

# Cataract prevalence, cataract surgical coverage and barriers to uptake of cataract surgical services in Pakistan: the Pakistan National Blindness and Visual Impairment Survey

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**Aim:** To estimate the prevalence of visual impairment and blindness caused by cataract, the prevalence of aphakia/pseudophakia, cataract surgical coverage (CSC) and to identify barriers to the uptake of cataract services among adults aged  $\geq 30$  years in Pakistan.

**Methods:** Probability proportional-to-size procedures were used to select a nationally representative sample of adults. Each subject underwent interview, visual acuity measurement, autorefraction, biometry and ophthalmic examination. Those that saw  $< 6/12$  in either eye underwent a more intensive examination procedure including corrected visual acuity, slit lamp and dilated fundus examination. CSC was calculated for different levels of visual loss by person and by eye. Individuals with  $< 6/60$  in the better eye as a result of cataract were interviewed regarding barriers.

**Results:** 16 507 Adults were examined (95.5% response rate). The crude prevalence of blindness (presenting  $< 3/60$  in the better eye) caused by bilateral cataract was 1.75% (95% CI 1.55%, 1.96%). 1317 Participants (633 men; 684 women) had undergone cataract surgery in one or both eyes, giving a crude prevalence of 8.0% (95% CI 7.6%, 8.4%). The CSC (persons) at  $< 3/60$ ,  $< 6/60$  and  $< 6/18$  were 77.1%, 69.3% and 43.7%, respectively. The CSC (eyes) at  $< 3/60$ ,  $< 6/60$  and  $< 6/18$  were 61.4%, 52.2% and 40.7%, respectively. Cost of surgery (76.1%) was the main barrier to surgery.

**Conclusion:** Approximately 570 000 adults are estimated to be blind ( $< 3/60$ ) as a result of cataract in Pakistan, and 3 560 000 eyes have a visual acuity of  $< 6/60$  because of cataract. Overall, the national surgical coverage is good but underserved populations have been identified.

Cataract remains the leading cause of blindness worldwide, accounting for nearly half (47.8% or 17.7 million) of all blindness.<sup>1</sup> The treatment for cataract is surgical, a highly cost-effective intervention, with excellent prognosis for sight restoration. There has been an international drive (VISION 2020: the Right to Sight) to increase cataract surgical services in order to reduce the cataract "backlog". It is estimated that globally approximately 15 million<sup>2</sup> cataract operations are performed annually, an increase of 5 million from only 5 years ago.<sup>3</sup> Evaluation of any eye care programme requires an assessment of cataract surgical delivery, the indicators commonly used being: (a) the prevalence of visually disabling, unoperated cataract; (b) cataract surgical coverage (CSC) by person and by eye; and (c) cataract surgical rate (CSR; i.e. the number of cataract operations performed per million population per year). Increasing the utilization of cataract surgical services will entail addressing the barriers perceived by patients with significant cataract.

Pakistan, a developing country situated in the Eastern Mediterranean Region of the World Health Organisation (WHO), is bordered by India, China, Iran and Afghanistan. The current population estimated at 160 million makes Pakistan the sixth most populous country in the world. The country is divided into four provinces: Punjab, Sindh, North West Frontier Province (NWFP) and Balochistan, each with widely varying geography. The population is concentrated in the fertile Indus valley, whereas in most parts of Balochistan the population density is low. In this paper, findings from the Pakistan National Blindness and Visual Impairment Survey are reported with respect to the prevalence and magnitude of visual

loss caused by cataract, the CSC, and barriers to the uptake of cataract services.

## MATERIALS AND METHODS

A comprehensive description of the sampling strategy and ocular examination methods have already been published.<sup>4</sup> A brief summary is provided below.

### Sampling strategy

Using an assumed prevalence of blindness of 1.8%, a random sampling error precision of 0.3%, a design effect of 2.0, and a 10% increase for non-response, the total sample size was calculated as 16 600. Multistage stratified cluster random sampling, with probability proportional-to-size procedures, were adopted to select a nationally representative sample of adults aged 30 years and older.<sup>5</sup>

### Ethical approval

The Pakistan Medical Research Council provided ethical approval in 2002, and the survey followed the tenets of the Declaration of Helsinki.

### Definitions

The WHO categories of visual impairment were used,<sup>6</sup> i.e. blindness was defined as a presenting visual acuity (i.e. with glasses for distance if normally worn, or unaided) of  $< 3/60$

**Abbreviations:** CSC, Cataract surgical coverage; CSR, cataract surgical rate; NWFP, North West Frontier Province; WHO, World Health Organisation

(<20/400, logarithm of minimum angle of acuity >1.30) in the better eye. As visual fields were only assessed in a subgroup, constricted visual fields were not included in the definition. Moderate visual impairment was defined as <6/18 to ≥6/60, and severe visual impairment as <6/60 to ≥3/60. Snellen notation for visual acuity has been used in this paper for ease of comparison with other survey data.

### Clinical examination

Oral informed consent was obtained from each subject and all were interviewed. Distance visual acuities were measured using a reduced logarithm of minimum angle of acuity tumbling "E" chart.<sup>7</sup> All adults had a basic eye examination by an ophthalmologist. Participants with normal visual acuity in both eyes who did not have any ocular pathology were then discharged, with ophthalmic advice, if necessary. Adults with an acuity of <6/12 in either eye underwent a more detailed examination.

This included retesting visual acuity with the autorefraction results, and a slit lamp examination (Topcon SL 7F; Tokyo, Japan) with biomicroscopic dilated fundus examination. Participants presenting with severe visual impairment/blindness caused by cataract were questioned about why they had not accessed cataract surgical services. They were asked to choose from a selection of barriers that had been refined following responses to open-ended questions used in a pilot study.<sup>4</sup> Responses included cost, lack of relatives/friends to accompany the subject, lack of awareness and fear of treatment, and time constraints. There was also an open question should none of the options be applicable. Participants who chose more than one barrier were asked to rank them in order of importance.

### Determining causes of visual loss

Cause(s) of visual loss were determined using methods described by the WHO.<sup>8</sup> For each eye all pathological findings were recorded at the time of examination. One main cause was then selected for each eye, the WHO recommendation stipulating that: (a) if any pathology is secondary to another, the primary pathology should be selected (e.g. if the pathologies were rubeotic glaucoma and central retinal vein occlusion, vein occlusion should be selected); and/or (b) conditions amenable to treatment; or (c) conditions that could have been prevented are preferentially selected over and above unavoidable causes. Following this, the main cause in the right eye or in the left eye was chosen to represent the principle cause for the individual. If the main causes in the right eye and the left eye differed, the principal disorder for the individual was selected as the one most readily treatable or, if not treatable, the one that was more amenable to prevention.

### Statistical analysis

Two data processors carried out double data entry. Data were analysed in STATA (Stacorp. Release 9.0; Stata Corporation, College Station, Texas, USA). The prevalence of principle cause cataract (person) and main cause (eye) was calculated stratified by age and gender. The prevalence of bilateral cataract blindness and cataract surgery prevalence were also calculated. Age and gender standardised prevalence data were used to produce estimates using the latest national population data.<sup>9</sup> The number of participants blind from cataract and the number of eyes with cataract causing <6/60 vision was estimated and projected to the year 2020 by applying the survey's stratified prevalence figures to Pakistan population projections from the United States Bureau of Census.<sup>10</sup>

### Calculation of CSC (persons)

Calculation of CSC was performed for three visual impairment cut-offs: <3/60, <6/60 and <6/18 using the formula:  $(x + y) / (x + y + z) \times 100$  where  $x$  is individuals with unilateral pseudo/aphakia and visual impairment in the contralateral eye;  $y$  is individuals with bilateral pseudo/aphakia, regardless of acuity; and  $z$  is individuals with <3/60, <6/60 and <6/18 in whom the principle cause was cataract (unilateral or bilateral).

### Calculation of CSC (eyes)

Calculation of CSC was performed for three visual impairment cut-offs: <3/60, <6/60 and <6/18 using the formula:  $(a / a + b) \times 100$  where  $a$  is all eyes that are aphakic or pseudo/aphakic, regardless of acuity; and  $b$  is all eyes with cataract causing an acuity of <3/60, <6/60 or <6/18.

### Barriers

Logistic regression was used to assess whether cost was associated with age, gender, province, rural/urban dwelling and literacy. Odds ratios (OR) and 95% confidence intervals (CI) are quoted with two-sided significance tests.

## RESULTS

A total of 16 507 adults were examined (95.5% response rate). Details of responders and non-responders and of the prevalence of the different categories of visual loss have been described elsewhere.<sup>11</sup> A total of 4416 participants (27%, 95% CI 26.1%, 27.4%) were identified with a visual acuity <6/12 in the better eye on presentation, 561 of whom (crude prevalence 3.4%, 95% CI 3.1%, 3.7%) were bilaterally blind.<sup>11</sup>

### Cataract prevalence and magnitude

A total of 289 participants were blind with cataract as the cause (crude prevalence 1.75%, 95% CI 1.55% to 1.96%, table 1). The prevalence of cataract blindness was higher in Punjab province, in rural areas and among illiterate participants. The prevalence of cataract blindness was higher in women than men (1.80% versus 1.67%,  $p < 0.001$ ). There are estimated to be 570 000 adults (225 000 men, 345 000 women) who are blind from cataract in Pakistan, projected to increase to 1 210 000 by the year 2020. The prevalence of cataract causing <6/60 in eyes was 5.0% (95% CI 4.7%, 5.2%), which projects to an estimated 3 560 000 eyes with a visual acuity of <6/60 caused by cataract in Pakistan (year 2003). This number is projected to increase to 7 380 000 by the year 2020.

### Bilateral cataract blindness

Of the 289 blind participants in which cataract was the principal cause, 179 (61.9%) were bilaterally cataract blind (crude prevalence 1.08%, 95% CI 0.93% to 1.25%), ranging from 0.8% in Balochistan and Sindh to 1.0% in NWFP and 1.3% in Punjab. The proportion of blindness caused by bilateral cataract was highest in NWFP (38%) and lowest in Balochistan (22%).

### Prevalence of aphakia/pseudophakia and cataract output

A total of 1317 adults (633 men; 684 women) had undergone cataract surgery in one eye (845 participants, 64.2%) or both eyes (472 participants, 35.8%). Their visual acuity results and outcomes of surgery will be presented elsewhere. Among individuals who had had cataract surgery, 48% of men and 39% of women were above the age of 70 years and 90% were aged 50 years or older. The crude prevalence of aphakia/pseudophakia (in one or both eyes) was 8.0% (95% CI 7.6%, 8.4%, table 2). The prevalence varied from 6.1% in NWFP to 8.6% in Sindh. Overall, men had a slightly higher prevalence than women (8.2% versus 7.8%,  $p = 0.425$ ). From these data,

**Table 1** Crude prevalence (%) of cataract as the cause of visual impairment

		Presenting visual acuity		
		<6/18	<6/60	<3/60
Province p<0.001*	Punjab	748 (8.5)	250 (2.8)	177 (2.0)
	Sindh	343 (9.4)	113 (3.1)	50 (1.4)
	NWFP	195 (6.3)	70 (2.2)	46 (1.5)
	Balochistan	52 (5.5)	22 (2.3)	16 (1.7)
Dwelling p=0.004*	Rural	589 (5.3)	337 (3.0)	214 (1.9)
	Urban	968 (8.7)	118 (2.2)	75 (1.4)
Literacy p<0.001*	Illiterate	1225 (10.5)	425 (3.7)	273 (2.3)
	Literate	113 (2.3)	30 (0.6)	16 (0.3)
Total		1338 (8.1)	455 (2.8)	289 (1.8)

NWFP, North West Frontier Province. \*Chi-squared test (blindness).

approximately 2.7 million people have undergone cataract surgery (1 700 000 in Punjab; 600 000 in Sindh; 270 000 in NWFP and 130 000 in Balochistan).

### Cataract surgical coverage

The CSC (person) at visual acuity cut-offs of <3/60, <6/60 and <6/18 were 77.1%, 69.3% and 43.7%, respectively (table 3). Coverage at the <3/60 level varied between the provinces. Coverage was higher in urban than rural areas ( $p=0.087$ ), in men than in women ( $p=0.009$ ) and in literate participants compared with illiterate participants ( $p<0.001$ ). CSC for eyes at <3/60, <6/60 and <6/18 cut-offs were 61.4%, 52.2% and 40.7%, respectively (table 4). As with coverage for individuals, coverage for eyes was significantly higher in men, in literate participants and urban dwellers.

### Barriers to cataract surgery in Pakistan

A total of 455 participants presented with <6/60 vision in the better eye in whom cataract was the principle cause, and information on barriers was obtained from 356 (78.2%), 53.9% of whom were women, 94.4% were illiterate and 73% lived in rural areas. There were no statistically significant demographic differences between participants who were interviewed about barriers and those who were not. Cost was overwhelmingly the commonest barrier (76.1%) followed by lack of knowledge of the condition (11.5%), 'waiting for the cataract to mature' (9%), no escort (1.7%) and fear of surgery (1.4%). In all adults who gave more than one response, cost was always the first barrier. Compared with adults in NWFP, participants in Balochistan (OR 7.0, 95% CI 1.50, 33.4,  $p=0.014$ ) and participants in Punjab (OR 8.10, 95% CI 4.10, 16.10,  $p<0.001$ ) were significantly more likely to report cost as a barrier. Women were 27% (95% CI 0.8, 2.1,  $p=0.34$ ) more likely to report cost

as a barrier as were rural dwelling participants (OR 1.3, 95% CI 0.74, 2.2,  $p=0.4$ ) and illiterate participants (OR 1.1 95% CI 0.4 to 3.0,  $p=0.90$ ).

### DISCUSSION

Cataract was identified as the main cause of blindness in Pakistan in a study undertaken between 1987 and 1990 (66%).<sup>12</sup> Although the study had some methodological flaws it served its purpose, leading to the establishment of the National Committee for the Prevention of Blindness (NCPB) and the development of a five year National Plan for the Prevention of Blindness (1994–1999). The plan highlighted the need for large-scale expansion of cataract surgical services. Findings from the current survey indicate that cataract is still the leading cause of blindness in Pakistan, but cataract is now responsible for a lower proportion of blindness (51.5%).<sup>13</sup>

In 1994 it was estimated that approximately 500 ophthalmologists performed 140 000 cataract surgeries in Pakistan, giving a CSR of 1115/million population per year.<sup>14</sup> The current figure is uncertain because reliable national evidence is lacking but the WHO estimates that the CSR has more than doubled to 2400/million population per year.<sup>15</sup> The prevalence of cataract surgery (aphakia/pseudophakia) was 8.0% in participants aged 30 years and over and 17% in those aged 50 years and older, the latter being slightly higher than has been reported from India (i.e. 12.8% in Rajasthan, northern India,<sup>16</sup> 11.8% in Tirunelveli, south India<sup>17</sup> and 14.7% in Sivaganga, south India),<sup>18</sup> where the CSR is now over 4000/million population per year.<sup>19</sup> These data suggests that Pakistan's CSR may in fact be similar to the Indian estimate. CSR calculation was not possible because recall bias by the participants for their date of surgery was found to be significant.

**Table 2** Crude prevalence (%) of aphakia/pseudophakia (unilateral or bilateral)

	Prevalence (%)		Prevalence (%)		Total
	Men	Women	<50 years	≥50 years	
Province					
Punjab	8.1	8.5	1.7	17.2	8.3
Sindh	9.6	7.8	1.0	20.2	8.6
NWFP	6.4	5.8	0.9	12.9	6.1
Balochistan	8.7	7.8	1.8	17.5	8.3
Dwelling					
Rural	8.5	7.7	1.4	17.6	8.1
Urban	7.3	8.0	1.3	17.9	7.7
Literacy					
Illiterate	4.5	1.7	0.9	11.3	3.7
Literate	11.3	8.9	1.7	18.3	9.4
Total	8.2	7.8	1.4	17.0	8.0

NWFP, North West Frontier Province.

**Table 3** Cataract surgical coverage in persons (%)

	Presenting VA <6/18			Presenting VA <6/60			Presenting VA <3/60		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
Province									
Punjab	43.1	42.4	42.7	69.3	69.7	69.4	76.9	74.8	75.7
Sindh	45.5	45.0	45.3	68.2	69.8	69.0	84.8	78.7	81.7
NWFP	43.4	40.7	42.0	71.8	64.5	68.1	79.8	70.6	75.0
Balochistan	53.6	44.2	49.2	77.2	59.5	68.6	78.9	71.8	75.7
Age (years)									
<50	47.2	35.4	39.5	72.0	65.3	67.7	73.1	71.8	72.4
≥50	44.4	43.9	44.2	70.0	68.9	69.3	80.0	75.3	77.6
Dwelling									
Rural	43.6	41.8	42.7	68.9	67.4	68.1	77.9	74.0	75.9
Urban	47.3	45.3	46.2	73.2	71.0	72.0	83.9	76.9	80.0
Literacy									
Literate	51.2	40.0	50.0	81.8	70.5	80.5	89.7	71.4	87.9
Illiterate	43.0	43.0	43.0	67.3	68.5	68.0	77.2	75.1	76.0
Total	44.6	42.8	43.7	70.1	68.4	69.3	79.6	74.9	77.1

VA, Visual acuity.

### Cataract surgical coverage

CSC gives important information about the uptake of cataract surgical services. The indicator measures the proportion of individuals (or eyes) with operable cataract (that can be defined at different visual acuity cut-offs) who have accessed services. Comparison with data from other studies needs caution, as different formulae are in use. For example, some studies have used a formula that only includes participants if they are blind with bilateral cataract, and unilateral pseudo/aphakes with “operable cataract” in the other eye.<sup>20–24</sup> The formula used for assessing CSC in our study was the same as that used in Nepal, Tibet and Bangladesh,<sup>25–27</sup> which tends to give lower but, we believe, more accurate estimations.

CSC for individuals at <6/0, <6/60 and <6/18 cut-offs were 77%, 69% and 44%, respectively. Lower CSC at better visual acuity cut-offs are to be expected, as the perceived need for surgery is less. There was little variation between provinces, which suggests that access is fairly uniform across the country. A recent rapid assessment survey in a remote part of Pakistan that lacks eye care services reported CSC data for individuals aged over 50 years at the <3/60 level. Coverage was 60.9% for persons and 46% for eyes.<sup>24</sup> In our study, coverage at the <3/60 level for participants aged 50 years and older was 77.6%. In our study, CSC at the <6/60 level for participants aged 50 years and older (69.3%) was lower than an urban area in Gujarat, India,<sup>22</sup> but comparable to 66% in Rajasthan, India,<sup>16</sup> 61% in Bangladesh<sup>27</sup> and 56% in Tibet.<sup>26</sup>

The new rapid assessment methodology<sup>27</sup> allows CSC assessments to be repeated every four to five years, which, together with CSR data, can be used to monitor and plan cataract services.

Variation in coverage was noted in relation to gender, place of residence, and level of education. Gender inequalities in uptake have been reported in many surveys, and globally women access cataract surgery at two-thirds the rate of men (OR 0.67, 95% CI 0.60 to 0.74).<sup>28</sup> In our study gender differences were most marked in NWFP and Balochistan, and a rapid assessment study conducted in NWFP had similar findings (CSC of 68.9% for men and 51.6% for women).<sup>24</sup> Although individuals living in urban areas had significantly higher CSC (80%) than those in rural areas (75.9%), this difference was not as marked as in India,<sup>16, 29</sup> suggesting that individuals from underserved rural areas are either traveling to urban areas for surgery, and/or outreach activities (where cases are detected in rural areas and operated on locally by an outreach team, or are operated on at the “base” hospital) are, to a large extent, reaching rural populations. Educated adults in Pakistan had a higher CSC than illiterate individuals (89% versus 81%) a finding that was also reported in the Indian studies.<sup>16, 29</sup> The inequalities in coverage identified in this survey provide evidence for those sectors of the population who need to be targeted.

### Barriers to accessing cataract services

In individuals with severe visual impairment or blindness caused by unoperated cataract, cost was the single most important barrier (76%), a finding that has already been reported in

**Table 4** Cataract surgical coverage in eyes (%)

	Presenting VA <6/18			Presenting VA <6/60			Presenting VA <3/60		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
Province									
Punjab	39.2	39.9	39.6	52.3	52.1	52.2	60.9	59.7	60.2
Sindh	42.1	41.1	41.6	52.9	54.5	53.7	67.8	64.0	65.9
NWFP	44.1	38.4	41.1	53.6	46.2	49.7	62.4	54.8	58.5
Balochistan	50.4	44.8	47.7	56.9	51.1	54.1	65.9	61.0	63.6
Age (years)									
<50	43.9	32.9	36.8	56.7	43.8	48.5	58.6	52.0	54.6
≥50	41.0	41.2	41.1	52.6	52.7	52.7	63.5	61.0	62.2
Dwelling									
Rural	39.6	38.6	39.1	51.4	49.6	50.5	61.3	58.2	59.8
Urban	45.7	43.4	44.4	56.9	55.8	56.3	67.6	63.3	65.2
Literacy									
Literate	48.2	47.5	48.1	62.2	59.2	61.8	71.4	65.9	70.7
Illiterate	36.9	40.0	39.7	50.4	51.4	51.0	60.7	59.7	60.2
Total	42.8	38.6	40.7	54.5	50.0	52.2	64.5	58.4	61.4

VA, Visual acuity.

Pakistan and many other developing countries.<sup>30-33</sup> The cost of surgery could be reduced by: (a) improving efficiency by conducting high volume cataract surgery and thus reducing unit costs<sup>34</sup>; (b) decreasing the cost of consumables (e.g. cheaper intraocular lenses) through bulk purchasing; and (c) allowing flexible/tiered pricing systems that are based on the paying capacity of the population, thus allowing even the poorest patients to have ophthalmic care. In most communities, patients are willing to pay the equivalent of one month's wages for a cataract operation.<sup>35</sup>

It is likely that the associations identified (although not statistically significant as a result of small numbers) are real and identify high-risk groups (i.e. women, rural dwellers and illiterate adults) that require economic flexibility in order to access surgical care.

Other barriers, which largely reflected a lack of understanding of cataract and its current management, or fear of surgery, were quoted in just over one fifth of participants. This represents an opportunity for health education, which will need to take account of the very high levels of illiteracy found among individuals with operable cataract (93%).

## CONCLUSION

Although this survey found the CSC (<3/60) to be 77.1%, there remain inequalities in service delivery, with women, individuals living in rural areas and those who are illiterate having lower surgical coverage. An estimated 570 000 individuals are bilaterally blind from cataract in Pakistan, and there are estimated to be 3 560 000 eyes with a visual acuity of <6/60 as a result of cataract. Cost is the most frequently reported barrier to accessing eye care services in Pakistan.

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