



**Inclusive Futures**

Promoting disability inclusion

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# **Rapid Assessment of Avoidable Blindness (RAAB) report, Kogi State, Nigeria**

October 2020



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## Suggested reference

Gascoyne B, Jolley E, Ogundimu K, Chailloux A, Owoeye J,. Rapid Assessment of Avoidable Blindness (RAAB) report, Kogi State, Nigeria. Haywards Heath (UK): Sightsavers. 2020 25p.

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# Contents

<b>Report authors and contributors</b>	<b>1</b>
Suggested reference	1
<b>Executive summary</b>	<b>3</b>
<b>Introduction</b>	<b>4</b>
Methods	5
Study design	5
Study population	5
Sample size	6
Sampling	6
Data collection and tools	7
Visual examination	7
Disability tool	7
Nigeria Equity Tool	8
Data analysis	8
Ethical considerations	8
Results (RAAB)	8
Results (Eye health, wealth and disability)	17
Discussion	22
Conclusions	24
References	25

# Executive summary

In 2015, an estimated 253 million people were visually impaired, globally, and 36 million people were blind (1). The overwhelming majority of blind and visually impaired people live in resource-poor settings, where treatments for the most common causes of avoidable visual impairment – refractive error and cataract – are often inaccessible. Efforts to improve eye health have therefore focused on increasing access to quality and comprehensive eye care services.

Planning for eye health services depends on access to up-to-date data on the prevalence and causes of visual impairment. Moreover, equity in eye health requires an understanding of the burden of vision loss and access to eye care services among potentially vulnerable subgroups, such as people living in poverty conditions and people with disabilities.

The Rapid Assessment of Avoidable Blindness (RAAB) is a standardised survey methodology, designed to measure the magnitude and causes of visual impairment and the extent to which services are reaching different groups of people. The RAAB focuses on people aged over 50 years because the majority of blindness and visual impairment is found in this age group. In September 2019, we conducted a RAAB in Kogi State, Nigeria, to assess the prevalence and causes of blindness and visual impairment. Additional, internationally-comparable measures of self-reported functional impairments and relative household wealth were also used to better understand associations between eye health outcomes, poverty and disability. We recruited 4,150 individuals aged 50 years and over, of whom 3,926 were examined (94.7% response rate). After adjusting for age and sex, the prevalence of blindness was 3.5 per cent (measured as presenting visual acuity in the better eye), which was similar to the 3.7 per cent observed in the North-Central geopolitical zone in the 2005-2007 Nigeria national blindness and visual impairment survey (4). No significant differences were observed between males and females.

The main cause of blindness and severe visual impairment was untreated cataracts. Cataract surgical coverage among bilaterally blind people was almost 50 per cent, although coverage was higher among blind males compared to blind females. In terms of surgical outcomes, roughly half of all operated eyes (52.6%) had good vision, which represents an improvement compared with earlier national estimates of cataract surgical outcomes (the 2005-2007 national survey found only 30.8% per cent of operations had a good outcome) (4).

Uncorrected refractive errors were the most common cause of moderate visual impairment. The prevalence of moderate visual impairment was almost twice as high among the poorest 20 per cent of families, compared to the richest 20 per cent (9.5% vs 5.5%, respectively). Important variation in blindness and visual impairment was observed between people with additional, non-visual disabilities and people with no disabilities. Prevalence of severe visual impairment or worse, with the best available correction, was more than 27 times higher among people living with additional, non-visual disabilities than people with no disability. Men with additional, non-visual disabilities were also significantly more likely to be blind or visually impaired, compared with similar women.

# Introduction

Visual impairment is a major global public health issue. In 2015, an estimated 253 million people were visually impaired, globally; 217 million had moderate or severe vision impairments; and 36 million people were blind (1). Almost 90 per cent of the population of blind and visually impaired people live in low- and middle-income countries (LMICs); the vast majority are aged 50 years or older; and 55 per cent are women (2).

Yet, the most common causes of visual impairment – refractive error and cataract – are preventable (3). Thus, efforts to improve eye health, such as those set out in the VISION 2020 agenda, have focused on increasing access to quality and comprehensive eye care services.

Effective planning for eye health services depends on access to up-to-date data on the prevalence and causes of visual impairment from national and subnational surveys, not least since aging LMIC populations have seen a steady and substantial increase in the prevalence of blindness and severe or moderate vision impairment over the last 25 years (1). Moreover, ensuring equity in eye health requires knowledge and understanding of the burden of vision loss, and access to eye care services among potentially vulnerable subgroups, such as people living in relative poverty and people with additional, non-visual disabilities.

No new data has been collected in Kogi State, Nigeria, since the national blindness and visual impairment survey was completed in 2007 (4). The present survey aimed to address this lack of data and inform the development of a new inclusive eye health project in the state that will provide comprehensive eye health services to the people who need them most. Additionally, the data collected in this survey will serve as a baseline measure of eye health status and service coverage that can be replicated after a number of years to evaluate any change or progress.

This report describes the results of an eye health and disability survey conducted in Kogi State, Nigeria, between September 2019 and March 2020. It was composed of a RAAB, as well as a disability and wealth component, which allowed us to examine associations between eye health outcomes, wealth and disability, and to better understand how individual characteristics may drive health status and health seeking behaviour.

## Methods

### Study design

The Rapid Assessment of Avoidable Blindness (RAAB) surveys are a cross-sectional population-based survey of blindness and visual impairment in people aged 50 years or older (5). RAABs have been validated in LMIC settings where results have been shown to be comparable to findings obtained from total population-based surveys (6).

### Study population

The study population composed people aged 50 years or older who were resident in Kogi State, Nigeria (Figure 1). The RAAB methodology restricts surveys to older adults because the prevalence of blindness is highest in this age group.

The inclusion criteria were:

1. Aged 50 years or above.
2. Consented to participation.
3. Ordinarily resident for at least six months prior to the survey.

Figure 1 Kogi State



## Sample size

The sample size calculation was based on the following parameters: an expected prevalence of blindness of 3.75 per cent (in the North-Central zone according to the Nigeria national blindness and visual impairment survey conducted between 2005 and 2007); 20 per cent precision; 5 per cent alpha; non-response was anticipated to be 10 per cent; and the design effect was 1.5.

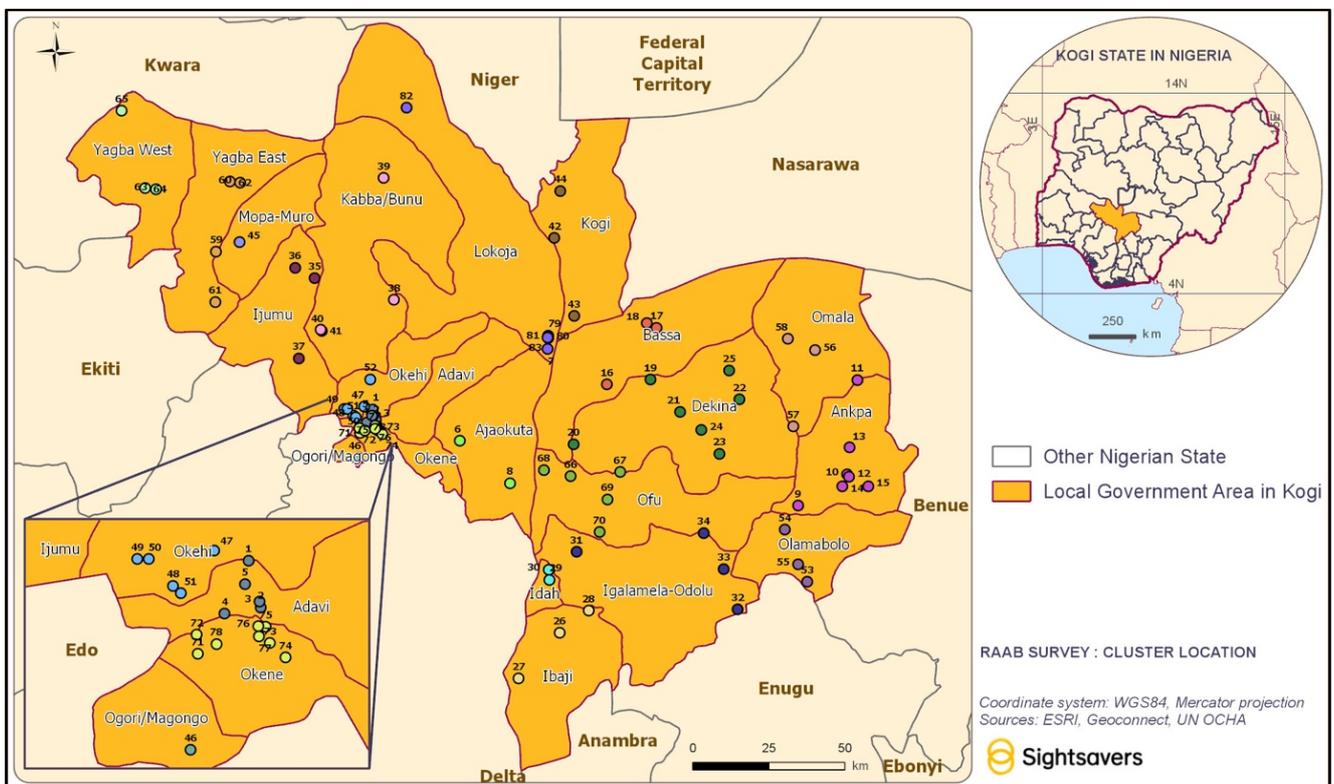
The minimum number of people required for the study was estimated to be 4,106, but surveying the same number from each sample cluster gave a final sample size of 4,150 people aged 50 years or older.

## Sampling

This study used a two-stage cluster sampling approach. First, a complete list of villages in Kogi State was obtained from the Nigerian National Bureau of Statistics official website (based on 2006 census and 2016 projections), and 83 villages were selected at random using probability proportionate to size methodology (Figure 2).

Second, each village was visited a few days before the survey team arrived to identify village borders. If the village population was large, a map was developed with the village leader and the village was divided into segments. In larger villages, where the population exceeded 500 inhabitants, a segment was then selected at random and that segment was surveyed. Then, 50 eligible participants were enrolled from each village.

Figure 2 Survey cluster location



## Data collection and tools

Each participant enrolled onto the RAAB underwent a visual examination and answered questions regarding disability and household wealth. Details of these are described below. All data was collected using an app on a touch-screen smartphone. Precise location of villages (not households) were recorded using global positioning system (GPS) coordinates so that cluster level data could be visually mapped and geospatially analysed.

Written consent was obtained from all participants, unless illiterate, in which case thumb prints were substituted for written consent and witnessed by an independent person – not a member of the study team.

## Visual examination

All participants underwent an eye examination conducted by the ophthalmic members of the study team, following the standard RAAB protocol:

1. Presenting visual acuity (VA) measurement of each eye (all participants).
2. Pinhole visual acuity assessment of each eye presenting VA<6/18.
3. Lens examination of each eye with a torch in a darkened room (all participants).
4. Posterior-segment examination with a torch of each eye presenting VA<6/18 where the principal cause cannot be attributed to refractive error, cataract or corneal scarring.
5. Assessment of the major cause of VI of each eye presenting VA<6/18 and in persons where both eyes present VA<6/18 and the causes are not the same.
6. Questions regarding cataract surgery where it has taken place.
7. Questions regarding why cataract surgery has not taken place, where it is indicated.

Minor ocular conditions identified were treated by the team. Other conditions were referred to the nearest appropriate health centre or hospital.

## Disability tool

Disability is a complex multidimensional concept, which in this study was measured using the Washington Group Short Set on Functioning – Enhanced (WG-SS Enhanced) (7). This tool comprises 12 questions regarding self-reported difficulties in eight different domains of functioning, including seeing, hearing, climbing stairs or walking, remembering or concentrating, self-care, communication, upper body activities, and affect (depression and anxiety). The four main response categories are 'no difficulty', 'some difficulty', 'a lot of difficulty' and 'cannot do at all'. Upper body activity and affect functioning was assessed using a scale based on symptom frequency and severity. This study used a binary indicator of non-visual disability, which took one if an individual reported at least a lot of difficulty in one or more of the first six functional domains other than seeing; severity levels three or four for upper body activity; the highest severity level for anxiety and depression (level 4); and zero otherwise. Visual impairments were diagnosed following an eye examination by a

clinician (described above). The Washington Group tool has been validated and is widely used.

## Nigeria Equity Tool

The Nigeria Equity Tool (NET) is an internationally-recognised tool designed to evaluate differences between social groups (8): participants are categorised into one of five quintiles according to ownership of a standardised list of household assets, with the poorest and often most marginalised in the bottom quintile, and the wealthiest in the top quintile. In a short survey, this tool allowed us to compare the wealth of our respondents to the national population (or populations) in other countries.

## Data analysis

The data was analysed in two main stages. First, a standardised analysis was carried out using the RAAB software programme, which is available and free to download (9). Second, bivariate and multivariate analyses – including chi-squared tests and adjusted logistic regression models – were used to estimate the associations between eye health outcomes, gender, wealth and disability. Regression model standard errors were clustered to account for complex sample design. The second stage of analysis was conducted in Stata, version 15 (10).

## Ethical considerations

This study was submitted to the Research Ethics Committee of Kogi State Ministry of Health Nigeria (NHREC), and satisfied all legal and regulatory requirements pertaining to research in Kogi State.

## Results (RAAB)

Table 1 Examination status of enrolled participants

	Male		Female		Total	
	n	%	n	%	n	%
<b>Examined</b>	1,643	94.8	2,283	95.2	3,926	94.7
<b>Not examined</b>	68	3.9	50	2.1	118	2.8
<b>Refused</b>	34	1.9	39	1.6	73	1.7
<b>Unable to communicate</b>	6	0.3	27	1.1	33	0.8
<b>Total</b>	1,751	100	2,399	100	4,150	100

Overall, the RAAB surveyed 4,150 participants aged 50 years or older, of whom 3,926 were examined (94.7% response rate).

**Table 2 Age and sex distribution of examined individuals**

	Male		Female		Total	
	n	%	n	%	n	%
<b>50-59</b>	747	47.7	1,091	48.3	1,838	48.0
<b>60-69</b>	502	27.2	634	29.3	1,136	28.4
<b>70-79</b>	232	13.8	339	12.7	571	13.2
<b>80+</b>	162	11.3	219	9.7	381	10.4
<b>Total</b>	1,643	100	2,283	100	3,926	100

The sample was approximately 58 per cent female (n=2,283) and 42 per cent male (n=1,643). Compared to sample females, a higher proportion of males were aged 80+ years and the oldest men were slightly older on average than the oldest women (in the oldest age group the median age was 85 years for men and 82 years for women).

**Table 3 Comparison of study sample and regional population (1)**

		Male				Female				Total			
		Region		Study sample		Region		Study sample		Region		Study sample	
		n	%	n	%	n	%	n	%	n	%	n	%
<b>Age</b>	50-59	73,631	47.0	747	45.5	57,897	47.9	1,091	47.8	131,528	47.4	1,838	46.8
	60-69	44,150	28.1	502	30.6	35,192	29.1	634	27.8	79,342	28.5	1,136	28.9
	70-79	21,739	13.9	232	14.0	15,455	12.8	339	14.8	37,194	13.4	571	14.6
	80+	17,222	11.0	162	9.9	12,385	10.2	219	9.6	29,607	10.7	381	9.7
<b>Total</b>		156,742	100	1,643	100	120,929	100	2,399	100	277,671	100	3,926	100

(1) Distribution of Population in National Assembly, Nigeria 2012 (accessed at <https://nigeria.opendataforafrica.org>).

Compared to the population, males were substantially under-represented in the sample (men made up just 42% of the sample, compared to 56% of the population), although the age distributions of sample and population for males and females were broadly comparable. Since this had the potential to bias estimates of the prevalence of blindness and visual impairment, non-coverage weights were used to adjust the sample distribution for sex and age so it corresponds to the known population distribution in Kogi.

Adjusted for age and sex, the prevalence of all-cause bilateral blindness was 3.5 per cent (95% CI 2.7-4.1) (Table 4). Compared with the overall sample, prevalence in the male subgroup was slightly higher (4.1%, 95% CI 3.1-5.2), while among females it was marginally lower (3.0%, 95% CI 2.4-3.9). With pinhole correction, the adjusted prevalence of bilateral blindness was 3.3 per cent (95% CI 2.7-4.1). Prevalence of SVI was 2.0 per cent (2.1% for men and 2.0% for women) and MVI was 8.4 per cent (8.8% for men and 8.1% for women).

Table 4 Prevalence of blindness, SVI and MVI (adjusted) – all cause (1)

	Male			Female			Total		
	n	%	95% CI	n	%	95% CI	n	%	95% CI
<b>Blindness - VA&lt;3/60 in the better eye with available correction or pinhole</b>									
<b>Bilateral blindness</b>	62	3.9	[3.0,5.1]	65	2.9	[2.3,3.8]	127	3.3	[2.7,4.1]
<b>Blind eyes</b>	279	8.5	[7.2-9.8]	281	6.2	[5.1-7.2]	560	7.1	[6.2-8.1]
<b>Blindness - VA&lt;3/60 in the better eye with available correction (presenting VA)</b>									
<b>Bilateral blindness</b>	64	4.1	[3.1,5.2]	68	3.0	[2.4,3.9]	132	3.5	[2.9,4.2]
<b>Blind eyes</b>	289	8.8	[7.5-10.1]	293	6.4	[5.4-7.5]	582	7.4	[6.5-8.4]
<b>Severe visual impairment (SVI) - VA&lt;6/60 - 3/60 in the better eye with available correction</b>									
<b>Bilateral SVI</b>	33	2.1	[1.5,2.9]	44	2.0	[1.4,2.8]	77	2.0	[1.6,2.6]
<b>SVI eyes</b>	87	2.7	[2.0-3.3]	118	2.6	[2.0-3.2]	205	2.6	[2.2-3.0]
<b>Moderate visual impairment (MVI) - VA&lt;6/18 - 6/60 in the better eye with available correction</b>									
<b>Bilateral MVI</b>	142	8.8	[7.0,10.9]	184	8.1	[6.7,9.7]	326	8.4	[7.2,9.8]
<b>MVI eyes</b>	296	9.0	[7.3-10.7]	458	10.0	[8.5-11.5]	754	9.6	[8.3-10.9]

(1) Non-coverage weights were used to adjust for differences between the sample distribution of age and sex and the known population totals in Kogi.

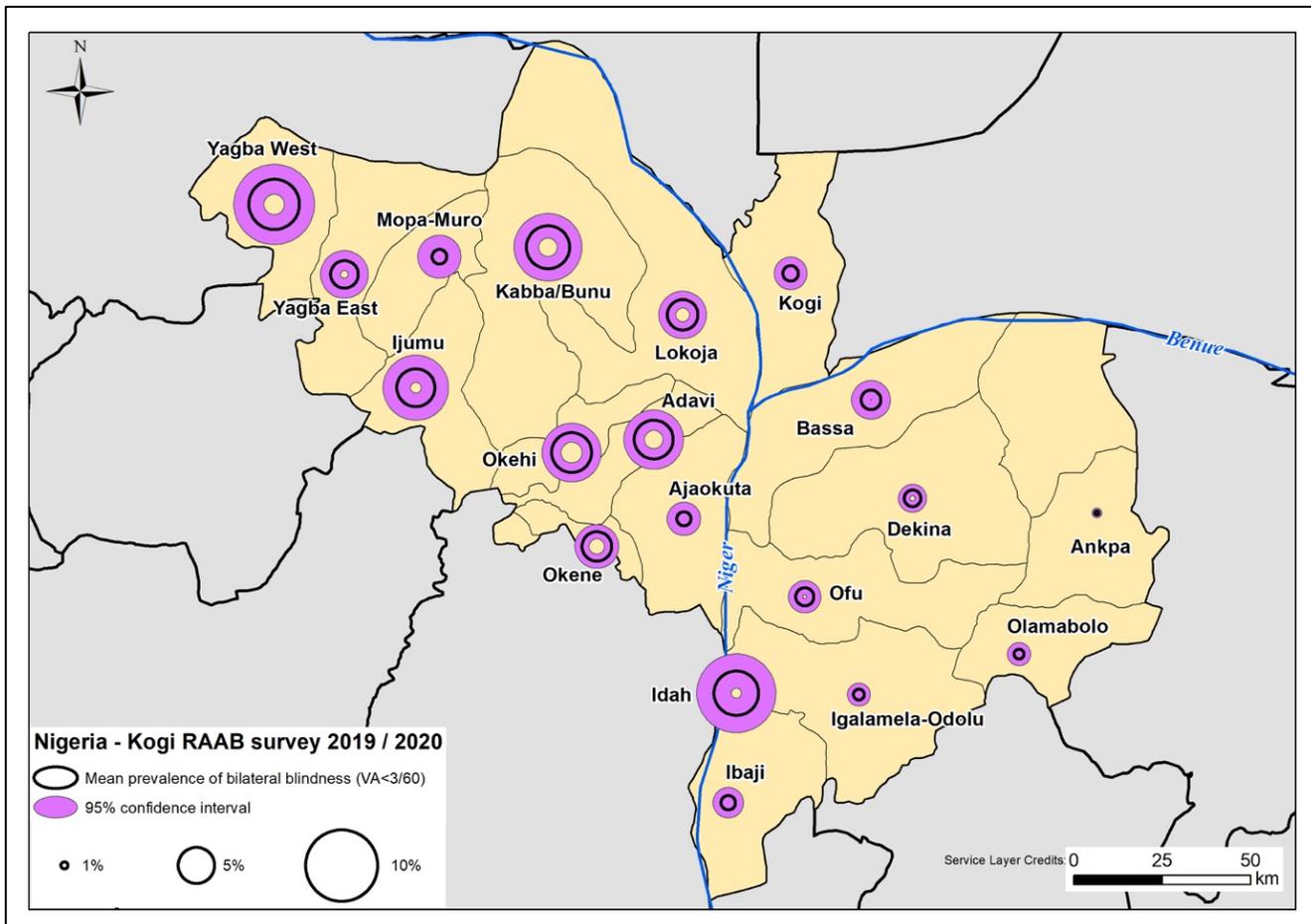
Table 5 Age and sex distribution of bilateral blindness among people aged 50+ (adjusted) (1)

		Male		Female		Total	
		%	95% CI	%	95% CI	%	95% CI
<b>Age</b>	50-59	14.0	[7.0,25.9]	10.1	[4.8,20.0]	12.0	[7.1,19.5]
	60-69	16.6	[9.7,27.1]	25.6	[16.4,37.6]	21.2	[15.0,29.1]
	70-79	19.2	[10.6,32.3]	13.6	[7.7,23.0]	16.3	[10.5,24.6]
	80+	50.2	[36.9,63.5]	50.7	[38.7,62.6]	50.5	[41.4,59.5]

(1) PVA<3/60 in better eye.

As expected, the prevalence of bilateral blindness increased with age (Table 5). Roughly half of all cases of bilateral blindness among men and women over 50 years of age were observed in the oldest age group – individuals aged 80 years or older.

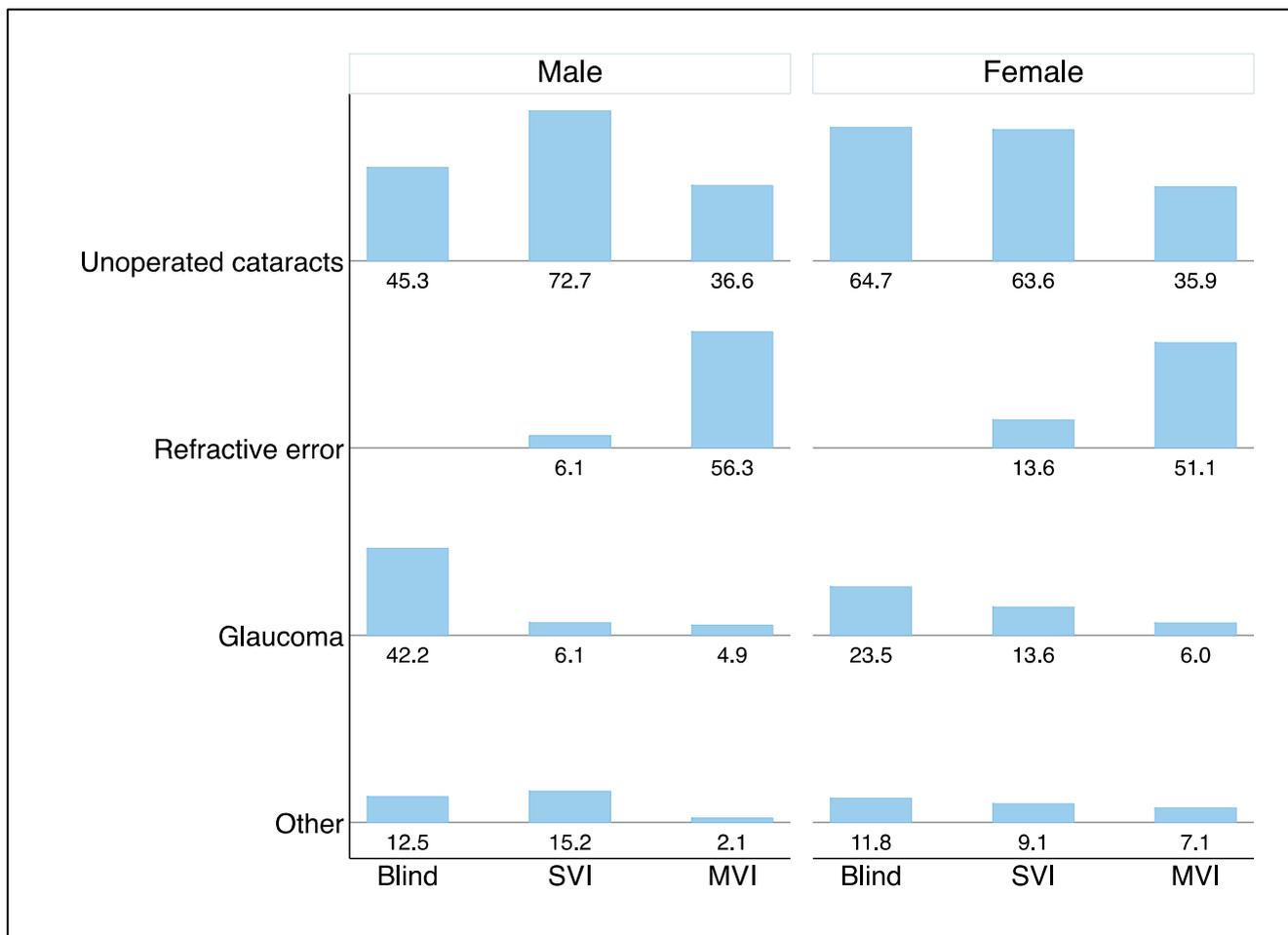
**Figure 3 Mean prevalence of all-cause bilateral blindness at Local Government Area (LGA) level (1)**



(1) Survey clusters in several LGAs contained no bilateral blindness (Ogori-Magongo; Omala).

Figure 3 shows the geographic distribution of bilateral blindness (all-cause) by local government area (LGA). In general, people in LGAs west of the River Niger appeared to experience more visual impairment than those living east, although these unadjusted estimates of prevalence should be interpreted with caution.

**Figure 4 Main causes of visual impairment and blindness by sex (%)**



Overall, the principal cause in 55.6 per cent of cases of bilateral blindness was untreated cataracts (95% CI 47.0-63.9). The proportion was considerably higher among females than males, although the difference was only borderline statistically significant (64.7% vs 45.3%,  $p=0.054$ ). The second most common cause of bilateral blindness also appeared to be unevenly distributed by sex: 42.2 per cent of blindness in men was attributed to glaucoma, whereas this was just 23.5 per cent in women. However, due to the small sample size for this subgroup we were unable to determine whether these differences were non-random.

Unoperated cataracts was also the main cause of SVI in both male and female subgroups (72.7% and 63.6%, respectively). Refractive error accounted for 13.6 per cent of SVI among women. The majority of male and female MVI was caused by refractive error (56.3% for men and 51.1% for women). However, cataracts were still responsible for more than a third of MVI.

**Table 6 Prevalence of bilateral cataracts with VA<3/60, VA<6/60, and VA<6/18 (adjusted)**

	Male			Female			Total		
	n	%	95% CI	n	%	95% CI	n	%	95% CI
<b>Cataract and VA&lt;3/60 in the better eye with available correction or pinhole</b>									
	20	1.2	[0.7,2.0]	35	1.5	[1.1,2.2]	55	1.4	[1.0,1.9]
<b>Cataract and VA&lt;6/60 in the better eye with available correction or pinhole</b>									
	40	2.4	[1.8,3.2]	57	2.5	[1.9,3.3]	97	2.5	[2.0,3.0]
<b>Cataract and VA&lt;6/18 in the better eye with available correction or pinhole</b>									
	90	5.4	[4.4,6.7]	127	5.6	[4.7,6.6]	217	5.5	[4.8,6.4]

The adjusted prevalence of bilateral blindness due to cataracts was 1.4 per cent (95% CI 1.0-1.9). Cumulatively unoperated cataracts was also estimated to cause between 2.0 and 3.0 per cent of severe visual impairment and blindness (VA<6/60), and from 4.8 to 6.4 per cent of moderate to severe visual impairment and blindness (VA<6/18). No statistically-significant differences in the distribution of visual impairment and bilateral blindness due to cataracts was observed between male and female subgroups.

**Table 7 Cataract surgical coverage (adjusted)**

	Male	Female	Total
	%	%	%
<b>Cataract surgical coverage (eyes)</b>			
VA < 3/60	29.9	25.4	28.1
VA < 6/60	24.2	20.2	22.6
VA < 6/18	16.6	12.7	15.0
<b>Cataract surgical coverage (persons)</b>			
VA < 3/60	54.9	42.1	49.3
VA < 6/60	39.1	31.8	36.0
VA < 6/18	24.1	17.8	21.5

Cataract surgical coverage (CSC) measures the proportion of cataracts that have been operated on. Coverage was noticeably lower for individual eyes. Age and sex adjusted CSC was just 28.1 per cent for blind eyes (VA<3/60), although slightly higher for males and lower for females (29.9% vs 25.4%). CSC was 49.3 per cent among bilaterally blind persons, and again coverage was higher among men compared to women (54.9% vs 42.1%).

Table 8a Visual outcomes of cataract surgery

	Non-IOL		IOL		Couching		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%
<b>VA with available correction (PVA)</b>								
<b>Good: can see 6/18</b>	0	0.0	61	55.0	0	0.0	61	52.6
<b>Borderline: can see 6/60</b>	0	0.0	19	17.1	0	0.0	19	16.4
<b>Poor: cannot see 6/60</b>	4	100.0	31	27.9	1	100.0	36	31.0
<b>Total</b>	4	100.0	111	100.0	1	100.0	116	100.0
<b>VA with best pinhole correction (BCVA)</b>								
<b>Good: can see 6/18</b>	0	0.0	71	64.0	0	0.0	71	61.2
<b>Borderline: can see 6/60</b>	0	0.0	15	13.5	0	0.0	15	12.9
<b>Poor: cannot see 6/60</b>	4	100.0	25	22.5	1	100.0	30	25.9
<b>Total</b>	4	100.0	111	100.0	1	100.0	116	100.0

Table 8a shows that of the 116 eyes operated on for cataract, 61 (52.6%) had good presenting vision (VA>6/18) increasing to 71 (61.2%) with best correction; 16.4 per cent had borderline presenting vision, and even with pinhole correction more than a quarter (25.9%) of operated eyes still had poor visual outcomes after surgery (VA<6/60).

Table 8b Causes of visual outcomes in operated eyes

	Selection		Surgery		Spectacles		Sequelae		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%	Eyes	%
<b>Good: can see 6/18</b>	0	0.0	0	0.0	0	0.0	0	0.0	61	52.6
<b>Borderline: can see 6/60</b>	0	0.0	8	27.6	7	77.8	4	40.0	19	16.4
<b>Poor: cannot see 6/60</b>	7	100.0	21	72.4	2	22.2	6	60.0	36	31.0
<b>Total</b>	7	100.0	29	100.0	9	100.0	10	100.0	116	100.0

Surgical complications were identified as the most common cause of poor visual outcomes in operated eyes (21/36), followed by selection (7/36) and sequelae (6/36) (Table 8b). Both surgical complications and lack of spectacles were important causes of borderline outcomes.

**Table 8c VA in operated eyes by years after surgery**

	3 yrs post-op.		4-6 yrs post-op.		7+ yrs post-op.		Total	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%
<b>Good: can see 6/18</b>	21	63.6	20	66.7	20	37.7	61	52.6
<b>Borderline: can see 6/60</b>	5	15.2	4	13.3	10	18.9	19	16.4
<b>Poor: cannot see 6/60</b>	7	21.2	6	20.0	23	43.4	36	31.0
<b>Total</b>	33	100.0	30	100.0	53	100.0	116	100.0

Table 8c shows 63.6 per cent of operated eyes in the last three years had good visual outcomes, which rises to 66.7 per cent for those operated in the last four to six years. In contrast, just 37.7 per cent of eyes operated on seven or more years ago had good vision (VA<6/18).

**Table 8d VA in operated eyes by place of surgery**

	Gov. hospital		Vol. hospital		Priv. hospital		Eye camp		Traditional	
	Eyes	%	Eyes	%	Eyes	%	Eyes	%	Eyes	%
<b>Good: can see 6/18</b>	42	50.6	7	58.3	9	56.3	3	75.0	0	0.0
<b>Borderline: can see 6/60</b>	15	18.1	2	16.7	1	6.3	1	25.0	0	0.0
<b>Poor: cannot see 6/60</b>	26	31.3	3	25.0	6	37.5	0	0.0	1	100.0
<b>Total</b>	83	100.0	12	100.0	16	100.0	4	100.0	1	100.0

Most operations took place in government hospitals (83/116), with approximately half achieving good outcomes, and slightly more than 30 per cent achieving poor outcomes. Private hospitals were the second most popular location, with similar proportions of good and poor outcomes. Fewer eyes were operated in voluntary hospitals or eye camps, but those that were had proportionately higher good outcomes (7/12 and 3/4, respectively) (see Table 8d).

**Table 9 Barriers to cataract surgery**

	Male		Female		Total	
	n	%	n	%	n	%
<b>Bilateral (BCVA&lt;6/60) due to cataract</b>						
<b>Need not felt</b>	27	35.5	42	37.5	69	36.7
<b>Fear</b>	7	9.2	9	8.0	16	8.5
<b>Cost</b>	33	43.3	45	40.2	78	41.5
<b>Treatment denied by provider</b>	4	5.3	2	1.8	6	3.2
<b>Unaware treatment is possible</b>	4	5.3	3	2.7	7	3.7
<b>Cannot access treatment</b>	0	0.0	7	6.3	7	3.7
<b>Local reason</b>	1	1.3	4	3.6	5	2.7
<b>Total</b>	76	100.0	112	100.0	188	100.0
<b>Unilateral (BCVA&lt;6/60) due to cataract</b>						
<b>Need not felt</b>	119	56.7	125	54.3	244	55.5
<b>Fear</b>	14	6.7	12	5.2	26	5.9
<b>Cost</b>	57	27.1	79	34.3	136	30.9
<b>Treatment denied by provider</b>	4	1.9	2	0.9	6	1.4
<b>Unaware treatment is possible</b>	11	5.2	2	0.9	13	3.0
<b>Cannot access treatment</b>	2	1.0	2	0.9	4	0.9
<b>Local reason</b>	3	1.4	8	3.5	11	2.5
<b>Total</b>	210	100.0	230	100.0	440	100.0

More than 40 per cent of people with untreated bilateral cataracts cited cost as the main barrier to surgery; 36.7 per cent didn't feel they needed the operation; and 8.5 per cent reported being too afraid to have surgery (Table 9). Relatively few were denied or unable to access treatment. There was little difference between how men and women reported barriers.

The most common barrier to surgery among individuals with unilateral cataracts was feeling the operation was unnecessary (55.5%).

**Table 10 Uncorrected refractive error and presbyopia**

	Male		Female		Total	
	n	%	N	%	n	%
<b>Total refractive errors</b>	129	7.9	134	5.9	263	6.7
<b>Uncorrected refractive errors</b>	82	5.0	100	4.4	182	4.6
<b>Uncorrected presbyopia</b>	1,381	84.1	2,083	91.2	3,464	88.2

The prevalence of refractive error (RE) was 6.7 per cent, more than two-thirds of which was uncorrected (Table 10). Among men, the prevalence of RE was higher than among women (7.9% vs 5.9%). Uncorrected presbyopia was 88.2 per cent, and slightly higher in females compared with males (91.2% for women and 84.1% for men).

## Results (Eye health, wealth and disability)

**Table 11 Prevalence of additional, non-visual disability (adjusted) (1)**

	Male			Female			Total		
	n	%	95% CI	n	%	95% CI	n	%	95% CI
<b>Non-visual disability</b>									
Yes	1513	92.1	[90.3,93.6]	2095	91.8	[89.4,93.7]	3608	91.9	[90.0,93.5]
No	130	7.9	[6.4,9.7]	188	8.2	[6.3,10.6]	318	8.1	[6.5,10.0]

(1) Definition based on Washington Group Short Set on Functioning – Enhanced (WG-SS Enhanced), excluding self-reported difficulties seeing.

The adjusted prevalence of non-visual disability was an estimated 8.1 per cent (95% CI 6.5-10.0). No significant difference was observed between male and female subgroups.

**Table 12 Prevalence of bilateral blindness and VI by disability status (adjusted) – all cause**

	Non-visual disability			No disability		
	n	%	95% CI	n	%	95% CI
<b>Blindness - VA&lt;3/60 in the better eye with available correction or pinhole</b>						
	86	27.1	[19.5,36.5]	45	1.2	[0.9,1.8]
<b>Blindness - VA&lt;3/60 in the better eye with available correction (presenting VA)</b>						
	87	27.5	[19.8,36.9]	49	1.3	[1.0,1.9]
<b>Severe visual impairment (SVI) - VA&lt;6/60 - 3/60 in the better eye with available correction</b>						
	17	5.3	[3.1,9.2]	61	1.7	[1.3,2.3]
<b>Moderate visual impairment (MVI) - VA&lt;6/18 - 6/60 in the better eye with available correction</b>						
	43	13.5	[10.3,17.5]	286	7.9	[6.7,9.4]

Adjusted for age and sex, the prevalence of all cause bilateral blindness among people living with additional, non-visual disabilities was 27.5 per cent (95% CI 19.8-36.9). With pinhole correction, the prevalence of bilateral blindness in this population was slightly lower – at 27.1 per cent (95% CI 19.5-36.5). Prevalence of SVI and MVI was estimated at 5.3 per cent and 13.5 per cent, respectively.

In general, bilateral blindness was evenly distributed by wealth (Table 13). For example, for the poorest households the prevalence of blindness with pinhole correction was 3.2 per cent, while for the richest households it was 3.3 per cent. However, the prevalence of SVI and MVI was slightly higher among poorer families compared to their wealthier counterparts.

Table 13 Wealth distribution of blindness and visual impairment

	1st quintile		2nd quintile		3rd quintile		4th quintile		5th quintile	
	%	95% CI	%	95% CI						
<b>Blindness - VA&lt;3/60 in the better eye with available correction or pinhole</b>										
	3.2	[2.1,4.6]	3.9	[2.5,6.1]	4.4	[3.1,6.0]	2.1	[1.3,3.4]	3.3	[2.3,4.7]
<b>Blindness - VA&lt;3/60 in the better eye with available correction (presenting VA)</b>										
	3.2	[2.1,4.6]	4.2	[2.8,6.4]	4.4	[3.1,6.0]	2.4	[1.5,3.7]	3.5	[2.5,4.9]
<b>Severe visual impairment (SVI) - VA&lt;6/60 - 3/60 in the better eye with available correction</b>										
	2.7	[1.8,3.9]	1.7	[0.9,3.2]	2.3	[1.4,3.7]	1.8	[1.0,3.2]	1.0	[0.4,2.3]
<b>Moderate visual impairment (MVI) - VA&lt;6/18 - 6/60 in the better eye with available correction</b>										
	9.5	[7.3,12.2]	9.0	[6.9,11.7]	8.3	[6.2,11.2]	8.6	[6.5,11.2]	5.5	[3.6,8.3]

Table 14 Results from multivariate logistic regression models (odds ratios)

		Visual impairment (VA<6/60)					
		Model 1			Model 2 (1)		
		OR	95% CI	p-value	OR	95% CI	p-value
<b>Non-visual disability</b>	No	-	-	-	-	-	-
	Yes	9.29	[5.49, 15.73]	<0.001	14.57	7.80, 27.23	0.609
<b>Sex</b>	Male	-	-	-	-	-	-
	Female	0.83	[0.61, 1.13]	0.242	1.11	0.75, 1.65	0.242
<b>Age</b>	50-59	-	-	-	-	-	-
	60-69	3.24	[1.98, 5.30]	<0.001	3.22	1.96, 5.29	<0.001
	70-79	4.92	[2.90, 8.37]	<0.001	4.77	2.79, 8.17	<0.001
	80+	12.89	[7.78, 21.33]	<0.001	12.73	7.72, 21.00	<0.001
<b>Wealth</b>	1st quintile	-	-	-	-	-	-
	2nd quintile	0.94	[0.57, 1.54]	0.802	0.92	0.56, 1.51	0.733
	3rd quintile	1.03	[0.62, 1.73]	0.897	1.00	0.59, 1.68	0.996
	4th quintile	0.69	[0.39, 1.20]	0.187	0.67	0.39, 1.17	0.158
	5th quintile	0.83	[0.48, 1.41]	0.484	0.81	0.47, 1.40	0.458
<b>Non-visual disability*sex (2)</b>	-	-	-	0.44	0.22, 0.89	0.021	

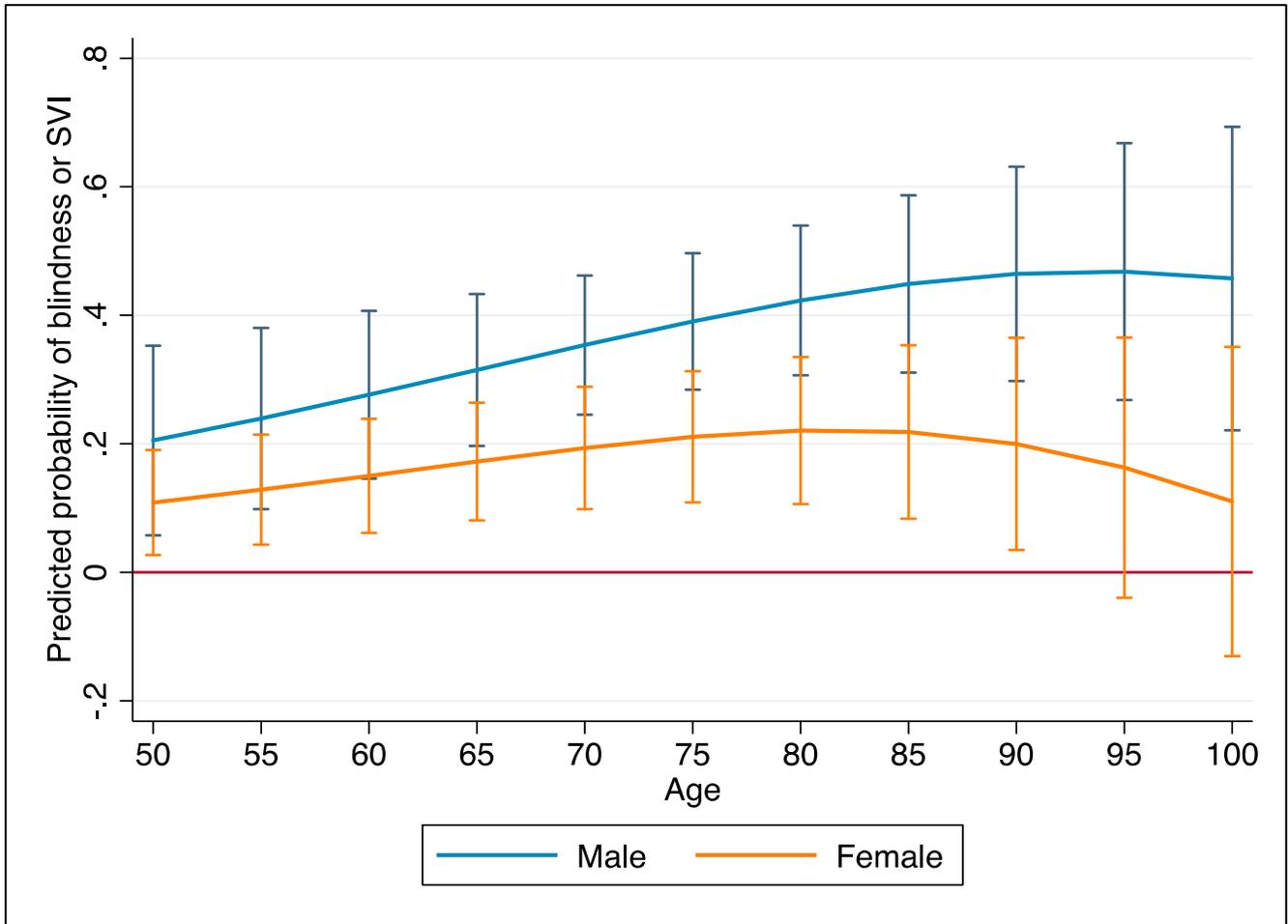
(1) Two-way interaction model (non-visual disability with sex).

(2) Wald  $\chi^2=5.30$ ,  $p=0.021$ .

Consistent with crude estimates (see Table 13), results from a multivariate logistic regression model indicated a significant association between non-visual disability and severe visual impairment or worse (OR 9.29, 95% CI 5.49-15.73). In other words, the likelihood of being blind or severely visually impaired for a person living with additional, non-visual disabilities was more than nine times higher than for a person without disabilities of the same

sex, age and wealth. However, two-way interaction model results also suggest that women with non-visual disabilities were more than half as likely to have vision impairment compared to similar men.

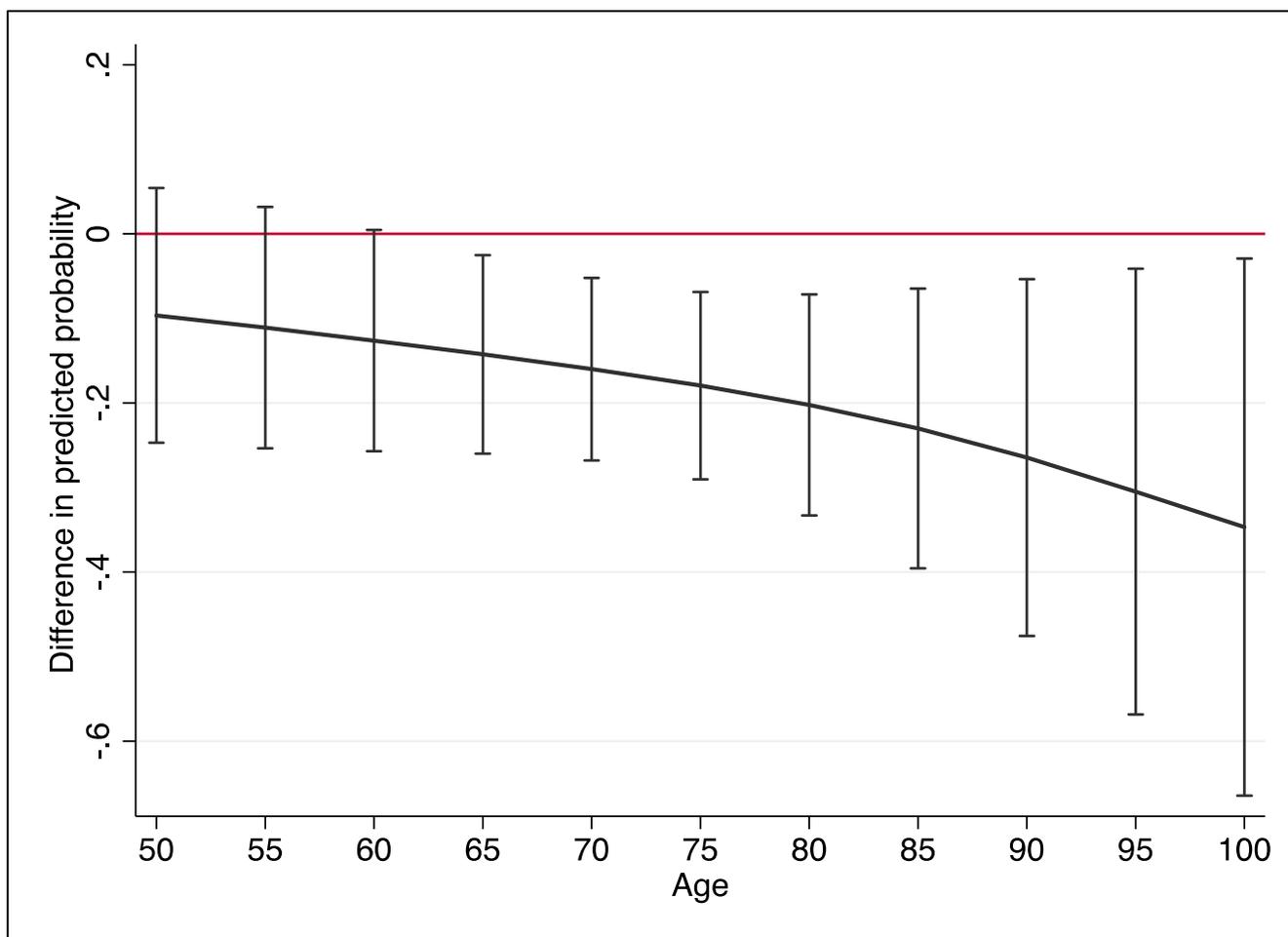
**Figure 5 Predicted probability of SVI or worse (VA<6/60) for people with disabilities**



Using stored results from a three-way interaction model (non-visual disability with sex with age) to obtain predicted probabilities, it is clear that the likelihood of SVI or worse for both men and women with additional, non-visual disabilities was significantly higher than for men and women without disability (Figure 5).

The difference in the probability of SVI or blindness between males and females with non-visual disabilities was statistically significant from 65 years onwards (Figure 6). That is, the likelihood that a woman with additional, non-visual disabilities was blind or visually impaired compared with a similarly disabled man decreased in a non-random way as men and women got older.

**Figure 6 Difference between men and women with disabilities in the predicted probability of SVI or worse (VA<6/60)**



## Discussion

This study adopted a standardised RAAB methodology to assess the prevalence and causes of visual impairment in Kogi State, Nigeria. It also used internationally comparable measures of self-reported functional impairments and relative household wealth to better understand associations between eye-health outcomes, poverty and disability.

The response rate of 94.4 per cent was good, although non-response was slightly higher among men. Comparing the population distribution in Kogi with the study sample also suggests the study may have been under-representative of the male group, so non-coverage weights were used to adjust the sample to better reflect known population totals. One possible explanation for the under-representation of males is the largely agricultural economy in Kogi, which may lead to more men being absent from the household for farm work, despite being informed of the survey.

The authors are unaware of any earlier estimates of the prevalence of blindness and visual impairment for Kogi State. However, the prevalence of blindness (VA<3/60) in this study measured in the better eye with best [pinhole] correction was 3.5 per cent (95% CI 2.9-4.2) of the population – similar to the 3.7 per cent (95% CI 3.0-4.7) observed in the North-Central geopolitical zone in the 2005-2007 Nigeria national blindness survey (4).

Blindness and visual impairment in Kogi were highly correlated with age – the oldest age-group in the survey accounting for more than 50 per cent of the total number of cases of blindness – which is consistent with global estimates (11). Yet, in contrast with previous Nigerian study findings, no clear gender differences were observed (4); the male group in Kogi had a higher prevalence of all-cause blindness compared with the female population, but the difference was not statistically significant.

The principal cause of visual impairment was identified following an eye examination of individuals with presenting VA<6/18 in the better eye. Cataract was the most common cause of bilateral blindness (64.7% for women; 45.3% for men) and severe visual impairment (63.6% for women; 72.7% for men). Cataract surgical coverage (CSC) is a ratio of the number of cataracts surgeries performed and the total number needed. In Kogi, CSC (for eyes) was just 28.1 per cent of cataract blind eyes, indicating almost three-quarters of cataract blind eyes were untreated. Meanwhile, total CSC (persons) was 49.3 per cent, but noticeably higher for blind males (54.9%) than for females (42.1%). In comparison, a systematic review of CSC in sub-Saharan Africa found coverage varied widely, with total CSC (persons) as low as 22 per cent for cataract blind people in Burundi and as high as 80 per cent in Cameroon (12). The difference in CSC for male and female subgroups suggests there are gender-specific barriers facing women who require surgery in Kogi. However, no statistically-significant differences were observed between men and women in reported barriers to surgery, and so further analysis into gender specific barriers may be required. The issue of one operated eye indicates some issue with services – a common practice in public services in the central zone and some other parts of Nigeria is to provide waivers to cataract surgical fees for people with bilateral cataract who cannot afford the fees. These waivers usually do not apply to the second eye unless the person demonstrates very severe economic deprivation. Another contributor could be the increasing reliance on eye camps in Kogi State. Given that eye camps are intermittent, it is possible that some people stay long periods of time with only one eye operated on. Also, a person bilaterally blind from cataracts might not feel compelled to operate the other eye if he/she sees well with the other earlier operated eye. Conversely, if the initial surgery went awry, the individual may have a risk adverse attitude to future surgery.

Roughly, half of all operated eyes (52.6%) had good vision (presenting vision of 6/18 or above). However, almost one in three patients (31.0%) were still blind in the operated eye following surgery. This represents an improvement compared with earlier national estimates of cataracts surgical outcomes – the nationwide survey conducted between 2005 and 2007 found only 30.8% per cent of operations had a good outcome, and 43.2 per cent of eyes were blind after surgery (4) – but the proportion of poor outcomes remains high.

Among men and women, uncorrected refractive errors were the most common cause of moderate visual impairment (56.3% and 51.1%, respectively). The prevalence of moderate visual impairment was almost twice as high among the poorest families compared to the richest 20 per cent (9.5% vs 5.5%, respectively). Yet, the proportion of the population with severe visual impairment or blindness was fairly evenly distributed across wealth quintiles. This indicates fairly good levels of equity with regards to wealth in accessing eye care services currently, which programme managers should make efforts to maintain when considering changes to the eye health system in Kogi. It may be useful to investigate this

further so the factors linked with success in this regard can be understood and developed further in Kogi and elsewhere in Nigeria.

In contrast, significant variation in blindness and visual impairment was observed between people with additional, non-visual disabilities and people with no disabilities. The prevalence of bilateral blindness with the best available correction was more than 27 times higher among people living with additional, non-visual disabilities than people with no disability. This was underscored by results from the multivariate regression analysis. After accounting for the influence of gender, age and household wealth, the likelihood of being either bilaterally blind or severely visually impaired was, on average, nine times higher for people with additional, non-visual disabilities than it was for the rest of the population (OR 9.29, 95% CI 5.49-15.73,  $p < 0.001$ ). Important gender differences between men and women with non-visual disabilities were also observed. Compared to similar women, sample men with additional, non-visual disabilities were significantly more likely to be blind or visually-impaired, and this gender gap increased with age. Further analysis to understand the pathways through which disadvantage occurs for individuals with different physical, sensory and mental and psychosocial disabilities is an important step to deliver services that are accessible to all.

This study has several limitations common to all RAAB surveys, including the inability to diagnose causes of posterior segment disease, measure more than one cause per eye, and take into account the exclusion of non-visually impairing conditions (4). In addition, the estimated prevalence of blindness and visual impairment excludes people under 50 years of age. The distribution of sex in the study sample also differed to the distribution in population, making the study results potentially unrepresentative of the prevalence and causes of visual impairment among men in Kogi State (though non-coverage weights were used to compensate for this weakness).

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## Conclusions

This study provides up-to-date evidence on the prevalence and causes of blindness and visual impairment in Kogi State, Nigeria, which can be used to inform state level planning for eye care services, as well as better ensure equity of eye health outcomes.

The prevalence of blindness, compared to estimates obtained in 2005-2007, is roughly unchanged. However, meaningful differences observed in the eye health of men and women with additional, non-visual disabilities highlights the urgent need for actions to prevent vulnerable subgroups bearing a disproportionate burden of vision loss.

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