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Assessment of Cataract Surgical Needs and Avoidable Blindness in Southern Bangladesh

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Abstract

Background: Cataract remains a leading cause of avoidable blindness worldwide, particularly in low- and middle-income countries. Despite advances in surgical techniques, millions, especially in rural and underserved areas, remain visually impaired due to inadequate access to cataract surgery. In Bangladesh, cataract-related blindness is a significant public health concern, particularly in the southern regions where access to specialized healthcare is limited. ***Objective:*** This study aims to assess the prevalence of cataract-induced visual impairment and blindness among adults aged ≥50 years in the southern region of Bangladesh. It further evaluates the coverage and barriers to cataract surgical services to inform targeted interventions aimed at reducing avoidable blindness. ***Methods:*** A cross-sectional study was conducted using the Rapid Assessment of Avoidable Blindness (RAAB) methodology. A total of 4,868 individuals were selected through probability-proportionate-to-size cluster sampling. Ophthalmic examinations, including visual acuity and lens status assessments, were performed following standardized protocols. Cataract surgical coverage was calculated, and the primary causes of visual impairment were identified. Data were analyzed using RAAB V.3.1 software. ***Results:*** The prevalence of bilateral severe visual impairment (visual acuity <6/60) was 1.6%, and bilateral visual impairment (<6/18) was 8.4%. Cataract was responsible for 79% of bilateral blindness cases, 78.2% of severe visual impairment, and 41.9% of visual impairment. Cataract surgical coverage for individuals with a visual acuity <3/60 was 60.9%, indicating moderate access to surgical services. The main barriers to surgery included financial constraints, lack of awareness, and fear of surgery. ***Conclusion:*** Cataract remains the primary cause of avoidable blindness in the southern region of Bangladesh, with significant gaps in surgical coverage. Addressing barriers to cataract surgery through enhanced outreach programs, financial assistance, and community education is crucial in reducing the burden of blindness. Strengthening healthcare infrastructure and increasing the availability of ophthalmic professionals can further improve access to timely cataract treatment.

Keywords: Cataract, Blindness, Visual Impairment, Cataract Surgical Coverage, Public Health, Bangladesh, Avoidable Blindness.

INTRODUCTION

Cataract remains one of the leading causes of blindness worldwide, particularly in low- and middle-income countries. It is a condition characterized by the clouding of the lens in the eye, leading to visual impairment and, if untreated, eventual blindness. While cataract surgery is a highly effective treatment, millions of individuals, especially in rural and underserved areas, continue to suffer from cataract-induced blindness due to inadequate access to surgical services, delayed interventions, or a lack of awareness about the condition. In Bangladesh, where the healthcare infrastructure is still developing, cataract-related blindness remains a significant public health challenge, particularly in the southern regions, which are often more remote and less equipped with specialized healthcare services [1-4].

The global burden of avoidable blindness due to cataracts is immense, with an estimated 20 million people worldwide affected. Despite advancements in surgical techniques and the availability of affordable cataract surgery, a substantial portion of the population remains deprived of this life-changing procedure. A key factor contributing to this is the disparity in access to surgical care between urban and rural areas, with individuals in remote areas often not seeking treatment until the condition severely affects their quality of life [5-

6]. This delay in seeking treatment results in a higher incidence of blindness and permanent visual impairment, underscoring the urgent need for targeted interventions aimed at reducing cataract-related blindness.

In Bangladesh, the southern region faces particular challenges in cataract management. Limited healthcare facilities, a lack of trained ophthalmic professionals, and socio-economic barriers prevent many from receiving timely surgical care. Studies have shown that the prevalence of cataract-induced blindness in rural regions is significantly higher compared to urban areas. Moreover, factors such as age, poverty, and inadequate awareness about the disease exacerbate the problem. As a result, many individuals in these areas suffer needlessly, with cataract being a major cause of avoidable blindness [7-11].

To address these issues, it is essential to assess the current surgical needs and the extent of avoidable blindness in southern Bangladesh. Understanding the scope of the cataract burden in this region, along with the barriers to accessing surgical treatment, is critical in designing effective public health interventions. This includes the identification of gaps in cataract surgery services, the availability of resources, and the role of healthcare providers in educating communities about the importance of early intervention. By highlighting the unmet surgical needs and the prevalence of avoidable blindness, this study aims to guide the development of strategies to improve cataract surgical services and reduce the impact of preventable blindness.

Furthermore, a comprehensive assessment of cataract surgical needs will help inform the allocation of resources and the design of programs aimed at increasing access to affordable cataract surgery. These programs could involve outreach initiatives, mobile eye care units, and partnerships with local health providers to ensure that individuals in even the most remote areas can access timely and effective care. Early detection and intervention are key to preventing avoidable blindness, and as such, understanding the barriers to cataract surgery in southern Bangladesh will be instrumental in formulating policies that can reduce the incidence of avoidable blindness in this region.

Ultimately, addressing cataract surgical needs in southern Bangladesh is not only a matter of providing treatment but also improving the overall quality of life for individuals who have been deprived of sight.

Objective

This study seeks to identify the magnitude of the cataract problem, the factors that contribute to the delay in treatment, and the opportunities for intervention, aiming to pave the way for a future where cataract-induced blindness is significantly reduced, and access to surgery is universally available.

METHODOLOGY

This cross-sectional study was conducted to assess cataract surgical needs and avoidable blindness in adults aged ≥50 years in the southern region of Bangladesh. The expected prevalence of blindness in this age group, as indicated by national surveys, was estimated at 5.7%. To ensure a confidence level of 95% and a precision of 20% (i.e., worst acceptable result of 4.6%), with a population size of approximately 207,500 adults aged ≥50 years in Satkhira, a design effect of 1.7 for clusters of 50, and an anticipated 10% non-response rate, the required sample size was estimated at 3,166 individuals using EPI-INFO V.6.04.

A total of 64 clusters of 50 adults each were originally planned for this survey; however, for logistical reasons, 106 clusters were ultimately selected. The tertiary hospital affiliated with this study served as the primary base for coordination, data collection training, and validation of ophthalmic assessments.

Cluster Selection and Household Sampling

Clusters were selected using probability-proportionate-to-size sampling, based on updated data from the 1991 national census. Four clusters had to be replaced due to inaccessibility or safety concerns. Households within clusters were chosen using a modified compact segment sampling method. Enumeration areas were mapped 2–3 days before data collection, with village leaders providing sketches indicating household distributions. On the day of the survey, each enumeration area was divided into segments, with each segment comprising approximately 50 adults aged ≥50 years. One segment was randomly chosen, and all households within it were sequentially visited until the required number of participants was identified. If a segment had fewer than 50 eligible individuals, another segment was randomly selected to complete the sampling.

Survey Implementation

The survey was conducted over an eight-week period from November to December 2005. Survey teams, including an ophthalmologist and support staff, visited households accompanied by local village guides. Visual examinations were performed within households. If an eligible individual was absent, the team made multiple attempts to revisit the household on the same day. If the person remained unavailable, vision status information was collected from relatives or neighbors.

Ophthalmic Examination

A standardized protocol was used for the rapid assessment of avoidable blindness (RAAB). The survey record included seven sections: general demographics, vision and pinhole examination, lens examination, principal cause of visual impairment, history of visual impairment, reasons for lack of cataract surgery, and surgical details.

Visual acuity was assessed by an ophthalmologist using a Snellen tumbling "E" chart, with optotypes of 6/18 (20/60) and 6/60 (20/200) at distances of 6 or 3 meters. Measurements were taken in full daylight with available spectacle correction. If visual acuity was <6/18 in either eye, pinhole vision was also tested.

Visual impairment was categorized as:
Blindness: Visual acuity <3/60 in the better eye with available correction.
Severe visual impairment: Visual acuity between ≥3/60 and <6/60 in the better eye with available correction.
Visual impairment: Visual acuity between ≥6/60 and <6/18 in the better eye with available correction.

A tertiary hospital ophthalmologist examined all participants using a torch, direct ophthalmoscope, or portable slit lamp. Lens status was classified as normal, presence of obvious lens opacity, aphakia, or intraocular lens implantation. If the lens could not be examined (e.g., due to corneal scarring), it was recorded as "no view of lens." In cases of visual acuity <6/18, a more detailed examination was performed, including pupil dilation if necessary. The principal cause of visual impairment was recorded per World Health Organization (WHO) conventions, prioritizing the primary disorder that was easiest to treat.

Training and Quality Control

Four survey teams, each consisting of one ophthalmologist and one assistant, underwent one week of intensive training at a tertiary hospital. Interobserver agreement was tested by re-examining 40 patients per team, ensuring an acceptable standard (kappa ≥0.60) for visual acuity measurement, lens examination, and cause of blindness assessment. A field supervisor monitored data collection at least once per week to maintain consistency and accuracy.

Needs Assessment for Cataract Surgery

To evaluate cataract surgical needs, five in-depth interviews were conducted with ophthalmologists and healthcare administrators at the tertiary hospital and associated eye care facilities in the Satkhira district. A validated questionnaire from the University of South Asia, Dhaka, was used to gather data on available equipment, human resources, and the number of surgeries conducted in the previous year.

Statistical Analysis

Data entry and analysis were conducted using RAAB V.3.1 software, developed in EPI-INFO V.6.04d. Prevalence estimates accounted for the design effect when calculating confidence intervals. Cataract surgical coverage was computed as the proportion of individuals requiring surgery who had undergone cataract surgery. This was determined by summing the number of people with bilateral pseudophakia/aphakia and those with unilateral pseudophakia/aphakia with unilateral visual impairment, then dividing by the total number of visually impaired individuals with cataract. Surgical coverage was also calculated at the eye level. Due to the absence of preoperative visual acuity data, an assumption was made that surgery was performed only on patients with visual acuity below specific thresholds (<3/60, <6/60, and <6/18).

RESULTS

Among the 5,295 individuals in the study population, 370 (7.0%) were unavailable, and 57 (1.1%) declined examination, resulting in a final sample of 4,868 participants (91.9%). The sampled population closely reflected the district's demographic distribution in terms of age and sex, though women were slightly overrepresented.

Table-1: Composition of the district and sample population

Age groups (years)	Men		Women	
	District (n=207 548)	Sample (n=2160)	District (n=94 831)	Sample (n=4868)
50–59	51 058 (45.3)	789 (36.6)	43 559 (45.9)	1371 (50.6)
60–69	34 331 (30.5)	734 (33.9)	29 238 (30.9)	817 (30.2)
70–79	18 821 (16.7)	456 (21.1)	14 518 (15.3)	387 (14.3)
80+	8507 (7.5)	181 (8.4)	7516 (7.9)	133 (4.9)

The prevalence of bilateral severe visual impairment was 1.6% (95% CI 1.2%–2.0%; DEFF 1.2), while bilateral visual impairment was observed in 8.4% (95% CI 7.5%–9.3%; DEFF 1.3). Prevalence estimates were comparable between men and women. However, visual impairment and blindness showed a sharp increase with age. A total of 48 individuals were identified with pseudophakia or aphakia in both eyes, while 131 had unilateral (pseudo)aphakia. The likelihood of having (pseudo)aphakia was similar for both men and women.

Table-2: Distribution by visual acuity with available correction in the better eye in adults aged ⩾50 years

VA with available correction	Men (n=2160)		Women (n=2708)		Total (n=4868)	
	n	Prevalence (%, 95% CI)	n	Prevalence (%, 95% CI)	n	Prevalence (%, 95% CI)
VA <3/60						
Bilateral blindness	61	2.8 (2.2 to 3.5)	82	3.0 (2.3 to 3.8)	143	2.9 (2.4 to 3.5)
Blind eyes	270	6.3 (5.4 to 7.1)	349	6.4 (5.6 to 7.3)	619	6.4 (5.7 to 7.0)
VA between <6/60 and ⩾3/60						
Bilateral severe visual impairment	31	1.4 (0.9 to 2.0)	47	1.7 (1.2 to 2.3)	78	1.6 (1.2 to 2.0)
Severe visually impaired eyes	110	2.6 (2.0 to 3.1)	135	2.5 (2.0 to 3.0)	245	2.5 (2.1 to 2.9)
VA between <6/18 and ⩾6/60						
Bilateral visual impairment	193	8.9 (7.7 to 10.2)	215	7.9 (6.9 to 9.0)	408	8.4 (7.5 to 9.3)
Visually impaired eyes	510	11.8 (10.5 to 13.1)	538	9.9 (8.9 to 11.0)	1048	10.8 (9.9 to 11.6)
Bilateral aphakia	21	1.0 (0.5 to 1.4)	27	1.0 (0.6 to 1.4)	48	1.0 (0.7 to 1.3)
Unilateral aphakia	52	2.4 (1.8 to 3.0)	79	2.9 (2.3 to 3.5)	131	2.7 (2.2 to 3.1)
Aphakic eyes	94	2.2 (1.6 to 2.7)	133	2.5 (2.0 to 3.0)	227	2.3 (2.0 to 2.7)

Posterior segment diseases, including glaucoma, diabetic retinopathy, and age-related macular degeneration, were the second leading cause of bilateral blindness (13.3%) and bilateral severe visual impairment (15.4%). Refractive error accounted for the majority of bilateral visual impairment (52.9%), followed by cataract (41.9%). Avoidable causes—such as cataract (both unoperated and post-surgical complications), refractive error, and corneal scarring—were responsible for the vast majority of bilateral blindness (86.7%), bilateral severe visual impairment (84.6%), and bilateral visual impairment (95.6%).

Table-3: Causes of blindness, severe visual impairment and visual impairment in people with available correction

	Bilateral blindness, VA <3/60 (n=143)	Bilateral severe visual impairment, VA between <6/60 and ⩾3/60 (n=78)	Bilateral visual impairment, VA between <6/18 and ⩾6/60 (n=408)
Refractive error	1 (0.7)	4 (5.1)	216 (52.9)
Cataract, untreated	113 (79.0)	61 (78.2)	171 (41.9)
Aphakia, uncorrected	2 (1.4)	0	1 (0.2)
Surgical complications	2 (1.4)	1 (1.3)	1 (0.2)
Phthysis	1 (0.7)	0	1 (0.2)
Other corneal scar	5 (3.5)	0	1 (0.2)
Posterior segment	19 (13.3)	12 (15.4)	16 (3.9)
Globe abnormalities	0	0	1 (0.2)
Avoidable blindness	124 (86.7)	66 (84.6)	391 (95.8)

Cataract surgical coverage was moderately high for both individuals and eyes (Table 4). Among those requiring surgery at a visual acuity of <3/60, 64% had undergone the procedure. Additionally, 31% of eyes with cataract at a visual acuity of <6/60 had been operated on. Out of 377 individuals in the sample who required spectacles for distance correction (including those already wearing spectacles and those with uncorrected refractive errors), 156 were using spectacles, resulting in a coverage rate of 41% (95% CI: 36%–47%).

Table-4: Cataract surgical coverage by person and eyes in people aged ⩾50 years (best correction)

	CSC by persons (%, 95% CI)	CSC by eyes (%, 95% CI)
VA <3/60		
Men	63.6 (53.3 to 72.9)	34.6 (29.0 to 40.6)
Women	59.0 (50.3 to 67.2)	34.9 (30.2 to 40.0)
Total	**60.9 (54.4 to 67.1)**	**34.8 (31.1 to 38.6)**
VA <6/60		
Men	57.9 (48.3 to 67.0)	30.9 (25.8 to 36.5)
Women	55.1 (47.0 to 62.9)	30.4 (26.1 to 34.9)
Total	**56.3 (50.1 to 62.2)**	**30.6 (27.3 to 34.1)**
VA <6/18		
Men	34.5 (28.1 to 41.4)	17.4 (14.4 to 21.0)
Women	36.4 (30.7 to 42.5)	18.7 (15.9 to 21.8)
Total	**35.6 (31.3 to 40.1)**	**18.1 (16.1 to 20.4)**

Surgical outcomes were suboptimal (Table 5). With available correction, only 60.1% (95% CI: 53.2%–66.7%) of eyes achieved a good outcome (visual acuity ⩾6/18) post-surgery, while 16.4% (95% CI: 11.9%–22.3%) had a borderline outcome (visual acuity <6/18 to 6/60), and 23.5% (95% CI: 18.1%–29.9%) experienced poor outcomes (visual acuity <6/60) [9]. However, outcomes improved with best correction, raising the percentage of eyes achieving good vision to 67.6% (95% CI: 60.8%–73.7%). Among 160 respondents, satisfaction levels varied, with 41.3% reporting being very satisfied and 41.9% somewhat satisfied, while smaller proportions were indifferent (3.1%), somewhat dissatisfied (7.5%), or very dissatisfied (6.3%). Individuals with cataract-related visual acuity <6/60 in the better eye cited lack of awareness about surgery (45.0%) and financial constraints (36.0%) as the primary reasons for not undergoing the procedure.

Table-5: Postoperative visual acuity in 213 eyes after cataract surgery, by intraocular lens status

Available correction	Non-IOL eyes (n=96)		IOL eyes (n=117)		All eyes (n=213)	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Available correction						
Can see 6/18	32	33.3 (24.2 to 43.8)	96	82.1 (73.6 to 88.3)	128	60.1 (53.2 to 66.7)
Cannot see 6/18, can see 6/60	21	21.9 (14.3 to 31.7)	14	12.0 (6.9 to 19.6)	35	16.4 (11.9 to 22.3)
Cannot see 6/60	43	44.8 (34.7 to 55.3)	7	6.0 (2.6 to 12.4)	50	23.5 (18.1 to 29.9)
Best correction						
Can see 6/18	42	43.8 (33.8 to 54.2)	102	87.2 (79.4 to 92.4)	144	67.6 (60.8 to 73.7)
Cannot see 6/18, can see 6/60	17	17.7 (10.9 to 27.1)	9	7.7 (3.8 to 14.5)	26	12.2 (8.3 to 17.5)
Cannot see 6/60	37	38.5 (28.9 to 49.1)	6	5.1 (2.1 to 11.3)	43	20.2 (15.1 to 26.3)

DISCUSSION

The rapid assessment of avoidable blindness among individuals aged ⩾50 years in Satkhira district revealed a relatively low prevalence of bilateral blindness, severe visual impairment, and visual impairment. Cataract was identified as the primary cause of blindness and severe visual impairment, while cataract and refractive error were the leading causes of visual impairment. Nearly all cases of blindness, severe visual impairment, and visual impairment were attributable to avoidable causes. Despite a relatively low cataract surgical rate (CSR) and concerns about surgical quality, cataract surgical coverage was reasonably high. However, fewer than half of the individuals requiring spectacles used them, likely due to limited access to refractive services. Although the overall prevalence of blindness and visual impairment was low, the absolute number of affected individuals remains significant. Most visual impairment cases are preventable, but current service provision remains insufficient to fully address this issue.

The current CSR in Satkhira is approximately 550 surgeries per million people per year, a figure that is low for Asia and comparable to CSR levels in African countries [10]. Increasing CSR in Satkhira could be achieved through straightforward measures, such as ensuring that hospital equipment remains operational. Additionally, improving the quality of cataract surgeries is crucial, as nearly one in four eyes had poor postoperative outcomes. Implementing a structured monitoring system for cataract surgical results could heighten surgeons' awareness of quality control, ultimately leading to improved surgical outcomes [11-14]. The provision of spectacles remains inadequate, with only 4 in every 10 individuals requiring corrective lenses at a visual acuity threshold of <6/18 having access to them. This finding aligns with the widespread unmet need for spectacles reported in the national survey [15]. Although this study did not assess presbyopia, given the age profile of survey participants, a substantial number are also likely to require presbyopic glasses. Enhancing the availability of spectacles could be achieved by training more mid-level ophthalmologists and increasing the accessibility of ready-made spectacles [15].

Based on findings from the national survey, the prevalence of blindness observed in the Satkhira rapid assessment of avoidable blindness was lower than expected, despite a similar distribution of underlying causes [3]. It is particularly surprising that blindness prevalence in Satkhira was lower than national figures, given that Satkhira is a disadvantaged, underserved region with limited eye care services. The observed difference in prevalence is unlikely to indicate a declining trend, as the interval between the two surveys was relatively short. Additionally, selection bias in the Satkhira survey is unlikely, as the high response rate ensured the sample was representative of the district population. Information bias was also minimized, as experienced ophthalmologists conducted the examinations with acceptable interobserver reliability. A key methodological difference between the surveys may explain the discrepancy: the national survey utilized the random walk method for selecting individuals in clusters, [16] which may have overestimated blindness prevalence by inadvertently including more blind individuals. In contrast, the Satkhira survey employed compact segment sampling, [7] which ensures greater objectivity in household selection [17] and mitigates biases inherent in the random walk methodology [18].

CONCLUSION

The majority of blindness and visual impairment cases can be effectively addressed through cataract surgery and improved access to corrective spectacles. However, the current CSR remains inadequate to meet existing demands, highlighting the need for enhanced surgical outcomes and better post-operative care.

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