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WORLD VIEW

Outcomes of cataract surgery in Pakistan: results from The Pakistan National Blindness and Visual Impairment Survey

Rupert Bourne, Brendan Dineen, Zahid Jadoon, Pak S Lee, Aman Khan, Gordon J Johnson, Allen Foster, Daud Khan

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See end of article for authors' affiliations

Correspondence to: Dr R Bourne, Clinical Research Unit, Department of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, England; rupert.bourne@lshtm.ac.uk

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Aim: To evaluate the outcomes of cataract surgery in Pakistan.
Methods: Cross-sectional, nationally representative sample of 16 507 adults (aged ⩾30 years). Each underwent interview, logarithm of the minimum angle of resolution visual acuity (VA), autorefraction, examination of optic disc. Those with <6/12 VA on presentation underwent best-corrected VA and dilated biomicroscopic ocular examination.
Results: 1317 subjects (633 men) had undergone surgery in one or both eyes. Of the 1788 operated eyes, 1099 (61%) had undergone intracapsular cataract extraction (ICCE) and 607 (34%) extracapsular surgery with an intraocular lens (ECCE+IOL). Presenting VA: 275 (15.4%) eyes: 6/12 or better; 253 (14.1) <6/12 ⩾6/18; 632 (35.3%) 6/18 to 6/60; 85 (4.8%): 6/60 to 3/60; 528 (29.5%): <3/60. With ''best'' refractive correction, these values were: 563 (31.5%), 332 (18.6%), 492 (27.5%), 61 (3.4%), 334 (18.7%), respectively. Of the 1498 eyes with VA ⩽6/12 on presentation, 352 (23.5%) were the result of coincident disease, 800 (53.4%) refractive error and 320 (21.4%) operative complications. Eye camp surgery (OR 1.72, p=0.002), ICCE (OR 3.78; p<0.001), rural residence (OR 1.36, p=0.01), female gender (OR 1.55, p<0.001) and illiteracy (OR 2.44, p<0.001) were associated with VA of <6/18. More recent ICCE surgeries were associated with a poorer outcome. The ratio of ECCE+IOL:ICCE in the last 3 years was 1.2:1, compared with 1:3.3 ⩾4 years before the survey.
Conclusion: Almost a third of cataract operations result in a presenting VA of <6/60, which could be halved by appropriate refractive correction. This study highlights the need for an improvement in quality of surgery with a more balanced distribution of services.

The National Blindness and Low Vision Survey of Pakistan (2001–3) comprised a nationally representative population-based survey of eye disease. This survey is one of the largest of its kind worldwide and follows a previous population-based survey (1988–90).[1] Despite the previous survey being less rigorous in terms of sampling strategy and diagnostic methodology, it served its purpose at the time, and it provided the basic data for the National Committee for Prevention of Blindness (formed in 1990), which began to implement expanded eye-care services in Pakistan. The recent survey[2] incorporated a method that facilitated the detection of diseases of the posterior segment, the importance of which has been highlighted in two recent low vision and blindness surveys in Bangladesh[3 4] and India.[5–7] Cataract and uncorrected refractive error were the most common causes of reduced bilateral visual impairment and blindness in the recent survey.

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 VA of worse than 6/18, with as many as 50% worse than 6/60.[8–11] Fewer surveys have measured outcomes based on best-corrected VA, however, several have reported up to 20% of eyes with corrected VA of <6/60.[8 9 11]

Eye-care services in Pakistan are provided by the government, local and international non-governmental organisations and charitable organisations. The non-governmental organisations play important funding, collaborative and logistical roles with service providers in Pakistan. The 1800 trained, qualified ophthalmologists of Pakistan 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 (ECCE+IOL) surgery.

The objective of this report was to establish the visual outcomes of cataract surgery in Pakistan and to investigate factors associated with poor outcomes.

METHODS

The method used in the Pakistan National Blindness and Visual Impairment Survey has been described in detail elsewhere.[2]

Based on the target-age population of ⩾30 years (44.7 million persons), a blindness prevalence estimate of 1.8% for adults of Pakistan, a random sampling error of 0.3% with a design effect of 2 owing to the cluster sampling strategy, a sample size of 16 600 subjects was determined.

Multistage stratified cluster random sampling, with probability proportional-to-size 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)[12] was incorporated in the process of sample-selection. Within each of the four provinces of Pakistan, a proportional number of clusters in relation to the overall national population were identified based on official census data. A total of 221 cluster sample sites were selected by probability proportional to size of which 112 were rural villages while the remaining 109 were urban block areas. For logistical purposes, the rural cluster areas consisted of 100

Abbreviations: ECCE+IOL, extracapsular cataract extraction with intraocular lens; ICCE, intracapsular cataract extraction; IOL, intraocular lens; logMAR, logarithm of the minimum angle of resolution; NWFP, North West Frontier province; VA, visual acuity; Nd:YAG, neodymium–yttrium–aluminium–garnet; YAG, yttrium–aluminium–garnet.

subjects, while the urban study areas consisted of 50 subjects each.

An ophthalmologist (RB), two epidemiologists (BD and MZJ) and a specialist in ophthalmic instruments (PSL) were responsible for training members of the survey team concerning enumeration, interviewing and the ophthalmic examination process. Three separate survey teams (each with two ophthalmologists) were appointed, one each from the North West Frontier province (NWFP), the Punjab province and the Sindh province. The Punjab team was also designated to survey the sparsely populated province of Balochistan. The survey commenced in March 2002 and was completed by September 2003.

The examination began with an interview in which the interviewer checked whether the individual was an enumerated subject. Demographic data such as age and sex were collected in addition to specific information such as 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 VA was measured with a reduced logMAR-based (logarithm of minimum angle of resolution) tumbling E chart.[13 14] 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, Tokyo, Japan), performed by trained medical technicians. Subjects with <6/12 VA on presentation in either eye were tested again for VA in each eye with their autorefraction result placed in a trial frame using trial lenses.

The subjects were asked by the ophthalmologist whether they had been previously treated 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 the history from the patient and subsequent findings from the examination based on clinical biomicroscopy using a slit lamp. Direct ophthalmoscopy was used to measure the cup to disc ratio in each eye. Eyes of all subjects with <6/12 VA in either eye were subsequently dilated (following a check for relative afferent pupil defect), and the cup to disk ratio checked again at that stage, in addition to an examination of the retina. Digital photographs (Nidek NM-100, Nidek, Aichi, Japan) of the optic disc and macula were taken if retinal disease was noted during the dilated fundal examination. Validation of the cause of reduced vision made by the ophthalmologist on the record sheet was achieved by checking these photographs independently at the Moorfields Eye Hospital Reading Centre (Moorfields Eye Hospital, London, UK).

Cases of glaucoma were defined using the International Society of Geographical and Epidemiological Ophthalmology scheme,[15] which classifies cases of glaucoma according to three levels of evidence or categories. Ascertainment of cases of glaucoma is described in detail elsewhere.[2]

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

The Pakistan Medical Research Council provided written ethical approval in March 2002. Oral informed consent was sought from each subject by the ophthalmic assistant, after explaining the procedures to be conducted. This study followed the tenets of the Declaration of Helsinki.

Data analysis

The VA of a given eye or that for a subject (VA 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, >0.30–1.00); 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 VA was defined as the VA 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 of eyes such as type of surgery, VA postoperatively and certain demographic variables (age group, sex, urban vs rural residence). Data management and analysis were carried out in Epi Info (V.6.04b), MS Excel, and MS SPSS (V.11.0.2).

RESULTS

The national survey examined 16 507 individuals aged ⩾30 years (7741 (46.9%) men and 8766 (53.1%) women). The overall response rate for the survey was 95.5% (women 97%, men 93%). Of the subjects examined, 11 084 (67.1%) were from rural and 5423 (32.9%) from urban areas.

In all, 1317 adults, 633 men and 684 women had undergone cataract surgery in one (844 (64.1%) subjects) or both eyes (472 (35.8%) subjects). The time of surgery was recorded from 1269 subjects (96.4%), enabling the age of subjects to be calculated at the time of surgery. The age of subjects at the time of surgery ranged from 8 to 105 years (mean (SD) 59.6 (13.2) years).

Table 1 illustrates the presenting and best-corrected visual outcome of the 1788 operated eyes in relation to demographic variables.

Intracapsular cataract surgery had been performed on 1099 (61.5%) eyes and 607 (33.9%) eyes underwent ECCE+IOL. The ratio of ECCE+IOL:ICCE in the last 3 years was 1.2:1, quite different to a ratio of 1:3.3 ⩾4 years before the survey.

There was no significant sex, urban/rural, literacy or hospital/eye camp difference between subjects with unilateral versus bilateral surgeries. Of the 1728 cataract surgeries where the operative location was identified, 248 (14.3%) had taken place in eye camps and 1480 (85.6%) in hospitals. There was no significant difference in the ratio of eye camp to hospital surgeries before and after 3 years of the survey. In hospitals, the ratio of ICCE: ECCE+IOL was 1.62:1 (number of eyes, 877:541), whereas in eye camps, the ratio of ICCE: ECCE+IOL was 3.25:1 (number of eyes, 182:56). Subjects living in rural areas were more likely (OR 1.87; 95% CI 1.36 to 2.58, p<0.001) to have surgery performed in eye camps than in a hospital.

Of the 1788 cataract-operated eyes, 275 (15.4%) had a presenting VA of 6/12 or better, 253 (14.1) were <6/12 to 6/18, 632 (35.3%) were <6/18 to 6/60, 85 (4.8%) were <6/60 to 3/60, and 528 (29.5%) <3/60 (VA was not recorded in 15 eyes). With ''best'' refractive correction, these values were 563 (31.5%), 332 (18.6%), 492 (27.5%), 61 (3.4%) and 334 (18.7%), respectively.

Of the 1317 subjects who had had a cataract operation in one or both eyes, 300 (22.8%) had a presenting VA of 6/12 or better, 240 (18.2%) were <6/12 to 6/18, 484 (36.8%) were <6/18 to 6/60, 79 (6.0%) were <6/60 to 3/60 and 211 (16.0%) <3/60 (VA was not recorded in 3 eyes). With ''best'' refractive correction these values were 543 (41.2%), 250 (19.0%), 346 (26.3%), 43 (3.3%) and 132 (10.0%), respectively.

Of the 1773 eyes where VA was measured, 1498 (84.5%) had a presenting VA worse than 6/12. Of the 1484 eyes where a cause was found, 808 (54.4%) had poor vision on account of refractive error, 353 (23.8%) due to coincident disease and 323 (21.8%) due to operative complications. Of eyes that saw <6/12 postoperatively, coincident disease was not more likely (p = 0.99) to be the principal cause (as supposed to refractive

Table 1 Univariate distribution of outcome of cataract surgery

		Outcome as a result of any cause					
		Presenting (%)			Best corrected (%)		
Variable	n, eyes*	Good	Borderline	Poor	Good	Borderline	Poor
Type of surgery							
ICCE	1099 (5, 4)	210 (19.2)	395 (36.1)	489 (44.7)	454 (41.5)	353 (32.2)	288 (26.3)
ECCE+IOL	607 (9, 1)	297 (49.7)	219 (36.6)	82 (13.7)	411 (67.8)	130 (21.5)	65 (10.7)
ICCE wearing habitual glasses	707 (2, 2)	208 (29.5)	344 (48.8)	153 (21.7)	348 (49.4)	241 (34.2)	116 (16.5)
ECCE+IOL with glasses	73 (0, 0)	39 (53.4)	22 (30.1)	12 (16.4)	47 (64.4)	16 (21.9)	10 (13.7)
ECCE+IOL without glasses	497 (8, 1)	240 (49.1)	181 (37)	68 (13.9)	340 (68.5)	103 (20.8)	53 (10.7)
Duration between surgery and survey (years)†							
⩽3	850 (5, 2)	279 (33)	303 (35.9)	263 (31.1)	466 (55)	227 (26.8)	155 (18.3)
4–8	542 (2, 2)	173 (32)	177 (32.8)	190 (35.2)	274 (50.7)	141 (26.1)	125 (23.1)
⩾9	339 (3, 2)	68 (20.2)	134 (39.9)	134 (39.9)	135 (40.1)	107 (31.8)	95 (28.2)
Age at time of survey (years)							
30–39	43 (1, 1)	17 (40.5)	13 (31.0)	12 (28.6)	25 (59.5)	9 (21.4)	8 (19)
40–49	116 (1, 0)	44 (38.3)	34 (29.6)	37 (32.2)	69 (59.5)	24 (20.7)	23 (19.8)
50–59	298 (0, 0)	110 (36.9)	96 (32.2)	92 (30.9)	184 (61.7)	61 (20.5)	53 (17.8)
60–69	536 (7, 1)	176 (33.3)	183 (34.6)	170 (32.1)	298 (55.7)	139 (26)	98 (18.3)
70–79	474 (5, 3)	125 (26.7)	180 (38.4)	164 (35)	212 (45)	150 (31.8)	109 (23.1)
⩾80	321 (1, 1)	56 (17.5)	126 (39.4)	138 (43.1)	106 (33.1)	109 (34.1)	104 (32.5)
Sex							
Male	867 (10, 3)	287 (33.5)	284 (33.1)	286 (33.4)	450 (52.1)	215 (24.9)	199 (23)
Female	921 (5, 3)	241 (26.3)	348 (38)	327 (35.7)	445 (48.5)	277 (30.2)	196 (21.4)
Urban/rural							
Urban	577 (6, 2)	198 (34.7)	213 (37.3)	160 (28.0)	311 (54.1)	160 (27.8)	104 (18.1)
Rural	1211 (9, 4)	330 (27.5)	419 (34.9)	453 (37.7)	584 (48.4)	332 (27.5)	291 (24.1)
Literacy							
Literate	246 (4, 0)	117 (48.3)	72 (29.8)	53 (21.9)	168 (68.3)	42 (17.1)	36 (14.6)
Illiterate	1542 (11, 6)	411 (26.8)	560 (36.6)	560 (36.6)	727 (47.3)	450 (29.3)	359 (23.4)
Operation site‡							
Hospital	1480 (13, 5)	460 (31.4)	520 (35.4)	487 (33.2)	763 (51.7)	397 (26.9)	315 (21.4)
Eye camp	248 (1, 0)	55 (22.3)	93 (37.7)	99 (40.1)	111 (44.8)	78 (31.5)	59 (23.8)
Province							
Baluchistan	105 (0, 0)	33 (31.4)	38 (36.2)	34 (32.4)	53 (50.5)	28 (26.7)	24 (22.9)
Punjab	981 (7, 2)	270 (27.7)	370 (38)	334 (34.3)	474 (48.4)	291 (29.7)	214 (21.9)
NWFP§	271 (4, 3)	94 (35.2)	80 (30)	93 (34.8)	152 (56.7)	55 (20.5)	61 (22.8)
Sindh	431 (4, 1)	131 (30.7)	144 (33.7)	152 (35.6)	216 (50.2)	118 (27.4)	96 (22.3)

ECCE+IOL, extracapsular cataract extraction with intraocular lens; ICCE, intracapsular cataract extraction; NWFP North West Frontier province.
Best-corrected vision is the VA using the result from the autorefraction. Autorefraction was performed on all eyes but only eyes that had <6/12 VA on presentation, had a best-corrected VA measured.
*The numbers in parentheses refer to the numbers of eyes where there was no record of the presenting visual acuity (VA) or best-corrected VA, respectively. The denominator used for calculating percentages is the number of eyes within each particular variable category (eg, male or female) minus the number of eyes where the VA was not measured.
†The time since surgery was not known in 57 eyes.
‡The site of operation for 12 eyes was not known.
§North-West Frontier Province includes the Northern areas and Azad Kashmir regions in this analysis.

error or operative complications) in an eye-camp surgery than in a hospital-based surgery.

Table 2 categorises visual outcome (presenting vision) of eyes into those with <6/18 to 6/60 VA (''borderline'' visual outcome) and those with <6/60 (''poor'' visual 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 and is illustrated in table 3.

Eye camp surgery (OR 1.72, p = 0.002), ICCE (OR 3.78; p<0.001), rural residence (OR 1.36, p = 0.01) and female sex (OR 1.55, p<0.001) were more likely to result in a VA of <6/18 than hospital-based surgeries, ECCE+IOL, urban residence or male sex, respectively. Surgeries performed in the province of Punjab were significantly more likely to be associated with a <6/18 (OR 1.4, p = 0.02) outcome than those in NWFP, but there were no other significant differences between provinces.

The ratio of ICCE to ECCE+IOL surgeries in rural areas was 2.3:1 whereas in urban areas it was 1.0:1.1 (p<0.001). Women were significantly more likely to have undergone ICCE surgery rather than ECCE+IOL surgery than men (OR 1.43, 95% CI 1.17 to 1.74, p<0.001).

Following ICCE (1099 eyes), 90 (12.7%) of the 707 eyes with an aphakic spectacle correction achieved 6/12 or better. Eyes operated by ICCE in an eye camp were no more likely to result in a presenting VA outcome of <6/18, than hospital-based ICCE. 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 VA of <6/60, than those performed more than 3 years before the survey (OR 1.43, 95% CI 1.04 to 1.95, p = 0.032). Of the ECCE+IOL surgeries 49.7%, 36.6% and 13.7% achieved a good, borderline and poor presenting VA outcome, respectively. With refractive correction, the visual acuities

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

		Presenting visual acuity as a result of surgical or a refractive error		
	Eyes (n)	Poor (<6/60)	Borderline (<6/18 to 6/60)	Others (n)
Type of surgery				
ICCE	817	305 (37.3)	308 (37.7)	204 (25)
ECCE+IOL	519	45 (8.7)	185 (35.6)	289 (55.7)
ICCE wearing habitual glasses	546	79 (14.5)	265 (48.5)	202 (37)
ECCE+IOL with glasses	61	6 (9.8)	17 (27.9)	38 (62.3)
ECCE+IOL without glasses*	458	39 (8.5)	168 (36.7)	251 (54.8)
Duration between surgery and survey†				
⩽3 years				
ICCE	308	134	110	64
ECCE+IOL	368	31	135	202
All	698	176 (25.2)	250 (35.8)	272 (38.9)
4–8 years				
ICCE	298	105	110	83
ECCE+IOL	120	10	37	73
All	442	122 (27.6)	152 (34.4)	168 (38)
⩾9 years				
ICCE	186	54	81	51
ECCE+IOL	27	4	11	12
All	222	60 (27)	96 (43.2)	66 (29.7)
Age at survey (years)				
30–39	38	9 (23.7)	12 (31.6)	17 (44.7)
40–49	94	26 (27.7)	24 (25.5)	44 (46.8)
50–59	258	59 (22.9)	90 (34.9)	109 (42.2)
60–69	427	106 (24.8)	154 (36.1)	167 (39.1)
70–79	364	102 (28.0)	139 (38.2)	123 (33.8)
⩾80	214	70 (32.7)	90 (42.1)	54 (25.2)
Sex				
Male	664	155 (23.3)	229 (34.5)	280 (42.2)
Female	731	217 (29.7)	280 (38.3)	234 (32)
Urban/rural				
Urban	466	110 (23.6)	162 (34.8)	194 (41.6)
Rural	929	262 (28.2)	347 (37.4)	320 (34.4)
Literacy‡				
Literate	210	32 (15.2)	62 (29.5)	116 (55.2)
Illiterate	1185	340 (28.7)	447 (37.7)	398 (33.6)
Operation site§				
Eye Camp	190	63 (33.2)	76 (40)	51 (26.8)
Hospital	1166	295 (25.3)	420 (36)	451 (38.7)

ECCE+IOL, extracapsular cataract extraction and intraocular lens; ICCE, intracapsular cataract extraction.
*This includes those eyes where the prescribed glasses were not brought to the survey station either because of forgetfulness or because they had never been worn despite prescription.
†14 eyes with poor outcome, 11 with a borderline outcome and 7 eyes with another outcome had no record of time since surgery.
‡Those persons describing their ability to read/write as ''with difficulty'' were categorised among those who claimed they could read easily, rather than those who reported that they could not read or write.
§Two eyes with other outcome three with borderline outcome, and three with poor outcome had no location recorded.

improved with 67.8%, 21.5% and 10.7% of eyes in each respective category.

Refractive error was the principal cause of <6/12 presenting vision in 808 eyes (54.4%). Among those eyes, 567 (70.2%) eyes were ICCE operations, of which 165 (29.1%) had never received an aphakic correction and 12 (2.1%) had received a correction but did not wear them. Of the 808 eyes, 218 (26.9%) were ECCE+IOL operations, of whom 185 (84.9%) were uncorrected and 8 (3.7%) had received a correction but did not wear the spectacles. Among those eyes which had undergone ICCE, there was no significant difference ($p>0.05$) in terms of rural/urban location, sex, eye camp/hospital surgical location or literacy between those wearing an aphakic correction and those without. Interestingly, more subjects who had had ICCE >3 years before the survey were likely to wear an aphakic correction (OR 1.43, 95% CI 1.08 to 1.89, $p = 0.013$), than those operated in the previous 3 years. Among those eyes which had undergone ECCE+IOL operations and with refractive error as the principal cause of <6/12 presenting vision, there was no significant difference in terms of rural/urban location or sex between those wearing spectacles and those who do not. However, the illiterate were more likely to have an unmet need for spectacle correction (OR 12.8, 95% CI 4.02 to 40.55, $p<0.001$).

Coincident disease and operative complications were responsible for <6/12 presenting VA in 676 (45.6%) of 1484 eyes. Table 4 presents the principal cause of reduced vision alongside best-corrected VA. The most common cause was posterior capsule/posterior hyaloid face opacification which accounted for 38.5% of these eyes with <6/12 best corrected VA. Of the

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	OR (95% CI) of a poor outcome*	OR (95% CI) of a borderline outcome†
Operative technique		
ICCE	6.27 (4.48 to 8.79)	2.36 (1.83 to 3.05)
ECCE+IOL	1	1
	p<0.001	p<0.001
Time since surgery (years)		
⩽3	1.71 (1.33 to 2.21)	0.87 (0.68 to 1.11)
>3	1	1
	p<0.001	NS
Operation site		
Eye camp	1.46 (1.05 to 2.04)	1.60 (1.09 to 2.34_
Hospital	1	1
	p=0.026	p=0.017
Sex		
Female	1.39 (1.09 to 1.76)	1.46 (1.14 to 1.87)
Male	1	1
	p=0.008	p=0.003
Rural/urban residence		
Rural	1.27 (0.98 to 1.64)	1.30 (1.00 to 1.68)
Urban	1	1
	p=0.072	p=0.049
Literacy		
Illiterate	2.24 (1.50 to 3.33)	2.10 (1.50 to 2.94)
Literate	1	1
	p<0.001	p<0.001

ECCE+IOL, extracapsular cataract extraction and intraocular lens; ICCE, intracapsular cataract extraction, NS, not significant.
*Poor outcomes are compared with borderline and ''good'' (6/12 or better) outcomes combined.
†Borderline outcomes are compared with ''good'' (6/12 or better) outcomes.

304 ECCE+IOL eyes with a best-corrected outcome of <6/12, 119(39.1%) had posterior capsule opacification. The next most common cause and the most-common of the coincident pathologies were central corneal opacity, accounting for 17.1%, followed by other operative complications (10.6%), glaucoma (10.1%) and age-related macular degeneration (7.5%).

Operative complications as a principal cause accounted for 46.8% of eyes with <6/18 best-corrected VA and 38.4% of those with <6/60. Of the 1484 eyes with a presenting VA of worse than 6/12 with a known cause, 323 (21.8%) were due to operative complications. Operative complications (as supposed to reasons of uncorrected refractive error or coincident disease) were no more likely in eye camps than in hospitals among ICCE surgeries (p = 0.87) nor among ECCE+IOL surgeries (p = 0.07), yet the latter approached significance. Operative complications were however more likely to be responsible for reduced vision (<6/12) among more recently (⩽3 years before the survey) ICCE-operated eyes (p = 0.003), whereas there was no significant difference among the ECCE+IOL group (p = 0.41).

Of all the ECCE+IOL-operated eyes (n = 607), only 6 (0.98%) had had a yttrium–aluminium–garnet (YAG) already. Of the 146 ECCE+IOLs that had posterior capsule opacification recorded as the principal cause of a presenting vision of <6/12, 5 (3.4%) had had noedymium–YAG (Nd:YAG) laser already. One of the 110 ECCE+IOL eyes with posterior capsule opacification had had a capsulotomy. There was no significant difference between those that had YAG laser treatment and those who had not (despite a requirement) between eyes operated within 3 years of the survey and eyes operated before that time (p = 0.15).

DISCUSSION

This is one of the largest cross-sectional analyses of cataract surgical outcomes to be performed with a population-based survey. Although the sample size chosen for the national survey was calculated according to estimates of prevalence of blindness, 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 (95.5%) also makes bias less likely.

In Pakistan, eye-care services are provided in hospital-based clinical services, which are usually based in urban areas, usually without outreach facilities, and in surgical eye camps which are often based in district hospitals. The majority of cataract surgeries in this survey had been performed in hospitals rather than eye camps (86% vs 14%) and, interestingly, the ratio of hospital to eye camp surgeries had not changed significantly within 3 years of the survey and prior to 3 years before the survey. This differs from findings by other surveys such as the Bangladesh National Blindness and Low Vision survey[11] and a study in Rajasthan,[10] where more recent surgeries were more frequently performed in a hospital setting than in the past. It has been suggested that the reason for this shift in emphasis from eye camps to hospitals was because of advances in surgical techniques and awareness of the need of high-quality surgery and good postoperative follow-up. The reason may simply be that this shift in emphasis from eye camps to hospitals has already occurred. Certainly, this survey has shown a recent change in the operative technique with ECCE+IOL-operated eyes outnumbering ICCE-operated eyes in the 3 years prior to the survey, whereas prior to this, the reverse was observed with ICCE operations outnumbering ECCE+IOL by 3.3:1.

This study has shown eye camp surgeries to be significantly more likely to result in a VA of <6/18 than hospital-based surgeries (after excluding cases with coexistent ocular pathology) when considering all cataract-operated eyes. Visual outcomes of cataracts operated using ICCE in hospitals were not significantly different to those operated in eye camps, a similar finding to that of the Bangladesh National survey.[11] This may be surprising in view of the fact that eye camps tend to be staffed by more junior doctors with less experience, and more commonly in rural areas with less access to refractive services. However, some of the ICCE operations performed in hospitals may have been failed ECCE+IOL surgeries. Operative complications were also more likely to be responsible for reduced vision (<6/12) among more recently (⩽3 years before the survey) ICCE-operated eyes (p = 0.003). Reports from surgical eye camps in India[16 17] have shown that good results can be obtained provided that surgeons are appropriately skilled (specifically, in posterior segment examination), and that the camp is well organised, and these camps certainly have the advantage that they can be organised in rural areas serving people who are less able to obtain the surgery. Many such eye camps in Pakistan are, in fact, organised in district hospital facilities.

The ability to obtain a best-corrected VA in all subjects who presented with a VA acuity of <6/12 in either eye, was the particular strength of this survey. When comparing best-corrected outcomes with presenting outcomes, the impact of uncorrected refractive error was readily appreciated. ICCE-operated eyes fared worse on presentation than the ECCE+IOL-operated eyes. Another study in Pakistan, based in a very underdeveloped tribal area (Orakzai Agency)[18] also reported worse outcomes with non-intraocular lens (IOL) surgeries, reporting 67% with a poor outcome (<6/60), 33% with a

Table 4 Principal cause of reduced best-corrected vision in operated eyes

Cause	Best corrected visual acuity, n (%)			
	<6/12 to 6/18	<6/18 to 6/60	<6/60 to 3/60	<3/60
Posterior capsule/hyaloid face opacification*	43 (66.2)	111 (49.8)	24 (47.1)	65 (22.3)
Other operative complications†	2 (3.1)	22 (9.9)	2 (3.9)	41 (14)
Central corneal opacity	3 (4.6)	29 (13.0)	6 (11.8)	70 (24)
Glaucoma	3 (4.6)	8 (3.6)	4 (7.8)	49 (16.8)
Age-related macular degeneration	6 (9.2)	9 (4.0)	7 (13.7)	25 (8.6)
Diabetic retinopathy	3 (4.6)	7 (3.1)	2 (3.9)	7 (2.4)
Amblyopia		8 (3.6)		7 (2.4)
Optic atrophy		5 (2.2)	1 (2)	8 (2.7)
Retinitis pigmentosa	1 (1.5)	3 (1.3)		1 (0.3)
Other anterior segment pathology		2 (0.9)		2 (0.7)
Other maculopathy‡	2 (3.1)	3 (1.3)	1 (2)	4 (1.4)
Vitreous haemorrhage			1 (2)	2 (0.7)
Pathology suspected but unconfirmed	2 (3.1)	16 (7.2)	3 (5.9)	11 (3.8)
All	65 (100)	223 (100)	51 (100)	292 (100)

*119 were ECCE+IOL (32 saw <6/12 to 6/18, 62 saw <6/18 to 6/60, 9 saw <6/60 to 3/60, 16 saw <3/60); 122 were ICCE (10 saw <6/12 to 6/18, 49 saw <6/18 to 6/60, 15 saw <6/60 to 3/60, 48 saw <3/60); 2 were couched (1 saw <6/12 to 6/18, 1 saw <3/60).
†Excluding posterior capsule opacification.
‡For example, myopic maculopathy, macular dystrophy, macular hole.

borderline outcome (<6/18 to 6/60) and none with a good outcome (6/6 to 6/18). IOL surgeries had outcomes of 13%, 74% and 12%, respectively.

A striking finding of this study was the number of uncorrected aphakes, almost 30% of ICCE-operated eyes (with refractive error being the principal cause of <6/12 vision) that had never been corrected with a spectacle lens since surgery. Although ECCE+IOL-operated eyes had better outcomes, 85% of those with <6/12 vision would have improved with a refractive correction, yet no refractive correction was worn. Unlike the study in Bangladesh[11] where women, rural dwellers, illiteracy and eye camp surgeries were significantly associated with a lack of aphakic correction, no such associations were observed in the Pakistan survey. However, it was interesting to note that more recently (within 3 years of the survey), an aphakic correction was less likely to be worn after an ICCE. Only 2% of ICCE-operated and 4% of ECCE+IOL-operated eyes had received a correction spectacles, but did not wear them.

Posterior capsule/posterior hyaloid face opacification accounted for 38% of eyes with a postoperative best-corrected acuity of <6/12. Approximately 40% of ECCE+IOL eyes had posterior capsule opacification, whereas 5% of ICCE eyes had opacification of the posterior hyaloid face. The contribution of posterior capsule opacification seems very high but it is not different from the Rajasthan study[10] (40 pseudophakic eyes) where 5 of 13 (38.4%) pseudophakic eyes with a presenting VA of <6/18 had posterior capsule opacification. The Sivanganga study[19] (pseudophakic eyes) reported that 23% of ECCE+IOL eyes that saw <6/18 presenting had posterior capsule opacification. The high prevalence of posterior capsule opacification is alarming in view of the fact that there are very few Nd:YAG laser facilities outside tertiary level centres (based in urban areas) in Pakistan, and an increasing proportion of ECCE+IOL surgeries are now being performed. This was reflected in the finding that only 3% of ECCE+IOLs that had posterior capsule opacification recorded as the principal cause of a presenting vision of <6/12 had already had Nd:YAG laser treatment. Possible solutions to this escalating problem may be the provision of low-cost IOLs of a shape and material that reduces the risk of posterior capsule opacification and/or the provision of more laser facilities at district level.

Operative complications were the principal cause for 47% of eyes with <6/18 best-corrected VA and 38.4% of those with <6/60. The same analysis for the Bangladesh national survey[11] resulted in 17% and 46%, respectively. The Rajasthan study[10] also identified surgical complications as the principal cause of visual impairment or blindness, in a quarter of operated eyes and evident in half of all eyes examined. These findings emphasise the importance of maintaining quality of surgery when increasing the number of surgeries.

The survey highlighted important geographical associations with cataract surgical outcomes. Cataract surgeries performed on subjects in rural areas were more likely to be associated with a poor outcome than urban subjects, and there was a higher likelihood of an ICCE technique or an eye camp surgery in rural areas, with both these factors associated with poorer outcomes. Both the Rajasthan[10] and Sivaganga surveys[19] also reported better outcomes among subjects from urban areas than those from rural areas. Surgeries performed in the Punjab province were significantly more likely to be associated with a <6/18 outcome than those in NWFP, but there were no other significant differences between provinces.

The relationship between sex and cataract surgical outcomes differs between surveys in the region. The Pakistan survey found female sex to be associated with worse presenting vision, as did the Rajasthan study,[10] while the Sivaganga study[19] found no sex difference. Earlier in this report, we alluded to the gender issues surrounding the wearing of spectacles. These issues contribute to the uncorrected refractive error component of poor outcomes. Yet, there may also be sex differences in access to quality surgery, availability of resources for postoperative management and care, and perceived need (which may or may not be occupational) for refractive correction. Also, women were significantly more likely to have had ICCE surgery than men in this survey. The poorer outcomes are particularly important in view of the higher prevalence of cataract blindness in women noted in the Pakistan survey[20] and elsewhere in the world.

In conclusion, this study has reported presenting and best corrected visual cataract surgical outcomes for a nationally representative sample of adults. The fact that only a third of cataract surgeries resulted in a presenting VA of 6/18 or better is of great concern. However, the recent shift in operative technique from ICCE to ECCE+IOL noted by the survey should herald an improvement in outcomes, particularly once surgeons are experienced with the new technique. Studies performed by various institutions in Pakistan and India have shown how better outcomes can be attained despite high numbers[21–23] and how the economic cost of cataract surgery can be relatively low.[24] Evidence of a significant improvement in eye-care services has been obtained from the results of the Pakistan survey, with lower rates of blindness[25] compared with the last national survey (1998–2000[1]). Even poverty-stricken, underdeveloped areas of Pakistan have seen an improvement in surgical outcomes in recent years.[19] It is intended that the results of this survey and, in particular, the identification of those at risk of a poor outcome will be used to continue to improve the outcomes of cataract surgery in this country.

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Authors' affiliations

Rupert Bourne, Department of Ophthalmology, Hinchingbrooke Hospital, Hinchingbrooke Park, Huntingdon, Cambridgeshire, England
Brendan Dineen, Gordon J Johnson, Allen Foster, Clinical Research Unit, Department of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, England
Zahid Jadoon, Aman Khan, Daud Khan, Pakistan Institute of Community Ophthalmology, Khyber Institute of Ophthalmic Medical Sciences, Peshawar, Pakistan
Pak S Lee, Department of Epidemiology and International Eye Health, Institute of Ophthalmology, University College London & Moorfields Eye Hospital, London, England

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