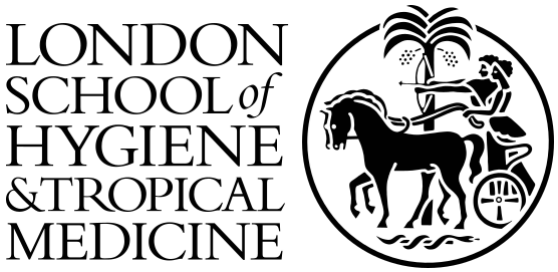

Prevalence and visual outcomes of cataract surgery and cataract surgical coverage in Sri Lanka: findings from the National Blindness and Visual Impairment Survey

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Abstract

Introduction Cataract surgical coverage and visual acuity outcomes are important population level indicators for monitoring access to and the quality of cataract surgery, allowing subgroups with poorer access to be identified. Data on these indicators are not available for Sri Lanka at national level.

Objectives Determine cataract surgical coverage and the outcomes of cataract surgery in a nationally representative sample of adults aged ≥40 years.

Methods Cluster random sampling with proportionate to size procedures was used. All participants were interviewed to obtain data on education level, movable assets, and the year and place of cataract surgery, if applicable. Presenting and best corrected visual acuities were measured. All participants underwent slit lamp examination, including a dilated examination of the fundus. Cataract surgical coverage was calculated at the person level vision of <3/30, <6/60 and <6/18. Outcomes of cataract surgery were categorized as good (6/18 or better), borderline (<6/18-6/60) or poor (<6/60).

Results A total of 345 persons among the 5,779 participants who were examined had undergone cataract surgery in one or both eyes (486 eyes). Cataract surgical coverage, which was high overall 85.4% for vision <3/60; 79.1% for vision <6/60), was significantly higher in younger age groups (Odds Ratio [OR] 5.65, 95% confidence interval [CI] 1.42-22.52), those in urban areas (OR 2.8, 95% CI 1.01-7.74) those with higher socio-economic status (OR 6.0; 95% CI 1.96-18.4). Coverage ranged from 60% in Uva Province to 100% in Southern Province. 59.7% of eyes had good outcomes at presentation increasing to 75.1% with correction.

Conclusions Cataract surgery indicators for Sri Lanka are good, being better than most other Asian countries. Services should target those living in underserved Provinces.

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Introduction

Cataract is the leading cause of blindness globally and in most low and middle-income countries (LMIC) in Asia and Africa [1,2]. The estimated number of people blind from cataract globally varies depending on the methodology used. Thus, The World Health Organization (WHO) estimates that 20 million are blind due to cataract [1] while the Global Burden of Disease (GBD) study suggests a figure of 10.8 million people for the same year [3]. The only population-based survey conducted to date in Sri Lanka also identified cataract as the principal cause of visual impairment, responsible for 79% [4].

Surgery is the only known treatment for cataract and is one of the most commonly performed elective surgical procedures in high income countries [5,6]. Evidence suggests that there has been an increasing trend in rates of cataract surgery globally over the past few decades

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[7,8]. It has been predicted that by 2050, the number of people aged 65 years and above will increase to 1.5 billion, representing 16% of the world's population. The proportion of people with age related conditions, including cataract, will also increase dramatically [9]. Sri Lanka has extremely good health indicators, including increasing life expectancy at birth [10], which is now 74.9 years, significantly higher than in other countries in South Asia [11]. However, to date there has been no data on the prevalence and causes of blindness and visual impairment nationally, and data on cataract surgical coverage and outcomes are available from only one province [12]. The existing data are therefore, not representative of the entire country. In this paper, we report data on cataract surgical coverage and cataract surgical outcomes from the recent National Survey of Blindness and Visual Impairment, initiated by the VISION2020 National Program for the Prevention and Control of Avoidable Blindness.

Methods

A detailed description of the survey methodology is provided in a companion paper in this issue and a brief summary is included here. The sample size was 6,800 persons aged ≥40 years in 68 clusters across the country. All nine provinces and a random sample of divisional secretariats were included, using population proportionate to size cluster random sampling. A total of 6,713 individuals were enumerated and invited to local clinical examination sites.

Two dedicated teams were recruited and trained, and study sites were visited concurrently. Each team had a trained ophthalmologist, two optometrists and a team of interviewers and enumerators. A survey coordinator led the two teams. All participants were interviewed by a trained interviewer to collect data on socioeconomic status (SES) (including ownership of movable assets), medical and ocular history, including a history of cataract surgery.

Distance presenting visual acuity (VA) (i.e., with distance correction if usually worn) was measured by an optometrist using an ETDRS (Early Treatment for Diabetic Retinopathy Study) logMAR tumbling E chart at four meters, and at one meter if required using a +0.75D sphere in a trial frame. Participants had to correctly see at least 4 of the 5 optotypes at any given level to pass. If no optotypes could be seen at one meter, participants were assessed for their ability to count fingers, see hand movements or perceive light.

All participants had autorefraction measurements taken by an optometrist (Topcon 8000). If the presenting VA was <6/12 in both eyes, autorefractor readings were used as the starting point to determine the best corrected VA, after retinoscopy if required. An ophthalmologist then conducted a basic eye examination on an undilated pupil. If the presenting VA in either eye was <6/12 this was followed by a full slit-lamp examination, including a dilated examination of the posterior segment. All those who had undergone cataract surgery in one or both eyes also underwent detailed examination regardless of their VA. Details of the time, place and type of cataract surgery were recorded.

Definitions used

Blindness and visual impairment: Presenting VA in the better eye was used for all categories of visual impairment i.e. tested with distance correction, if usually worn, or unaided. The following World Health Organization (WHO) categories were used: blindness <3/60 in the better eye; severe visual impairment <6/60-3/60 and moderate visual impairment <6/18-6/60) [13]. A further category was added, termed mild visual impairment i.e., <6/12-6/18.

Visual outcomes after cataract surgery: Outcomes were measured using presenting, unaided and best corrected VA in the operated eye. The quality of outcomes was categorized using presenting VA against WHO targets [14].

Cataract Surgical Coverage (CSC) This measure indicates the extent to which people who were cataract blind accessed services. Cataract surgical coverage can be calculated at the person and at the eye level [15]. Calculation of CSC at the person level 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 = persons with unilateral pseudo/aphakia and visual impairment in contralateral eye.

y = persons with bilateral pseudo/aphakia, regardless of acuity.

z = persons with <3/60, <6/60 and <6/18 in whom the principal cause was cataract (unilateral or bilateral).

Socio-economic status Each movable asset, such as ownership of a television, computer, radio, cycle, motor cycle, car, was assigned a presumed monetary value and a total household asset score was derived. These scores were then cumulated and then divided into quartiles. Each participant in the household was categorized into one of the following: highest SES – top quartile; upper middle – 2nd quartile; lower-middle – 3rd quartile or lowest SES – 4th quartile. For some analysis the 1st and 2nd quartile were combined as higher SES and the 3rd and 4th quartile were combined as lower SES.

Data Management

Data were entered by an experienced data officer into a customized database created in Microsoft Access, which had built-in range and consistency checks. Entries were cross-checked independently by a second data officer. Data cleaning and analysis were undertaken using STATA 13.0 (Stata Corp LP, Texas, USA) by a statistician at the Indian Institute of Public Health, Hyderabad.

Descriptive analysis and cross tabulations with calculation of Pearson's chi squared tests were performed. Prevalence estimates together with 95% confidence intervals were calculated. Further analysis was undertaken to explore risk factors for lower CSC using logistic regression with generalized equation to adjust for dependency in the data due to clustered sampling. All variables significant at 0.05 level in univariate analysis were included in the multivariate regression. All tests are two sided, and odd ratios (OR) and 95% confidence intervals (CI) are presented. Multiple logistic regression analysis was performed to identify risk factors for lower coverage and to estimate adjusted Odds Ratios (OR).

Ethics

The study protocol was approved by the institutional ethics committees of LSHTM, UK, the Faculty of Medicine, University of Colombo, Sri Lanka and the Indian Institute of Public Health, Hyderabad, India. All participants provided written informed consent, and all requiring further examination and/or treatment were referred to the nearest eye care provider.

Results

A total of 6,713 adults were enumerated in 68 clusters, 5,779 of whom were examined (overall response rate: 86.1%). Response rates were higher in older age groups and in females. Response rates by Province and by urban/ rural residence were similar (range 84.7-87.9% and 83.7-86.4% respectively). Those who were illiterate were more likely to respond than those with primary education or above (93.0% not literate; 80.9% graduates and above).

Prevalence of cataract surgery

A total of 345 persons had undergone cataract surgery in one or both eyes (486 eyes) (Table 1) giving a prevalence estimate of 6.0% (95% CI 1.3-23.3%]. In univariate analysis, the prevalence of cataract surgery was significantly higher in older age groups (X^2-511.6; p< 0.001), females (X^2-7.1; p=0.008), urban participants (X^2- 27.8; p<0.001), those with higher levels of education (X^2-34.6; p<0.001) and among participants from some of the provinces (X^2-67.1; p<0.001). SES or ethnicity did not have an influence on the prevalence of cataract surgery rates. In multivariate analysis, all these associations remained statistically significant apart from education level (Table 1). Cataract surgery prevalence varied from 2.6% in Uva to 8.9% in the Northern and Western Provinces, showing wide variation across the country.

Intraocular lenses were almost universal (93.8%) among those who underwent cataract surgery and 72.8% were operated in public funded facilities. 53.7% (261) of the cataract surgeries were performed within the preceding 5 years of the survey (i.e., after 2010) while 18.3% (89) were performed more than 10 years prior to the survey.

Cataract Surgical Coverage

Cataract surgical coverage (CSC) was calculated at three levels of presenting VA in the better eye at the person level: <3/60, <6/60 and <6/18. At the <3/60 cut-off level, CSC was 85.4%, 79.1% at the <6/60 level and 45.6% at the <6/18 level. At the <3/60 level CSC declined significantly with increasing age. CSC was higher in urban participants, Southern province, those with higher levels of education and those in the highest SES strata. There were no differences by sex or ethnic group (Table 2). Parameters which were statistically significant in univariate analysis continued to be significant in multivariate analysis (Table 2).

Visual outcomes after cataract surgery

Presenting and best corrected VA after cataract surgery in the operated eyes was compared with the WHO recommended targets (for presenting VA > 80% should have VA ≥61/8 and <5% should have VA < 6/60, while for best corrected VA > 90% should have VA ≥6/18 and <5% should have VA < 6/60).

		For presenting VA	For best Corrected VA
Good	≥6/18	> 80%	> 90%
Borderline	<6/18-6/60	< 15%	< 5%
Poor	< 6/60	<5%	< 5%

Using presenting VA, three out of every five operated eyes (59.7%) had good visual outcomes after surgery (Table 3) which increased to 75.1% with best correction. One in 8 operated eyes (12.1%) had poor visual outcomes (presenting VA) which reduced to 8.8% (43) after correction.

The cause of poor visual outcomes was not recorded in 30 eyes. Inadequate correction of refractive errors (27%), surgical complications (10.2%) and posterior capsular opacification (5.1%) were the commonest reported causes.

Determinants of poor visual outcomes after cataract surgery were also assessed (Table 4). Eyes operated more than a decade prior to the survey had significantly poorer outcomes than eyes operated within five years (X^2-12.98; p=0.002). Age was also associated with outcomes, with a "U" shaped distribution with poorer outcomes in youngest and oldest age groups (X^2-11.98; p=0.007). There were no significant associations between poor outcomes and sex, level of education, place of residence, SES or ethnic group.

Table 1. Prevalence of cataract surgery

					Multivariate Analysis	
Parameter	*Denominator (n)*	*Operated in one or both eyes (n)*	*Prevalence % [95% CI]*	*Chi; p*	*Adjusted Odds Ratio*	*95% CI*
Total	5779	345	6.0 [1.3-23.3]			
Age Group						
40 - 49 years	1708	13	0.8 [0.2-2.6]		Ref	-
50 - 59 years	1859	41	2.2 [1.9-2.5]		2.7	1.4-5.1
60 - 69 years	1424	116	8.1 [4.3-14.9]		11.6	6.4-21.2
≥ 70 years	788	175	22.2 [14.0-33.4]	X^2-511.6; p<0.001	37.5	18.6-75.5
Sex						
Male	2356	117	5.0 [2.1-11.1]		Ref	
Female	3423	228	6.7 [1.1-32.2]	X^2-7.1; p=0.008	1.5	1.2-2.0
Residence						
Rural	5102	274	5.4 [1.4-18.2]		Ref	
Urban	677	71	10.5 [2.3-36.0]	X^2-27.8; p<0.001	1.6	1.1-2.3
Education						
≥ Secondary school	4120	198	4.8 [1.7-12.8]		1.1	0.8-1.4
<Secondary school	1659	147	8.9 [1.4-40.3]	X^2-34.6; p<0.001	Ref	0.9-1.5
Province						
North West	586	15	2.6 [0.2-28.5]		Ref	-
Uva	348	9	2.6 [0.2-24.4]		1.2	0.5-2.8
Eastern	415	13	3.1 [0.8-11.4]		1.7	0.8-3.8
Central	695	25	3.6 [3.4-9.6]		1.3	0.7-2.7
North Central	346	16	4.6 [0.03-89.0]		1.8	0.9-3.9
Sabaragamuwa	510	30	5.9 [3.2-10.5]		2.6	1.3-5.0
Southern	678	41	6.0 [0.9-31.0]		2.4	1.3-4.5
Northern	553	49	8.9 [2.2-29.7]		4.1	2.2-7.7
Western	1648	147	8.9 [2.4-28.0]	X^2-67.1; p<0.001	3.3	1.9-5.7
Socio economic status						
Lower	3262	196	6.0 [0.9-31.9]			
Higher	2517	149	5.9 [2.2-14.7]	X^2-.02; p=0.9		
Ethnic Group						
Sinhala	4546	257	5.6 [1.2-2.3]			
Tamil	1053	77	7.3 [1.8-25.5]			
Moors	180	11	6.1 [1.8-18.6]	X^2-4.2; p=0.123		

Table 2. Cataract Surgical Coverage at person-level (presenting Visual Acuity < 3/60)y

Parameter	*N*	*Cataract operated persons*		*Operable Cataract Blind (PVA < 3/60)*		*Operated & operable persons*	*Cataract Surgical Coverage (%)*	*Adjusted Odds Ratio*	95% CI
		N	%	N	%				
All	5779	345	6.0	59	1.0	404	85.4		
≥ 50 years	4071	332	8.2	59	1.4	391	84.9		
Age Group									
40 - 49 years	1708	13	0.8	0	0	13	100.0	-	-
50 - 59 years	1859	41	2.2	2	0.1	43	95.3	48	1.1-21.5
60 - 69 years	1424	116	8.1	15	1.0	131	88.5	2.2	1.1-4.5
≥ 70 years	788	175	22.2	42	5.3	217	80.6	Ref	-
							X^2-10.6; p=0.01		
Residence									
Rural	5102	274	5.4	55	0.9	329	83.3	Ref	
Urban	677	71	10.5	4	0.5	75	94.7		
							X^2-14.6; p=0.01		
Sex									
Male	2356	117	5.0	21	0.9	138	84.8	-	-
Female	3423	228	6.7	38	1.1	266	85.7	-	-
							X^2-0.06; p=0.8		
Education									
< Secondary	1659	147	8.9	42	2.2	189	77.8	Ref	
≥ Secondary school	4120	198	4.8	17	0.4	215	92.1	2.2	1.1-4.6
							X^2-16.5; p<0.001		
Socio-economic status									
Lower	3262	196	6.0	45	1.2	241	81.3	Ref	
Higher	2517	149	5.9	14	0.5	163	91.4	2.3	1.05-5.1
							X^2-7.9; p=0.005		
Province									
North West	586	15	2.6	12	1.7	27	55.6	Ref	
Uva	348	9	2.6	6	1.5	15	60.0	1.4	0.3 - 6.4
Central	695	25	3.6	10	1.3	35	71.4	2.5	0.6 - 9.9
East	415	13	3.1	3	0.6	16	81.2	5.2	0.7 - 38.6
Sabaragamuwa	510	30	5.6	5	0.8	35	85.7	11.6	1.9 - 71.8
North	553	49	8.9	8	1.2	57	86.0	4.8	1.0 - 23.7
North Central	346	16	4.6	2	0.5	18	88.9	5.3	0.7 - 39.7
Western	1648	147	8.9	13	0.7	160	91.9	7.8	2.2 - 27.7
Southern	678	41	6.0	0	0	41	100	-	-
							X^2-45.3; p<0.001		
Ethnic Group									
Sinhala	1053	77	7.3	18	1.4	95	81.0		
Tamil	4546	257	5.6	40	0.8	297	86.5		
Moors	180	11	6.1	1	0.5	12	91.7		
							X^2-2.1; p=0.3		

Table 3. Visual acuity after cataract surgery

Visual Outcomes	*Visual Acuity*	*Presenting vision*		*Best corrected vision*	
		WHO Targets	*Sri Lanka National Survey % (N)*	*WHO Targets*	*Sri Lanka National Survey* % (N)
Good	≥ 6/18	> 80%	59.7% (290)	>90%	75.1% (365)
Borderline	<6/18-6/60	< 15%	28.2% (137)	<5%	16.0% (78)
Poor	< 6/60	<5%	12.1% (59)	<5%	8.8% (43)

Table 4. Determinants of poor visual outcome (n=59) after cataract surgery

Variable	*Cataract surgery*	*N*	*%*	*P value*
Interval since surgery				
<5 years (2010 to survey date)	246	28	11.4	
5-10 years (2004 to 2009)	187	15	8.0	
> 10 years (before 2004)	49	13	26.5	X^2-12.98;p=0.002
Year not known		3	0.1	
Age Group				
40 – 49 years	19	5	26.3	
50 – 59 years	53	5	9.4	
60 – 69 years	162	10	6.2	X^2-11.98; p=0.007
≥70 years	252	39	15.5	
Sex				
Male	164	25	15.2	X^2-2.23; p=0.13
Female	322	34	10.6	
Place of residence				
Rural	381	50	13.1	X^2-1.6;p=0.21
Urban	105	9	8.6	
Education (level of schooling completed)				
≥Secondary school	203	31	15.3	X^2-3.2;p=0.07
<Secondary school	283	28	9.9	
Family socio-economic status				
Lower	271	35	12.9	X^2-0.34;p=0.6
Higher	215	24	11.2	
Ethnic Group				
Sinhala	362	48	13.2	
Tamil	107	10	9.3	X^2-1.8;p=0.4
Moors	17	1	5.9	
Total	486	59	12.1	

Table 5. Determinants of poor visual outcome (n=59) after cataract surgery

Country	*Area*	*Year*	*Age group*	*CSC <3/60 (%)*	*Visual acuity outcome after surgery (%)*						*Ref.*
					Presenting visual acuity			***Best corrected acuity***			
					Good	*Borderline*	*Poor*	*Good*	*Borderline*	*Poor*	
Sri Lanka	National	2015	40+	85.4	59.7	28.2	12.1	75.1	16.0	8.8	
Sri Lanka	National	2015	50+	84.9							
Sri Lanka	Kandy	2009	40+	82.7	ND	ND	ND	ND	ND	ND	12
Bangladesh	National	2000	30+	ND	49.7	29.4	20.8	67.0	21.1	11.9	34
Bangladesh	Eight districts	2016	50+	69.3	ND	ND	ND	ND	ND	ND	18
Bangladesh	Satkhira	2005	50+	61%	60.1	16.4	23.5	67.6	12.2	20.2	19
China	Tibet	2000	50+	65.7	57.9	20.4	21.8	ND	ND	ND	20
China	Kunming	2006	50+	58.9	45.5	16.3	38.2	ND	ND	25.6	21
China	Nine Provinces	2006	50+	35.7*	46.5	30.0	23.5	63.8	18.5	17.7	22
China	Hainan	2010	50+	ND	59.4	20.0	20.6	61.3	16.7	18.7	35
China	Yunnan	2011	50+	52.8*	22.5	25.6	52.0	42.6	23.3	34.2	23
Hong Kong	Shatin	2000	60+	ND	59.6	29.2	11.2	72.1	18.6	9.3	36
India	Tirunelveli	2000	50+	56.5	64.0	15.5	20.5	83.0	7.2	9.8	24
India	Gujarat	2007	50+	72.2*	50.6	31.3	18.0	74.5	14.5	10.9	25
India	Andhra Pradesh	2012	50+	ND	54.0	31.8	14.2	71.2	19.3	9.5	37
India	Andhra Pradesh	2016	40+	ND	73.0	12.2	14.7	ND	ND	ND	38
Pakistan	National	2003	30+	77.1	ND	ND	ND	ND	ND	ND	26
Pakistan	National	2003	30+	ND	29.5	35.3	34.3	50.0	27.5	22.1	39
India	Karnataka	2002	50+	63.0	ND	ND	ND	ND	ND	ND	27
India	Maharashtra	2010	50+	30.8	ND	ND	ND	ND	ND	ND	28
Thailand	National	2012	50+	95.1	ND	ND	ND	ND	ND	ND	17
Cambodia	Takeo	2012	50+	64.7	ND	ND	ND	ND	ND	ND	29
Bhutan	National	2012	50+	72.7	ND	ND	ND	ND	ND	ND	30
Myanmar	Four districts	2005	40+	22.3	ND	ND	ND	ND	ND	ND	31

ND-No data

Discussion

This survey has generated national level data on cataract surgical services performance for the first time in Sri Lanka. This evidence is crucial for planning and setting up strategic priorities at both national and regional levels.

Cataract surgical rate (CSR) was initially the only means of assessing cataract surgical service output, but it cannot be used to predict the future need for cataract surgery in the population, nor to assess equity in access to services [16]. CSC, which identifies the proportion of those in need of services and those who have had their need met by cataract surgery, is a better measure to identify inequity [15]. The closer CSC is to 100% the better the access to and uptake of surgical services.

The CSC in Sri Lanka is high at both the <3/60 and <6/60 levels, being second only to Thailand [17], in the South-East Asia region (Table 5) [12,17,21-31]. Among the LMIC only a few countries in South America have reported higher CSC [32]. This is an impressive achievement, reflecting effective coordinated planning by the VISION2020 Secretariat, availability of a trained workforce at secondary and primary levels and strong Government support with services being free at the point of access.

Sri Lanka is also one of a few countries where there is no gender inequity in access to cataract surgical services, in contrast to many other countries [33]. However, certain subgroups in the population still have lower access to cataract surgical services, including the poor, the elderly, those living in rural areas, the less well educated and those living in Central, North West and Uva Provinces. The national prevention of blindness plan needs to address these differences by improving access to high quality cataract surgery outside the main urban areas and for the disadvantaged groups.

Visual outcomes after cataract surgery were better than in many other LMIC (Table 5) [19-25,34-39], with poor outcomes only slightly higher than the WHO recommended levels of <5% (12.1% presenting VA; 8.8% best correction VA). Visual outcomes have improved significantly in Sri Lanka due to the near universal use of IOLs, which have recently been provided free by the Ministry of Health. Even though the survey could not assess cause of poor outcome for about 78% of the eyes with the poor outcome, it suggests that some poor visual outcomes were due to recognized complications, such as posterior capsule opacification, which could be addressed by counselling patients to return for follow up should they notice a decline in VA. The relatively high proportion of poor outcomes in the youngest age group (26.3%), where CSC was 100%, may be because surgery was undertaken following trauma or complicated secondary cataracts.

Conclusions

The coverage of cataract surgery is high in Sri Lanka and the quality has improved over time. Initiatives to address current inequities in access could put Sri Lanka at the forefront in blindness control activities, becoming a model that could be adopted across many low and middle-income countries.

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Conflicts of Interest

All authors declare that they do not have any conflicts of interest.

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