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ORIGINAL ARTICLE

Prevalence and vision-related outcomes of cataract surgery in Gujarat, India

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ABSTRACT

Purpose: Investigate the prevalence and vision-related outcomes of cataract surgery in an area of high cataract surgical rate.
Methods: Cluster sampling was used in randomly selecting individuals ≥ 50 years of age in 2007. Participants were queried regarding year and place of previous cataract surgery. Cataract surgical procedures and evidence of surgical complications were recorded. The principal cause was identified for eyes presenting with visual acuity (VA) ≤ 20/40.
Results: A total of 4,738 persons were examined and 834 (17.6%) had cataract surgery. Intra-ocular lenses (IOLs) were used in 84.1% of the 1,299 cataract-operated eyes, with more than half of these having manual small incision surgery. Surgical coverage among the cataract blind (visual acuity [VA] < 20/200) was estimated as 72.2%. Coverage was associated with older age, literacy, and urban residence; gender was not significant. Among cataract-operated eyes, 18.7% presented with VA ≥ 20/32 and 18.0% were < 20/200. With best-corrected acuity, the corresponding percentages were 55.7% and 11.0%. Presenting and best-corrected VA ≥ 20/63 were associated with young age, literacy, and IOL surgery; urban residence and surgery in non-governmental organizations (NGO)/private facilities were also significant for presenting VA; and recent surgery was significant for best-corrected VA. Refractive error was the main cause of vision impairment/blindness in cataract-operated eyes.
Conclusions: Refractive error and posterior capsule opacification, easily treatable causes of visual impairment, are common among the operated. A greater emphasis on the quality of visual acuity outcomes along with sustained efforts to provide access to affordable surgery is needed.

KEYWORDS: Blindness; Cataract surgery; India; Surgical complications; Visual outcome

INTRODUCTION

Despite improvements in cataract surgical services in many parts of the world, cataract remains responsible for half of the global blindness burden.[1] A decade ago it was estimated that there are 100 million eyes with visual acuity < 20/200 in need of cataract surgery,

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triggered by population growth and increasing life expectancy especially in developing countries.[2]

Population based surveys among older populations have shown that cataract is the predominant cause of severe visual impairment/blindness in India.[3–9] In response to this cataract blindness burden, the Government of India negotiated with the World Bank a special project for the elimination of cataract blindness in 1994, with assistance worth USD ($) 117.8 million over a 7 year period.[10] This project produced a paradigm shift in ophthalmic surgical practice, which resulted in dramatic changes in both the quantum and technology for cataract surgery, even in regions of the country that were not explicitly included in the project. The annual number of cataract surgeries in India increased from 1.2 million in 1990 to 4.8 million in 2006.[11,12] In a country where relatively few patients received an intra ocular lens (IOL) implant in the early nineties, 90% of all cataract surgery in 2006 included an IOL.[12]

The western state of Gujarat saw a dramatic revolution in cataract surgical services, reporting cataract surgical rates (CSRs) that exceeded 10,000 per million population.[13] Navsari district, one of the districts with a high CSR, was chosen for the present study with the objective of discerning the impact of a high CSR on the prevalence of blindness, surgical coverage among the cataract- blind, and vision-related outcomes after cataract surgery. Even before the World Bank Project, CSR in Gujarat was higher than other parts of the country. Though no published evidence is available, the availability of skilled surgeons, access to services in terms of distances that need to be traversed to reach a surgical facility and a higher proportion of the population having the capacity to pay for services may all have contributed to this trend.

MATERIAL AND METHODS

The study population was selected using randomized cluster sampling, where clusters of approximately equal population size were geographically defined on the basis of Navsari Census information. Persons ≥ 50 years of age were enumerated through a door-to-door survey and invited to a temporary examination site, generally a primary health center or school, for ophthalmic assessment. A temporary examination site was required for refraction and dilated eye examination wherever needed. Written informed consent was obtained at the examination site in the presence of a local witness. The examination protocol, similar to that used in earlier studies in India,[5–7] Nepal,[14] China,[15–17] and Brazil,[18] was cleared by the World Health Organization (WHO) Secretariat Committee on Research Involving Human Studies. Implementation of the study in Gujarat was approved by the Ethics Committee of the All India Institute of Medical Sciences in New Delhi and by the Institutional Review Board of SEWA-Rural in Bharuch, India. The study adhered to guidelines of the Declaration of Helsinki.

Ophthalmic assistants measured presenting distance visual acuity (PVA), with spectacles if worn, using retro-illuminated LogMAR tumbling E charts. Those with PVA ≤ 20/40 in either eye were first auto-refracted and then underwent retinoscopy and subjective acceptance for determining best-corrected visual acuity (BCVA). Cataract-operated persons were queried as to the year and place of surgery for each operated eye. Slit-lamp examination of the anterior segment, lens and anterior vitreous along with intra-ocular pressure (IOP) measurement by Tonopen tonometer was performed. The type of cataract surgery, posterior capsule status, and signs of surgical complications were noted in the examination of cataract-operated eyes. Pupils of eyes with BCVA ≤ 20/40 were dilated for fundus examination. The principal cause of visual impairment/blindness was assigned using a 15-item list for eyes with PVA ≤ 20/40 by the examining ophthalmologist. Refractive error was assigned as the cause for eyes improving to ≥ 20/32 with best correction.

Further details regarding the enumeration of subjects, visual acuity measurements, and the ocular examination are contained in a companion article.[19]

The overall burden of cataract-related blindness was calculated as the sum of the un-operated blind because of cataract in one or both eyes plus the already operated who may have been bilaterally blind when first operated on for cataract. Because pre-operative status was not available, already-operated cases were presumed to have been bilaterally blind at the time of initial cataract surgery if both eyes were operated on or if only one eye had surgery and the un-operated fellow eye was blind.

Cataract surgical coverage was calculated for persons. Surgical coverage among the cataract blind was calculated as the ratio of the already operated to the un-operated plus the already operated, ie, the already operated divided by the cataract blindness burden. (To the extent that not all cataract-operated eyes were blind when operated on, as presumed, the surgical coverage rate is actually less than what is calculated.) The association of age, gender, level of education and rural/urban residence with cataract surgery, already operated cataract blindness, un-operated cataract blindness and surgical coverage was investigated with logistic regression.

In tabulating visual acuity (VA) outcomes, vision status was categorized as: normal/near normal vision,

≥ 20/32; mild visual impairment, 20/40 to 20/63; moderate visual impairment, < 20/63 to 20/200; moderate blindness (severe visual impairment), < 20/200 to 20/400; severe blindness, < 20/400. The association of age, gender, education, residence, time period of surgery, place of surgery and surgical procedure with PVA ≥ 20/63 and BCVA ≥ 20/63 was investigated with logistic regression.

The principal causes of visual impairment/blindness were tabulated by PVA categories. To remove the influence of refractive error, surgical complications were tabulated using BCVA.

Statistical analyses were performed using Stata Statistical Software, Release 8.0.[20] Confidence intervals for prevalence estimates and regression odds ratios were calculated taking cluster sampling design effects into account. P values ≤ 0.05 were considered statistically significant.

RESULTS

Over a 4-month period, March to June 2007, 5,158 study subjects were enumerated and 4,738 (91.9%) were examined. A total of 834 persons (1,299 eyes) had had cataract surgery, representing a cataract surgery prevalence of 17.6% (95% confidence interval [CI]: 15.3%–19.9%).

Two-thirds of the 1,299 cataract surgeries were conducted in 2002 or later. The distribution of cataract surgery by time period, as shown in Table 1, represents the cataract-operated individuals who were alive at the time of the survey. (Mortality disproportionately reduced the number of operated cases tabulated for the earlier years.) More than half of the surgeries (764 or 58.8%) were in hospitals managed by non-governmental organizations (NGOs), while another one-third (411 or 31.6%) were performed by surgeons in private hospitals. Of the operated eyes, 1,093 (84.1%) had an IOL implant, and 716 (65.5%) of these had manual small incision surgery (Manual SICS + IOL) (Table 1). With its introduction at the turn of the century, Manual SICS + IOL increased dramatically with a corresponding decrease in non-IOL surgery.

Of the 834 cataract-operated persons, unilateral aphakia was present in 40 (4.8%) and bilateral aphakia in 59 (7.1%)—including 11 eyes (six persons) with undetermined lens status. Unilateral pseudophakia was present in 329 (39.4%) and bilateral pseudophakia in 358 (42.9%); another 48 (5.8%) were pseudophakic in one eye and aphakic in the fellow eye. Among the 99 cataract-operated without an IOL, 56 (56.6%) were using spectacles for distance correction. Overall, 452 (54.2%) of the cataract operated were with spectacles, including 174 with bifocal/multi-focal correction.

Among the cataract-operated, 626 (75.1%) were presumed to have been bilaterally blind at the time of surgery (Table 2). An additional 241 (5.1%) were blind because of un-operated cataract. Thus, the cataract blindness burden included 867 (18.3%) of the 4738 study participants. Surgical coverage among the cataract blind was 72.2% (95% CI: 66.3%–78.1%).

Both cataract surgery as a whole and surgery among the cataract blind were associated with older age and urban residence (Table 3). Gender and education were

TABLE 1 Cataract operated eyes by place, type and year of surgery

	Year of cataract surgery											
	≤ 1998		1999–2001		2002–2004		≥ 2005		Unknown year		All	
Place of surgery	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Govt. hospital	25	11.0	14	6.9	30	6.5	22	5.5	1	11.1	92	7.1
Private hospital	78	34.4	83	40.7	152	33.1	98	24.5	0	0.0	411	31.6
NGO hospital	113	49.8	98	48.0	272	59.3	278	69.5	3	33.3	764	58.8
Outreach camps	6	2.6	9	4.4	5	1.1	2	0.50	0	0.0	22	1.7
Unknown	5	2.2	0	0.0	0	0.0	0	0.0	5	55.6	10	0.77
Type of surgery												
ICCE	71	31.3	11	5.4	2	0.4	2	0.5	0	0.0	86	6.6
ECCE	46	20.3	37	18.1	20	4.4	9	2.3	0	0.0	112	8.6
ECCE+PC-IOL	69	30.4	46	22.5	66	14.4	33	8.3	4	44.4	218	16.8
Phaco+ IOL	6	2.6	19	9.3	74	16.1	60	15.0	0	0.0	159	12.2
Manual SICS + IOL	32	14.1	91	44.6	295	64.3	293	73.3	5	55.6	716	55.1
Other/ undetermined	3	1.3	0	0.0	2	0.44	3	0.75	0	0.0	8	0.62
All	227	100.0	204	100.0	459	100.0	400	100.0	9	100.0	1299	100.0

NGO = Non-governmental organization; ICCE = intracapsular cataract extraction; ECCE = extracapsular cataract extraction; PC = Posterior Chamber; IOL = Intraocular lens; SICS = small-incision cataract surgery.

TABLE 2 Cataract surgery, presenting cataract blindness (< 20/200) and surgical coverage by age, gender, education and residence

	Number examined	Cataract operated				Un-operated cataract blind		Cataract blindness burden		% Surgical coverage
		All operated		Presumed blind						
		No.	Prevalence	No.	Prevalence	No.	Prevalence	No.	Prevalence	
Age (yrs)										
50–59	2595	169	6.5	115	4.4	70	2.7	185	7.1	62.2
60–69	1406	316	22.5	222	15.8	90	6.4	312	22.2	71.2
70+	737	349	47.4	289	39.2	81	11.0	370	50.2	78.1
Gender										
Male	2153	368	17.1	281	13.1	91	4.2	372	17.3	75.5
Female	2585	466	18.0	345	13.4	150	5.8	495	19.2	69.7
Education										
Illiterate	2220	386	17.4	297	13.4	188	8.5	485	21.9	61.2
≤ Grade 5	1515	300	19.8	226	14.9	45	3.0	271	17.9	83.4
Grade 6–10	671	94	14.0	64	9.5	7	1.0	71	10.6	90.1
≥ Grade 11	332	54	16.3	39	11.8	1	0.30	40	12.1	97.5
Residence										
Rural	3539	575	16.2	428	12.1	209	5.9	637	18.0	67.2
Urban	1199	259	21.6	198	16.5	32	2.7	230	19.2	86.1
All	4738	834	17.6	626	13.2	241	5.1	867	18.3	72.2

TABLE 3 Association of age, gender, education and residence with cataract surgery, operated cataract blindness, un-operated cataract blindness and surgical coverage

	All cataract operated	Operated cataract blind	Un-operated cataract blind	% surgical coverage
Age (yrs)				
50–59	Reference	Reference	Reference	Reference
60–69	4.25 [3.39–5.32][a]	4.09 [3.35–4.98][a]	2.39 [1.67–3.43][a]	1.59 [1.06–2.38][b]
70+	13.2 [9.9–17.5] [a]	14.0 [10.4–18.8][a]	4.30 [2.82–6.56][a]	2.12 [1.29–3.51][b]
Gender				
Male	Reference	Reference	Reference	Reference
Female	1.16 [0.99–1.36]	1.07 [0.89–1.28]	0.92 [0.67–1.25]	1.22 [0.90–1.66]
Education				
Illiterate	Reference	Reference	Reference	Reference
≤ Grade 5	1.08 [0.86–1.37]	1.01 [0.75–1.35]	0.32 [0.22–0.47][a]	2.96 [1.92-4.58] [a]
Grade 6-10	1.00 [0.71–1.39]	0.85 [0.63–1.14]	0.14 [0.07–0.28][a]	5.55 [2.84–10.9] [a]
≥ Grade 11	1.18 [0.77–1.80]	1.06 [0.66–1.70]	0.04 [0.06–0.23][a]	24.0 [3.29–174.6] [b]
Residence				
Rural	Reference	Reference	Reference	Reference
Urban	1.51 [1.13–2.01][b]	1.55 [1.15–2.09][b]	0.59 [0.31–1.11]	2.32 [1.11–4.84][b]

* Data are given as adjusted odds ratios [95% confidence intervals] by multiple logistic regression
[b] $P \leq 0.05$; [a] $P < 0.001$

not significant. Un-operated cataract blindness was associated with older age and illiteracy. Surgical coverage among the cataract blind was associated with older age, literacy and urban residence.

PVA ≥ 20/63 was found in 658 (50.7%) and 968 (74.5%) cataract operated eyes with BCVA respectively (Table 4). Two hundred and thirty four of the cataract-operated eyes (18.0%) presented blind. With best correction, 142 (10.9%) eyes remained blind. Analysis of cataract-operated eyes with PVA ≥ 20/63 and BCVA ≥ 20/63 by age, gender, education, residence, time period of surgery, place of surgery and surgical procedure was done (Table 5). Better vision outcomes were observed among those with younger age, more education, urban residence and recent IOL surgery in NGO/private facilities. Gender was not important. The association of these covariates with PVA ≥ 20/63 and BCVA ≥ 20/63 was explored with logistic regression (Table 6). Because the patient's decision regarding cataract surgery in the second eye could have been influenced by the visual acuity outcome in the first-operated eye, to maintain independence between eyes, only first-operated eyes were included in the regression. Younger age, literacy, and IOL surgery were significant for both PVA ≥ 20/63 and BCVA ≥ 20/63. Urban residence and surgery in

TABLE 4 Presenting and best corrected visual acuity outcomes in cataract operated eyes

Presenting Visual Acuity	Best corrected visual acuity											
	≥ 20/32		20/40–20/63		< 20/63–20/200		< 20/200–20/400		< 20/400		All	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
≥ 20/32	243	100.0									243	18.7
20/40–20/63	325	78.3	90	21.7							415	32.0
< 20/63–20/200	145	35.6	128	31.4	134	32.9					407	31.3
< 20/200–20/400	4	12.1	4	12.1	12	36.4	13	39.4			33	2.5
< 20/400	7	3.5	22	10.9	43	21.4	2	1.0	127	63.2	201	15.5
All	724	55.7	244	18.8	189	14.5	15	1.2	127	9.8	1299	100.0

TABLE 5 Presenting and best corrected visual acuity of cataract operated eyes in relation to age, gender, education, residence, year of surgery, place of surgery and surgical rocedure

	Cataract operated eyes			
	No.	%	% Presenting VA ≥ 20/63	% Best corrected VA ≥ 20/63
Age (yrs)				
50–59	246	18.9	58.5	84.1
60–69	486	37.4	53.5	78.8
70+	567	43.6	44.8	66.7
Gender				
Male	582	44.8	51.2	74.9
Female	717	55.2	50.2	74.2
Education				
Illiterate	586	45.1	39.8	67.1
≤ Grade 5	472	36.3	55.5	78.2
Grade 6–10	151	11.6	68.2	85.4
≥ Grade 11	90	6.9	66.7	85.6
Residence				
Rural	880	67.7	46.6	72.7
Urban	419	32.2	59.2	78.3
Year of surgery				
≤ 1998	227	17.5	33.9	54.2
1999–2001	204	15.7	50.5	73.0
2002–2004	459	35.3	51.4	76.7
≥ 2005	400	30.8	59.8	84.8
Unknown	9	0.7	33.3	55.6
Place of surgery				
Govt. hospital	92	7.1	27.2	62.0
Private hospital	411	31.6	59.1	77.6
NGO hospital	764	58.8	50.1	75.4
Outreach camps	22	1.7	22.7	59.1
Unknown	10	0.8	20	30.0
Surgical procedure				
ICCE/ECCE w/o IOL[a]	198	15.2	20.2	48.5
IOL implant	1093	84.1	56.5	79.6
Other/undetermined[b]	8	0.62	0.0	25.0
All	1299	100.0	50.7	74.5

NGO = non-governmental organization; ICCE = intracapsular cataract extraction; ECCE = extracapsular cataract extraction; PC = Posterior Chamber; IOL = Intraocular lens.

[a] Includes 84 without spectacles

[b] Includes five without spectacles

a NGO/private facility were also significant for PVA, and recent surgery was significant for BCVA. Gender was not significant for either presenting or best-corrected vision.

TABLE 6 Association of age, gender, education, residence, year of surgery, place of surgery and surgical procedure with presenting and best corrected visual acuity ≥ 20/63 in first cataract operated eyes

	First cataract operated eyes		Presenting VA ≥ 20/63	Best corrected VA ≥ 20/63
	No.	%		
Age (yrs)				
50–59	169	20.3	Reference	Reference
60–69	316	37.9	0.64[0.41–1.01]	0.75[0.39–1.44]
70+	349	41.8	0.52[0.34–0.80]*	0.43[0.24–0.79]*
Gender				
Male	368	44.1	Reference	Reference
Female	466	55.9	1.16[0.86-1.57]	1.13[0.75-1.72]
Education				
Illiterate	386	46.3	Reference	Reference
≤ Grade 5	300	36.0	1.67[1.17–2.40]*	1.55[1.05–2.28]*
≥ Grade 6	148	17.7	2.55[1.62–4.02]**	2.34[1.36–4.03]*
Residence				
Rural	575	68.9	Reference	Reference
Urban	259	31.1	1.45[1.06–1.97]*	1.12[0.70–1.81]
Year of surgery				
≤ 1998/Unknown	165	19.8	Reference	Reference
1999-2004	424	50.8	1.18[0.72–1.95]	1.65[1.03–2.65][a]
≥ 2005	245	29.4	1.39[0.80–2.41]	2.73[1.30–5.74][a]
Place of surgery				
Govt. hosp./Camp/Unknown	88	10.6	Reference	Reference
NGO/Private hospital	746	89.4	2.12[1.24–3.60]*	1.14[0.62–2.09]
Surgical procedure				
w/o IOL/Other/Unknown[§]	136	16.3	Reference	Reference
IOL Implant	698	83.7	4.69[2.71–8.11]**	2.98[1.86–4.76]**
All	834	100.0		

NGO = non-governmental organization; ICCE = intracapsular cataract extraction; ECCE = extracapsular cataract extraction; PC = Posterior Chamber; IOL = Intraocular lens.

Data are given as adjusted odds ratios [95% confidence intervals] by multiple logistic regression

[a] Includes 70 without aphakic spectacles

* $P \leq 0.05$; ** $P < 0.001$

TABLE 7 Principal causes of visual impairment/blindness in cataract-operated eyes by PVA

	Presenting visual scuity							
	20/40–20/63		<20/63–20/200		< 20/200		All	
Principal cause	No.	%	No.	%	No.	%	No.	%
Refractive error[a]	325	78.3	145	35.6	11	4.7	481	45.5
PCO	32	7.7	110	27.0	32	13.7	174	16.5
Macular degeneration	33	7.9	60	14.7	28	12.0	121	11.5
Glaucoma	5	1.2	15	3.7	25	10.7	45	4.3
Other optic atrophy	0	0.0	11	2.7	26	11.1	37	3.5
Other retinal disorders	3	0.7	12	2.9	19	8.1	34	3.2
Corneal opacity/Scar	1	0.2	6	1.5	11	4.7	18	1.7
Diabetic retinopathy	0	0.0	6	1.5	6	2.6	12	1.1
Phthsis/Globe disorder	0	0.0	0	0.0	7	3.0	7	0.7
Retinal detachment	0	0.0	1	0.2	5	2.1	6	0.6
Amblyopia	2	0.5	2	0.5	0	0.0	4	0.4
Other causes	9	2.2	31	7.6	55	23.5	95	9.0
Undetermined	5	1.2	8	2.0	9	3.8	22	2.1
All	415	100.0	407	100.0	33	100.0	1056	100.0

PCO = posterior capsule opacification.

[a] Includes only eyes improving to ≥ 20/32 with subjective refraction.

The principal causes for the 1,056 cataract-operated eyes with visual impairment/blindness were also analyzed (Table 7). Refractive error was predominating in eyes with mild vision impairment (20/40 to 20/63). Refractive error, posterior capsule opacification (PCO), and macular degeneration were common causes in eyes with moderate visual impairment (<20/63 to 20/200). In blind eyes (< 20/200), retinal disorders (macular degeneration, diabetic retinopathy, retinal detachment and other retinal disorders) were the main cause (24.8%), followed by PCO (13.7%) and glaucoma (10.7%). Eyes with a cause not represented by the specific itemized list are in the "Other Causes" category. A significant proportion of the other causes pertain to the various complications of cataract surgery.

A total of 161(19.3%) of the 834 cataract-operated persons were affected by surgical complications. Analysis by operated eyes revealed that surgical complications were identified in 192 (14.8%) of the 1,299 cataract operated eyes considering BCVA. BCVA < 20/200 was observed in 142 (10.9%) of the 1299 operated eyes. Posterior capsule rupture, cystoid macular edema, and vitreous loss were relatively common complications, identified in 6.85%, 5.85%, and 5.39% of eyes, respectively. The other complications recorded were pupillary capture (3.2%), corneal decompensation (2.6%), inflammation (1.2%), subluxated IOL (1.1%), iris prolapse (0.3%).and others (1.0%)

DISCUSSION

A major strength of this study is the large randomly selected, population-based sample of participants. With a 91.9% examination response rate, biases relating to participant self-selection should have been minimal.

Government facilities were not a popular choice, particularly in the more recent years as the volume in NGO hospitals became increasingly predominant.

The increasing popularity of the NGO hospitals may be due to the large number of screening camps that these hospitals conduct, wherein the operable cases are transported to the base hospital for surgery. Cataract surgical services have now been decentralized in India and respective districts formalize their plans on an annual basis. The plan is prepared in consultation with the government, NGO and leading private ophthalmologists in the district, optimizing the available facilities in the district. With this participatory approach, more NGO and private surgeons are contributing to the services in the district. Also notable is the increase in recent years in the proportion of cases receiving the Manual SICS + IOL procedure. This trend is seen across India as an overwhelming proportion of surgeons are now confident and skilled in this cost-saving procedure.

The prevalence of cataract surgery in Navsari district (17.6%) was higher than what was found using a similar protocol, a decade ago in Bharatpur district (12.8%) in the north-western state of Rajasthan,[7] and in the Tirunelveli (11.8%) and Sivaganga districts (14.7%) of the southern state of Tamil Nadu.[5,6] Comparatively low cataract surgery rates have also been reported from surveys in other parts of Tamil Nadu and in the state of Andhra Pradesh in southern India.[21, 22] Pakistan, a neighboring country with a high load of cataract blindness also reported a low crude cataract surgery rate of 8%.[23]

More than 10% of the operated eyes underwent a non-IOL procedure as shown by the prevalence of aphakia in the study. Though a significant proportion of these surgeries were prior to 2002, some of them were post 2002 also, mostly in the 2002–2004 period. This could be a transition phase where some surgeons were performing non-IOL ECCE surgery before moving on to an IOL implant.

Surgical coverage among the cataract blind (72.2%) was higher than that in Tirunelveli (56.5%),[5] but comparable to that in Rajasthan (65.7%)[7] and Sivaganga (77.5)[6] in India. Even a decade ago, high surgical coverage was reported for urban areas in Gujarat.[24] Surgical coverage greater than 70%, as seen in Navsari and Sivaganga, is notably higher than that found in many developing countries in the past decade.[25] Evidence to this effect is also available from population surveys in Ethiopia,[26] Nigeria,[27] Rwanda,[28] in Africa, China,[29] Myanmar,[30] Bangladesh,[31] Nepal[32] in Asia and Paraguay[33] in South America. Comparable high coverage rates have been reported from Pakistan (77.1%),[23] Kenya (78%),[34] Argentina (70% Males; 78% females).[35] Cataract surgical coverage (CSC) is a useful indicator for evaluating the performance of a cataract program and gives information on the remaining workload in the country or region at that point in time. As surgical coverage of those already blind increases, countries can look at surgical coverage among those who are visually impaired from cataract and can "potentially" become blind if they remain un-operated. Therefore many studies now report at better visual acuity cut-offs (Pakistan <6/18: 43.7%; Brazil < 20/63: 61.4%).[23,36]

In all four of the India surveys using a similar protocol, cataract surgery was associated with older age.[5,6,7] This is different from the trend in neighboring Nepal where younger respondents had a higher CSC.[32] Urban residence[6] and literacy[5,6,32] have been found to be associated with higher CSC in other studies in India and Nepal. Gender (female) was significant only in Rajasthan. With respect to surgical coverage, education/literacy was significant in all surveys. Gender

was not a significant predictor of surgical coverage in the present study. This is in general contrast with a meta-analysis of various population-based surveys showing that surgical coverage among the cataract blind was 1.2–1.7 times higher among males compared to females.[25] This is a positive trend as women in India like in most of South Asia face social discrimination. If CSC is similar among males and females, it would mean that women also have equal access to surgical services as men.

Among cataract-operated eyes, 50.7% had PVA ≥ 20/63. The difference between this percentage and the 74.5% based on BCVA ≥ 20/63 indicates that with simple refractive correction nearly a quarter of the operated eyes could be further improved to vision PVA ≥ 20/63 . With VA > 20/40, the differential benefit is 37.0% [55.7% minus 18.7%]). It is also pertinent to note that more than half (54%) of the operated individuals were wearing spectacles at the time of the survey. These observations suggest that refraction improves visual outcomes after cataract surgery and that a significant proportion of the operated individuals comply with spectacle usage after surgery. Therefore there is a need for providing refractive correction after cataract surgery. This need for refractive correction among the cataract operated is seen in many studies in India (64.0% with PVA ≥ 20/63 versus 83.1% with BCVA ≥ 20/63 in Tirunelveli[5]; 60.3% versus 86.9% in Sivaganga[37] and 31.5% versus 61.5% in Rajasthan.[38]) It is also notable that 11% remained blind even after best correction. This was similar to the 9.8% in Tirunelveli,[5] 8.6% in Sivaganga,[37] and 14.0% in Bharatpur (Rajasthan) [38] in India. Even in urban Singapore, poor post operative VA was observed in 10.8% of the operated population.[39]

The need for refractive correction, as illustrated by comparing PVA ≥ 20/63 with BCVA ≥ 20/63 among cataract-operated eyes, is similar in other studies using the same clinical protocol: 42.6% versus 73.1% in Nepal;[40] 25.0% versus 36.2% (with pinhole vision) in Shunyi County (northern China);[41] 23.7% versus 42.1% in Doumen County (southern China);[42] and 59.6% versus 72.1% (with pinhole vision) in Hong Kong.[43] The substantial differences between PVA and BCVA in cataract-operated eyes in developing countries underscore the importance of ensuring that IOL surgery is the norm and that the implanted IOL is of appropriate power.

Refractive errors, PCO, retinal disorders, macular degeneration, glaucoma and optic atrophy are commonly reported as causes of visual impairment/blindness in India.[5,37,38] Because retinal and other pathologies may have already been present at the time of cataract surgery, a rigorous preoperative examination to determine whether the patient is visually impaired/blind *from* cataract, rather than impaired/blind *with* cataract, is needed to help screen out cases in which cataract surgery is unlikely to improve vision.

The main complications of cataract surgery (cystoid macular edema, vitreous loss, and corneal decompensation) were similar to those reported in earlier studies in India. [5,37,38] Vitreous loss as a common and vision threatening complication, even in a tertiary center of excellence in India, is fully appreciated.[44] Although detailed comparisons of complication rates across studies is problematical because of differences in the thoroughness and rigor of the examination, it is apparent that addressing the quality of cataract surgery is a universal priority.

A total of 180 eyes were operated in the study area in Navsari district in 2006 in a population of 33,670 [all age population based on the household enumeration in the study]. CSR for the study area was therefore 5346 per million population ([180/33670] × 1,000,000). Since the survey clusters were randomly selected, this CSR would be representative for Navsari district. This CSR is approximately half the 10,310 per million population reported for Navsari district in 2006 by the Government of Gujarat. CSR calculated from the survey would be lower than that reported from secondary sources as the survey would not capture surgery among those aged < 50 years and mortality and migration among those operated in 2006 before the survey was undertaken would not be accounted for. It would also not be possible to estimate the number of cataract surgeries on people who came from other districts for cataract surgery to Navsari district. Even considering all these factors we do not feel that the CSR could be as high as that reported by the Government of Gujarat. This discrepancy in the calculated CSR suggests that the methods and data used by the Government of Gujarat in tabulating CSRs should be scrutinized so that inaccuracies, if any, may be rectified and truer estimates generated. Setting up a mechanism to record all surgeries done in each district and regular monitoring of the reported figures would help in providing more accurate data for computation of CSR.

Finally, it has been noted that most economically developed countries report a CSR of 4,000–6,000 per million population, and that it is unusual to find un-operated cataract blind individuals with a CSR in this range.[45] Analysts from India had suggested that if 8,000 cataract surgeries per million population were performed by 2005 across the country, then the elimination of cataract blindness could be a reality.[46] However, as observed in the present study, a CSR at this level may still not be adequate in countries, such as India, with rapidly increasing life expectancies, unless a substantial proportion of the surgeries are performed on blind individuals.

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