VIEW

Outcomes of cataract surgery in Bangladesh: results from a population based nationwide survey

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Aim: To evaluate the outcome of cataract surgery in the population of Bangladesh.
Methods: Data were collected by the National Blindness and Low Vision Prevalence Survey of Bangladesh, a cross sectional, nationally representative sample (12 782 subjects) of the population aged ⩾30 years. An interview recorded socioeconomic data. Each subject was tested for logMAR visual acuity (VA) of each eye, autorefracted, and then underwent optic disc examination. Those with <6/12 VA on presentation in either eye were retested with their refractive correction, dilated, and examined for anterior and posterior segment disease. In aphakic and pseudophakic subjects the date, location and operating conditions (eye camp/hospital), and type of operation(s) were recorded.
Results: 11 624 eligible subjects were examined (90.9% response rate) in the survey. 162 subjects, 77 men and 85 women, had undergone cataract surgery in one or both eyes. 199 (88%) eyes had undergone intracapsular cataract extraction (ICCE), and 22 (10%) extracapsular surgery with intraocular lens (ECCE+IOL); surgical technique(s) in four cases were not identified. Presenting VA for the 226 operated eyes were: 68 eyes (30.1%) were 6/12 or better, 31 (13.7%) <6/12 ⩾6/18, 63 (27.9%) 6/18 to 6/60, 8 (3.5%) <6/60 ⩾3/60, and 56 (24.8%) <3/60. With "best" refractive correction these values were 114 (50.4%), 31 (13.7%), 51 (22.6%), 5 (2.2%), and 25 (11.1%), respectively. Of the 158 eyes with VA of 6/12 or worse on presentation, 44 (28%) were the result of coincident disease (principally age related macular degeneration), 95 (60%) refractive error (44 of these had uncorrected aphakia), and 19 (12%) operative complications. ICCE was more likely to result in a VA of <6/18 (OR: 4.26, p = 0.01) than ECCE+IOL. Likewise, eye camp surgery was more likely to result in a VA of <6/60 (OR: 1.98, p = 0.04). No significant association was found between time since surgery and VA outcome, nor was there a sex difference for postoperative vision. Literate subjects were significantly less likely to have an outcome of <6/18 (OR: 2.38, p <0.01) or <6/60 (OR: 2.87, p <0.01). Following ICCE (199 eyes), 56 (37%) of the 151 eyes with an aphakic spectacle correction achieved 6/12 or better. Females, eye camp surgeries, illiterate subjects, and rural dwellers were less likely to wear their aphakic correction. The ratio of ICCE:ECCE+IOL has reduced in the past 3 years (3.8:1) compared to ⩾4 years before the survey (25:1). Hospital based ECCE+IOL surgeries were associated with a better outcome, yet 36% of these eyes were <6/12 postoperatively, after excluding coincident disease.
Conclusion: This evaluative research study into cataract surgery outcomes in Bangladesh highlights the need for an improvement in quality and increased quantity of surgery with a more balanced distribution of services.

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The National Blindness and Low Vision Survey of Bangladesh (1999–2000) is the first nationally representative population based survey to take place in this country. It resulted from an urgent need for detailed information on the prevalence and causes of low vision and blindness, in order to plan eye care services. The main results have been published elsewhere.[1] The survey also aimed to establish the outcomes of cataract surgery, which forms the basis for this report.

Bangladesh is part of the South East Asia region of the World Health Organization, which comprises a quarter of the world's population, but is estimated to comprise a third of the world's 45 million blind.[2] Cataract is responsible for 50–80% of blindness in this region. Low cataract surgical output (in some countries), combined with a rapid expansion of the population, particularly of the elderly, has led to an ever increasing cataract backlog.

The recent prevalence survey attributed 79.6% of bilateral blindness to cataract. Within the adult population more than 30 years of age (approximately 44 million people), it is estimated that there are approximately 650 000 adults (95% CI = 552 175 to 740 736) blind due to cataract in Bangladesh at present. Assuming the incidence of blinding cataract cases to be one fifth of those already existing, a further 130 000 new cases are thought to develop annually.[3] Similarly, by extrapolation, there are an estimated 6.65 million (95% CI 6.94 to 7.23) adults with <6/12 vision in either or both eyes.

Growing concern exists over the outcomes of cataract surgery in the developing world. Recent population based surveys have found that 40–75% of postoperative eyes have a presenting visual acuity of worse than 6/18, with as many as 50% worse than 6/60.[4–7] Fewer surveys have measured outcomes based on best corrected visual acuity; however, several have reported up to 20% of eyes with corrected VA of <6/60.[4–6]

Eye care services in Bangladesh are provided by the government, local and international non-governmental organisations (NGO), and charitable organisations. The NGO sector has important funding, collaborative, and logistical roles with Bangladesh service providers. The 400 trained, qualified ophthalmologists of Bangladesh work in either the government or the private sector. Most are concentrated in the urban centres and few are trained in extracapsular cataract extraction and intraocular lens surgery. Eye camps (with principally intracapsular cataract surgery) used to be the main approach of the non-governmental organisations; however, more recently modular eye care programmes have been developed,[8] with

ECCE+IOL increasingly being the surgery that is favoured by both the government and NGO service deliverers.

METHODS

The methodology used in the National Blindness and Low Vision Prevalence Survey of Bangladesh has been described in detail elsewhere.[9]

Based upon the target age population of 30 years and older (44 million adults), a blindness prevalence estimate of 2.5% for Bangladesh adults, a random sampling error of 0.35% with a design effect of 1.5 due to the cluster sampling strategy, a sample size of 11 463 subjects was determined. This figure was increased by an approximate further 10% (12 900 subjects) in order to increase the likelihood of attaining the minimal sample size in case of lower than expected participation by enumerated subjects. The 95% confidence interval projection for the adult blindness prevalence rate was 2.23 to 2.77.

Multistage stratified cluster random sampling, with probability proportional to size (PPS) procedures, was adopted as the strategy for the selection of a cross sectional, nationally representative, sample of the population. Stratification of the sample according to rural and urban residence (corresponding to official municipality ordinance status)[10] was incorporated in the sample selection process. Within each of the six regional administrative divisions in Bangladesh, a proportional number of clusters in relation to the overall national population was identified based upon official census data. 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, the rural cluster areas consisted of 100 subjects, while the urban study areas consisted of 50 subjects each.

All participants of the survey team underwent specialised training during a month long period. Both interobserver and intraobserver agreement was determined (Cohen kappa coefficient for agreement, κ)[11] among the groups of ophthalmic nurses and ophthalmologists with respect to visual acuity testing, intraocular pressure measurement, optic disc assessment, and for lens opacity grading. In addition, observer agreement was confirmed with the interviewers for the VF and QOL instruments.

Two pilot surveys[9] were performed, one in a rural area and the other in an urban setting to test the methods used and adjustment was made to the examination protocol in advance of the main survey. The survey commenced in October 1999 and was completed by June 2000.

The examination process began with an interview where the interviewer checked that the individual was an enumerated subject. Demographic data such as age and sex were collected, in addition to specific information regarding socioeconomic status, employment, literacy, and religion. Literacy was recorded as "literate," "somewhat literate," and "illiterate." For the purposes of this analysis the "literate" and "somewhat literate" groups have been grouped together.

Distance visual acuity was measured with a reduced logMAR based (logarithm of minimum angle of resolution) tumbling E chart.[12] The presenting vision was measured with the subject's current distance refractive correction, if worn, for each eye in turn.

All subjects underwent automated refraction (Topcon Corporation Model RM-8000B), performed by trained medical technicians. Measurements obtained included average refractive error (based on three consecutive readings), spherical equivalent, and vertex distance. If the autorefractor did not yield a measurement (due especially to a media opacity) in a subject with less than 6/12 visual acuity ("red card" holders), the ophthalmologist attempted a manual objective and subjective refraction.

Subjects with less than 6/12 visual acuity on presentation in either eye were then retested for visual acuity in each eye with their autorefraction result placed in a trial frame using trial lenses. This was performed to estimate the contribution of refractive error to these subjects' visual disability.

The subjects were asked by the ophthalmologist if they had been managed previously for cataract, glaucoma, or other disorders. With respect to previous cataract surgery, the time since surgery, location, and technique (couching/intracapsular/extracapsular) were documented. To record the technique, the ophthalmologist relied on a history from the patient and subsequent findings from the examination based on direct ophthalmoscopy. The presence or absence of intraocular lens, and the use of an aphakic correction were also noted. Direct ophthalmoscopy was used to measure the cup/disc ratio (CDR) in each eye. All subjects with less than 6/12 visual acuity in either eye were subsequently dilated (following a check for relative afferent pupil defect), and the CDR rechecked at that stage.

Intraocular pressure (IOP) was measured by Schiotz tonometry if either of the following two conditions were met: (i) at the time of undilated optic disc examination, carried out on all subjects, IOP was measured in only those subjects with a CDR of 0.7 or greater; (ii) if the optic disc could not be visualised (despite pupil dilatation) IOP was measured in those patients with a visual acuity of <6/12 in either eye.

Subjects with less than 6/12 visual acuity in either eye were assessed for cataract. During the training period, it was decided that the most appropriate cataract grading system for the purposes of this field survey would be the Mehra/Minassian system,[13] after evaluating other grading systems.

All patients with a presenting visual acuity of less than 6/12 in either eye (that is, red card holders) were dilated. Using direct ophthalmoscopy, the ophthalmologists recorded the presence or absence of three levels of diabetic retinopathy[14] (non-proliferative, proliferative, and maculopathy), and age related macular disease (early or late, geographic atrophy or exudative),[15] following training. There was an opportunity to record any other fundal findings on the record sheet.

The survey ophthalmologist, epidemiologist, and the three ophthalmologists coordinated a systematic approach for the decision making process for the identification of cause(s) of low vision and/or blindness, based on the ocular examination findings. As in the WHO Prevention of Blindness Proforma (Version III) allowance is made for the recording of all pathological findings, for each eye separately, which are identified at the time of the ocular examinations. The WHO standardised protocol further stipulates that the main cause of blindness or low vision for each eye must be selected.

All people with low vision or who were blind were referred to the nearest eye care facility (district or non-government hospital).

The Bangladesh Medical Research Council provided written ethical approval for this survey in March 1999. Oral informed consent was sought from each subject by the ophthalmic assistant, following explanation of the procedures to be conducted.

Data analysis

Standardisation of data against a reference population involved data from the Bangladesh Bureau of Statistics.[10] Although visual acuity was measured using the logMAR scale, the analysis for this article has used the Snellen equivalents for purposes of comparison with previous similar studies. The visual acuity of a given eye or that for a subject (visual acuity in the better eye) was categorised into the following outcome categories: "good" (6/18 or better; logMAR = 0.30), "borderline" (worse than 6/18 to 6/60; logMAR, >0.30 to 1.00); "poor" (worse than 6/60; logMAR, >1.00). An additional category of 6/12 or better was described in order to compare findings with other studies which have chosen the 6/12 cut off, rather than 6/18. "Best" corrected visual acuity was defined as the visual

Table 1 Univariate distribution of outcome of cataract surgery

Variable	Number	Outcome as a result of any cause					
		Presenting (%)			"Best" corrected (%)		
		Good	Borderline	Poor	Good	Borderline	Poor
Type of surgery*							
ICCE	199	81 (40.7)	56 (28.1)	62 (31.2)	122 (61.3)	48 (24.1)	29 (14.6)
ECCE + IOL	22	17 (77.3)	5 (22.7)	0 (0)	20 (90.9)	2 (9.1)	0 (0)
ICCE wearing habitual glasses	151	81 (53.6)	50 (33.1)	20 (13.2)	102 (67.5)	31 (20.5)	18 (11.9)
ECCE + IOL with glasses	10	8 (80.0)	2 (20.0)	0 (0)	8 (80.0)	2 (20.0)	0 (0)
ECCE + IOL without glasses	12	9 (75.0)	3 (25.0)	0 (0)	12 (100.0)	0	0 (0)
Duration between surgery and survey†							
≤3 years	84	38 (45.2)	25 (29.8)	21 (25.0)	50 (59.5)	22 (26.2)	12 (14.3)
4–8 years	87	34 (39.1)	23 (26.4)	30 (34.5)	57 (65.5)	20 (22.9)	7 (8.0)
≥9 years	48	25 (52.1)	13 (27.1)	10 (20.8)	33 (68.8)	9 (18.7)	6 (12.5)
Age at time of survey (years)							
30–39	9	3 (33.3)	4 (44.4)	2 (22.2)	5 (55.6)	4 (44.4)	0 (0)
40–49	14	7 (50.0)	4 (28.6)	3 (21.4)	12 (85.7)	2 (14.3)	0 (0)
50–59	25	10 (40.0)	2 (8.0)	13 (52.0)	18 (72.0)	3 (12.0)	4 (16.0)
60–69	66	37 (56.1)	18 (27.3)	11 (16.7)	49 (74.2)	13 (19.7)	4 (6.1)
70+	112	42 (37.5)	35 (31.2)	35 (31.3)	61 (54.5)	29 (25.9)	22 (19.6)
Sex							
Male	109	47 (43.1)	29 (26.6)	33 (30.3)	74 (67.9)	20 (18.3)	15 (13.8)
Female	117	52 (44.4)	34 (29.1)	31 (26.5)	71 (60.7)	31 (26.5)	15 (12.8)
Urban/rural							
Urban	63	37 (58.7)	12 (19.0)	14 (22.2)	49 (77.8)	10 (15.9)	4 (6.3)
Rural	163	62 (38.0)	51 (31.3)	50 (30.7)	96 (58.9)	41 (25.1)	26 (16.0)
Literacy							
Literate	93	55 (59.1)	23 (24.7)	16 (17.2)	66 (71.0)	16 (17.2)	11 (11.8)
Illiterate	133	45 (33.8)	40 (30.1)	48 (36.1)	79 (59.4)	35 (26.3)	19 (14.3)
Op site‡							
Eye camp	67	19 (28.4)	17 (25.4)	31 (46.3)	34 (50.7)	17 (25.4)	16 (23.9)
Hospital	147	73 (49.7)	43 (29.2)	31 (21.1)	103 (70.1)	32 (21.8)	12 (8.2)
Other	12	7 (58.3)	3 (25.0)	2 (16.7)	8 (66.7)	2 (16.7)	2 (16.7)

*One ICCE+IOL (good presenting outcome), 3 ECCE (2 borderline and 1 poor outcome) without IOL, and 1 couching (poor outcome) are excluded from this table.
†The time since surgery was unknown in 7 eyes.
‡The site of operation for 12 eyes was unknown.

acuity achieved by an eye (or subject) wearing the objective refractive result (obtained from the automated refraction) in trial frames (no subjective refinement of the refractive error took place). Statistical analysis involved logistical regression of key variables with cataract surgical outcome such as type of surgery, visual acuity postoperatively and certain demographic variables (age group, sex, urban versus rural residence). Data management and analysis was carried out in Epi-Info (Version 6.04b) and MS Excel.

RESULTS

The national survey examined 11 624 subjects (5685 men and 5939 women) of the 12 782 enumerated subjects (response rate, 90.9%). The response rate in the six divisions of Bangladesh ranged from 87.8% to 92.7%. Of the subjects examined, 9371 (80.6%) lived in rural areas and 2253 (19.4%) were from urban areas. Substantially more males ($p<0.001$) did not participate in the survey than females, especially among individuals aged 30–59 years, who were most likely to be economically active. No difference was found in the proportion of responders and non-responders according to rural versus urban residence of the subject.

In all, 162 subjects, 77 male and 85 female had undergone cataract surgery in one (98 subjects, 60.5%) or both eyes (64 subjects, 39.5%). The age of subjects at the time of the surgery ranged from 17.6 to 105 years (median 63.0; mean 62.1, SD 14.1).

Table 1 illustrates the presenting and best corrected visual outcome of the 226 operated eyes, in relation to operative technique, time elapsed since operation and the survey being conducted, age of the subject, sex, religion, urban/rural residence, literacy and operation site (eye camp or hospital).

Intracapsular cataract surgery was performed on 199 (88%) eyes, and 22 (8%) eyes underwent extracapsular surgery with an intraocular lens. In four eyes (2%), the ophthalmologist was unable to determine whether the technique was extracapsular without an IOL or intracapsular. In one eye (0.5%), the cataract had been couched. In Bangladesh, no extracapsular surgeries take place without insertion of an intraocular lens.

It is possible that some of the operations recorded as ICCE were in fact failed ECCE+IOL operations. The ratios of ICCE to ECCE+IOL more than 3 years before the survey, and within 3 years of the survey were 25:1 (number of eyes; 127:5) and 3.8:1 (65:17 eyes), respectively. All ECCE+IOL surgeries had taken place within 7 years of the survey.

Men ($p = 0.611$), urban dwellers ($p = 0.558$) and literate subjects ($p = 0.222$), and eye camp surgeries ($p = 0.562$) were more likely to have bilateral than unilateral cataract operations, yet these were not significant differences ($p > 0.05$).

Of the 214 cataract surgeries where the operative location was identified, 67 (31.3%) had taken place in eye camps and 147 (68.7%) in a hospital (the operative location of 12 eyes was unknown). Allowing for six cases where the time since surgery was unknown, the ratios of hospital to eye camp surgery more than 3 years before the survey, and within 3 years of the survey were 1.9:1 (number of eyes; 84:44) and 3.2:1 (61:19 eyes), respectively. In eye camps, only ICCE operations had been performed, yet in hospitals the ratio of ICCE to ECCE+IOL was 5.5:1 (number of eyes, 121:22). Subjects living in rural areas were more likely (OR: 2.01; 95% CI: 0.96 to 4.3) to have surgery performed in an eye camp than in a hospital.

Of the 226 surgeries, 68 eyes (30.1%) had a presenting visual acuity of 6/12 or better, 31 (13.7%) were less than 6/12 to 6/18, 63 (27.8%) less than 6/18 to 6/60, 8 (3.5%) less than

Table 2 Categorisation of visual outcome (presenting vision) of eyes into those with "borderline" (less than 6/18 to 6/60 visual acuity) and "poor" outcomes (less than 6/60 visual acuity), in eyes where refractive error or operative complications were the cause of reduced vision

		Presenting visual acuity outcome as a result of surgical or a refractive error cause		
	Number of eyes	Poor (<6/60)	Borderline (<6/18 to 6/60)	Number (others)
Type of surgery				
ICCE	199	46 (23.1%)	34 (17.1%)	119 (59.8%)
ECCE + IOL	22	0	3 (13.6%)	19 (86.4%)
ICCE wearing habitual glasses	151	7 (4.6%)	29 (19.2%)	115 (76.1%)
ECCE + IOL with g	10	0	0	10 (100.0%)
ECCE + IOL minus g	12	0	3 (25.0%)	9 (75.0%)
Duration between surgery and survey*				
⩽3 years	84	17 (20.2%)	14 (16.7%)	53 (63.1%)
4–8 years	87	22 (25.3%)	13 (14.9%)	52 (59.8%)
⩾9 years	48	6 (12.5%)	10 (20.8%)	32 (66.7%)
Age at survey (years)				
30–39	9	2 (22.2%)	2 (22.2%)	5 (55.6%)
40–49	14	3 (21.4%)	4 (28.6%)	7 (50.0%)
50–59	25	11 (44.0%)	1 (4.0%)	13 (52.0%)
60–69	66	9 (13.6%)	11 (16.7%)	46 (64.7%)
70+	112	23 (20.5%)	19 (16.9%)	70 (62.5%)
Sex				
Male	109	25 (22.9%)	17 (15.6%)	67 (61.5%)
Female	117	23 (19.7%)	20 (17.1%)	74 (63.2%)
Urban/rural				
Urban	63	11 (17.5%)	8 (12.7%)	44 (69.8%)
Rural	163	37 (22.7%)	31 (19.0%)	95 (58.3%)
Literacy				
Literate	93	11 (11.8%)	14 (15.1%)	68 (73.1%
Illiterate	133	37 (27.8%)	25 (18.8%)	71 (53.4%)
Op site				
Eye camp	67	20 (29.8%)	8 (11.9%)	39 (58.2%)
Hospital	147	26 (17.7%)	30 (20.4%)	91 (61.9%)
Other site†	12	2 (16.7%)	0	10 (83.3%)

*The time since surgery was unknown in 7 eyes.
†Other = village and unknown

6/60 to 3/60, and 56 (24.8%) less than 3/60. With best correction, these values became 114 (50.4%), 31 (13.7%), 51 (22.6%), 5 (2.2%), and 25 (11.1%), respectively.

Of the 162 subjects who had a cataract operation in one or both eyes, 62 subjects (38.2%) had a presenting visual acuity of 6/12 or better, 25 (15.4%) were less than 6/12 to 6/18, 47 (29%) less than 6/18 to 6/60, 7 (4.3%) less than 6/60 to 3/60, and 21 (12.9%) less than 3/60 in the better eye. With best correction, these values became 93 (57.4%), 25 (15.4%), 31 (19.1%), 3 (1.8%), and 10 (6.1%), respectively.

If an operated eye did not achieve a visual acuity of 6/12 or better on presentation, the principal reason for this was categorised into three groups: coincident disease, operative complications, and refractive error. Of the 226 operated eyes, 158 had a presenting visual acuity of 6/12 or worse. Of these, 44 (28%) were due to coincident disease, 19 (12%) operative complications, and 95 (60%) refractive error.

Table 2 categorises visual outcome (presenting vision) of eyes into those with less than 6/18 to 6/60 visual acuity ("borderline" outcome) and those with less than 6/60 visual acuity ("poor outcome") in eyes where refractive error or operative complications were the cause of reduced vision. The effect of these variables on these two categories of outcome was calculated using logistic regression. These are illustrated in Table 3. ICCE was more likely to result in a visual acuity of less than 6/18 (OR= 4.26, p = 0.01) than ECCE+IOL while eye camp surgery was more likely to result in a visual acuity of less than 6/60 (OR= 1.98, p = 0.04) than surgery in a hospital. Although, the ratio of ICCE to ECCE+IOL was actually higher in eyes of subjects in urban areas, this was not significant (p = 0.93). More men than women had undergone ICCE surgery, but there was not a significant sex difference (OR= 1.37 (0.52–3.67); p = 0.48). No significant association was found between "time since surgery" and visual outcome, nor was there a sex difference for postoperative vision. Literate subjects were significantly less likely to have an outcome of less than 6/18 (OR: 2.38, p <0.01) or <6/60 (OR= 2.87, p <0.01). Following ICCE (199 eyes), 56 (37%) of the 151 eyes with an aphakic spectacle correction achieved 6/12 or better. Eyes that were operated by ICCE in an eye camp were more likely to result in an outcome of less than 6/18 or less than 6/60 presenting visual acuity, when compared to a hospital based ICCE yet this was not a significant difference (less than 6/60, p = 0.201; less than 6/18; p = 0.962). After excluding those eyes with coexistent ocular pathology, those ICCE operations that had been performed at or within 3 years before the survey, were more likely to result in a presenting visual acuity of less than 6/60, than those performed more than 3 years before the survey; however, this was not a significant difference (p=0.598). No ECCE+IOL surgeries had an outcome of less than 6/60.

Refractive error was the principal cause of less than 6/12 presenting vision in 95 eyes (60%). Uncorrected aphakia accounted for 44 (46.3%) of these 95 eyes. Variables that were associated with not wearing an aphakic correction, were female sex (OR= 1.72 (0.84–3.55); p = 0.11), eye camp rather than hospital based surgeries (OR= 1.88 (0.91–3.89); p =0.06), illiteracy rather than literacy (OR= 4.21 (1.74–10.48); p <0.001), and rural residence (OR= 1.66 (0.72–3.91); p = 0.196). Interestingly, more subjects who had had ICCE more than 3 years before the survey were likely to wear an aphakic correction, than those operated in the recent 3 years. However, there was no significant difference between the two groups (OR= 1.39, p = 0.4)

Table 3 The effect of selected variables on borderline (<6/18 to 6/60) and poor (<6/60) presenting visual acuity outcome after excluding coincident disease as a principal cause of reduced vision

Variable	Odds ratio (95% CI) of a poor outcome	Odds ratio (95% CI) of a borderline outcome
Operative technique		
ICCE	Undefined	4.26 (1.14 to 18.74)
ECCE + IOL	1.00	1.00
	p=0.009	p=0.015
Time since surgery		
>3 years	1.03 (0.50 to 2.14)	1.04 (0.57 to 1.90)
≤3 years	1.00	1.00
	p=0.928	p=0.896
Operation site		
Eye camp	1.98 (0.96 to 4.09)	1.17 (0.62 to 2.19)
Hospital	1.00	1.00
	p=0.044	p=0.61
Sex		
Male	1.22 (0.61 to 2.42)	1.08
Female	1.00	1.00
	p=0.540	p=0.782
Rural/urban residence		
Rural	1.39 (0.62 to 3.14)	1.66 (0.85 to 3.24)
Urban	1.00	1.00
	p=0.38	p=0.11
Literacy		
Illiterate	2.87 (1.31 to 6.42)	2.38 (1.29 to 4.38)
Literate	1.00	1.00
	p=0.004	p=0.003

Coincident disease and operative complications were responsible for less than 6/12 presenting visual acuity in 63 (39.8%) of 158 eyes. The principal cause of reduced vision is presented in Table 4 alongside best corrected visual acuity. The only cause within this table that might be correctable would be posterior capsule opacification using laser capsulotomy. Of coexistent diseases, macular degeneration was the main cause of reduced vision, accounting for 50% of those eyes with less than 6/18 and 46% of those with less than 6/60 best corrected visual acuity. When considering those eyes with posterior segment ocular disease (including glaucomatous optic neuropathy), significantly more posterior segment disease existed in eyes that had been operated in eye camps than in hospital (OR: 2.26; 95% CI: 1.2 to 4.27; p = 0.006).

Operative complications as a principal cause accounted for 17% of eyes with less than 6/18 best corrected visual acuity and 46% of those with less than 6/60. Of all 226 eyes, operative complications were recorded as a principal or non-principal cause of <6/12 visual acuity on presentation in 34 cases (15%); 30 of these eyes had undergone ICCE and three ECCE+IOL. The risk of an operative complication (as a principal or non-principal cause of <6/12 visual acuity on presentation) as a result of ICCE surgery was significantly increased if the surgery had been performed in an eye camp (OR: 3.48; 95% CI: 1.37 to 8.95; p = 0.003) than in a hospital, and was also more likely (not significant) if the ICCE had been performed recently (within 3 years of the survey; OR: 2.03; 95% CI: 0.85 to 4.86; p = 0.079). Of the 22 eyes that underwent ECCE+IOL, five eyes (22.7%) had posterior capsule opacification and 12 (54.5%) did not, while there was no information available for five cases.

DISCUSSION

Although the sample size chosen for the national survey was calculated according to estimates of blindness prevalence, we have no reason to suspect that the sample of operated cases was not representative of the country as a whole. The high response rate of 90.9% also makes bias less likely.

In Bangladesh, eye care services are provided in hospital based clinical services, which are usually based in urban areas, usually without outreach facilities, surgical eye camps and, more recently, comprehensive eye care, which links activities in the community with primary eye care and tertiary services.[8] Surgical eye camps have been popular because the services are usually provided free. However, it has been reported[7] that they have recently been undertaken less frequently because of advances in surgical techniques and awareness of a need for high quality surgery and good postoperative follow up. The results of this study show that the majority of cataract surgeries were performed in hospitals rather than eye camps, but confirm that in the past 3 years increasingly more surgeries are being performed in hospital conditions. Certainly this study has shown eye camp surgeries to be significantly more likely to result in a visual acuity of less than 6/60, when compared to hospital based surgeries (after excluding cases with coexistent ocular pathology). Only ICCE surgeries had taken place in eye camps, an operative technique that resulted in 59% of operated eyes achieving a presenting visual acuity of less than 6/18 (and 28% blindness). However, although ECCE+IOL surgery was found in this study to result in a much improved visual outcome, approximately five times as many ICCEs were performed in a hospital setting. An ICCE in a hospital based setting tended to have a better outcome than ICCE in an eye camp, although this was not a significant difference. Despite the better outcome associated with hospital based surgery, 21.5% of ICCE operated eyes resulted in a presenting visual acuity (after excluding those with coexistent ocular pathology) of less than 6/60 and 42% less than 6/18; 13.6% of ECCE+IOL surgeries resulted in less than 6/18 vision, and none was worse than 6/60. It has been suggested that the poor results associated with eye camp surgeries may

Table 4 Principal cause of reduced "best" corrected vision and principal coexistent disease in eyes with corrected vision of better than 6/12 in operated eyes

	Best corrected visual acuity			
Cause	6/12 or better	6/12 to 6/18	<6/18 to 6/60	<6/60
Operative complications	2 (9%)		5 (17%)	12 (46%)
Macular degeneration	17 (81%)	4 (66%)	15 (50%)	12 (46%)
Optic atrophy			4 (13%)	
Glaucoma			1 (3%)	1 (4%)
Posterior capsule opacification	1 (5%)	2 (33%)		
Central corneal opacity				1 (4%)
Diabetic retinopathy	1 (5%)		1 (3%)	
Chorioretinitis			1 (3%)	
Other			3 (10%)	
All	21 (100%)	6 (100%)	30 (100%)	26 (100%)

Table 5 Comparison of cataract surgery outcomes in Bangladesh (current study) with population based studies in Nepal[4] and Rajasthan[7]

Visual acuity	Nepal	Rajasthan	Bangladesh
	Number of surgeries = 220 194 (88.1%) aphakic; 26 (16.4%) pseudophakic	Number of surgeries = 723 683 (94.5%) aphakic; 40 (5.5%) pseudophakic	Number of surgeries = 226 203 (89.8%) aphakic; 23 (10.2%) pseudophakic
Presenting	%*	%	%
6/6–6/18	41.8	31.5	43.8
<6/18–6/60	25.9	24.3	27.9
<6/60	30.4	44.1	28.3
Best corrected acuity			
6/6–6/18	71.8	58.8	63.3
<6/18–6/60	15.5	23.4	23.0
<6/60	10.9	13.4	13.7

*Data on 4 operated eyes was missing so these columns do not total 100%.

be due to a less than thorough preoperative examination to exclude coexistent ocular pathology.[16] The results of this study would appear to confirm this, in that proportionally more posterior segment disease was seen in those eyes that had been operated in eye camps than in hospitals. The majority of this disease was age related macular degeneration. This would highlight the importance of a thorough preoperative assessment that includes a dilated posterior segment examination. Surgical skill and supervision of the surgeon and postoperative rehabilitation of patients may also have differed between eye camps and hospitals. In addition, some of the poor results attributed to ICCE surgeries may have been failed ECCE+IOL surgeries, which may explain why operative complications due to ICCE were more likely in more recent surgeries. Operative complications of ICCE surgeries were significantly more likely to occur in eye camps than in hospitals. Failure of an ECCE+IOL surgery resulting in capsular rupture and vitreous loss is likely to be more common in a country where the majority of operated cataracts are mature or hypermature. At first glance, one might suggest that eye camps should be abandoned. However, it has also been shown in this study that the outcomes of ICCE in hospitals are far from adequate. It is also possible that a proportion of ICCE surgeries performed in the hospitals were failed ECCEs. Reports from surgical eye camps in India[17 18] have shown that good results can be obtained provided that surgeons are appropriately skilled (and specifically in posterior segment examination), and that the camp is well organised, and these eye camps certainly have the advantage that they can be organised in rural areas serving people that are less able to get surgery. Comprehensive eye care (known as modular eye care) programmes, which were started between 1994 and 1997 in several districts of Bangladesh, combine the rural outreach advantages of eye camps with the organisational and skill advantages of a base hospital. These have shown promise and have also proved to be sustainable.

The ability to obtain a best corrected visual acuity in all subjects who presented with a visual acuity of less than 6/12 in either eye, was a particular strength of this survey. It gives much more information than using a pinhole to gauge what improvement might be expected from a refractive correction. For logistical reasons, we were unable to refine the objective result obtained from the autorefractor instrument to give a subjective refraction; therefore, it is possible that the potential improvement in vision gained by wearing the correction may be understated.

One of the most striking findings of this work is the number of uncorrected aphakes, one quarter of ICCE eyes were not corrected with a spectacle lens. The imbalance of distribution of refractive rehabilitation was also evidenced by the finding that women, eye camp surgeries, illiterate subjects, and rural dwellers were less likely to wear aphakic spectacles. The improvement that could be gained by adequate postoperative refractive correction is highlighted by Table 1. Poor acuity experienced by some patients will influence the demand and uptake by other individuals in the community. An analysis of this and other factors or "barriers" will be the subject of a further report.

These cataract outcomes in Bangladesh can be compared with the outcomes of cataract surgery in two other population based studies in the Indian subcontinent, Nepal[4] and Rajasthan[7] (Table 5). It is interesting that the presenting visual outcomes in Bangladesh and Nepal are similar, whereas the proportion of poor outcome is greater in Rajasthan, which may be attributable to the smaller proportion of intraocular lens surgeries, presumably due to a predominance of eye camp surgeries in Rajasthan.

In Bangladesh there are approximately 500 trained ophthalmologists, a proportion of whom are surgically trained. Approximately 100 are trained in ECCE+IOL surgery. In addition to these trained ophthalmologists, there are also a number of medical officers in non-governmental and government hospitals who are trained in surgery. The results from this survey emphasise the need for greater quality and quantity of cataract surgery, with strategies targeted at improving operative technique and particularly at ensuring effective postoperative rehabilitation. A longitudinal study is planned to provide further specific information. Further work is required in this area, and this cross sectional analysis has indicated the areas where improvements need to be made.

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