Rapid Assessment of Avoidable Blindness: Sierra Leone, 2021

June 2022

Sightsavers

Report authors and contributors

Emma Jolley, Head of Portfolio: Health & Disability Research, Sightsavers, UK

Dr Jalikatu Mustapha, Programme Manager, National Eye Health Programme, Ministry of Health, Sierra Leone

Tiangay Elaine Gondoe, Programme Manager, Sightsavers, Sierra Leone

Nancy Smart, Country Director, Sightsavers, Sierra Leone

Dr Nazaradden Ibrahim, Global Technical Lead; Eye Health, Sightsavers, Nigeria

Dr Elena Schmidt, Director Evidence, Research and Innovations, Sightsavers, UK

The report authors were also the study investigators: (PI: Dr Jalikatu Mustapha)

Other contributors:

The authors thank all members of the fieldwork teams for their vital contributions to the study, in particular the team leads: Dr. Lloyd Harrison Williams, Dr. John Mattia, Lansana Sheriff, Sheku Koroma, and Feimata Yokie.

Suggested reference

Jolley E, Mustapha J, Gondoe T, Smart N, Ibrahim N, Schmidt E. Rapid Assessment of Avoidable Blindness (RAAB) report, Sierra Leone. Haywards Heath (UK): Sightsavers. 2022 43p.

Executive summary

In 2020, among 7.8 billion people globally, an estimated 43.3 million were blind and 295.0 million people had moderate or severe visual impairment (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 – unaddressed 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 December 2021, we conducted a RAAB in Sierra Leone 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 2,650 individuals aged 50 years and over, of whom 2,498 were examined (94.3% response rate). After adjusting for age and sex, the prevalence of blindness was 5.4% (measured as presenting visual acuity in the better eye), which was similar to the 4.9% observed in RAAB conducted in 2010/2011 (2). 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 50.5%, although coverage was more than twice as high among blind males (68.3%) compared to blind females (33.2%). In terms of surgical outcomes, roughly half of all operated eyes (53.0%) had good vision, which represents an improvement compared with earlier national estimates of cataract surgical outcomes (the 2010/2011 RAAB found only 38.3% of operations had a good outcome) (2). Uncorrected refractive errors were the most common cause of moderate visual impairment. Important variation in blindness and visual impairment was observed between people with additional, non-visual disabilities and people with no disabilities. People living in the poorest two wealth quintiles appeared more likely to experience severe visual impairment of blindness than those living in richer households.

The RAAB findings indicate a mixed picture in terms of the change in eye health status and coverage since 2010/2011. This is perhaps to be expected given the tumultuous decade faced by the Sierra Leonean health care system, and this data will support the strengthening and ongoing monitoring of the national eye health system and service delivery.

Contents

Introduction

Visual impairment globally and in Sierra Leone

In 2020, among 7.8 billion people globally, an estimated 43.3 million were blind (1). A further 295.0 million people had moderate or severe visual impairment. Among older adults, all-age-standardised prevalence of blindness decreased by 28.5% between 1990 and 2020, and yet the estimated number of blind persons increased by 50.6%, mainly due to population growth and aging (1, 3). More than 75% of visual impairment globally is either preventable or treatable. Measures to prevent or treat visual impairment should focus on increasing access to quality comprehensive and accessible eye care services, including at the community level.

To reduce the burden of visual impairment, the World Health Organization (WHO) recommends focus on strengthening eye care services through their integration into the broader health system. To achieve this, a global eye health resolution (Resolution WHA73.4 'Integrated people-centred eye care, including preventable vision impairment and blindness') sets feasible global eye care targets for 2030, focusing on effective refractive error coverage and effective cataract surgery coverage. The resolution builds on the principles of the global initiative, Vision 2020: the Right to Sight, and expresses the commitment of Member States to reducing avoidable visual impairment and achieving quality of life for all citizens. As part of the VISION 2020 initiative, many countries developed national plans for elimination of avoidable blindness. A major constraint in the implementation of these national plans and policies in developing countries has been the absence of country-specific epidemiological data. In order to resolve this issue, WHO recommends conducting periodic population-based studies, such as Rapid Assessment of Avoidable Blindness (RAAB) to provide data for decision-making and programme planning. RAAB is a standard methodology for obtaining reliable results for people in the age group with the highest prevalence of visual impairment, that is, those over 50 years of age (4).

Since the development of the methodology, over 300 RAABs have been conducted globally and over 50 in sub-Saharan Africa (5). According to the last RAAB survey conducted in Sierra Leone in 2010/2011, the prevalence of blindness in the sample of people aged 50+ years was 5.9%; 6.5% for males and 5.5% for females (2). Of all blindness in Sierra Leone at that time, 91.5% was due to avoidable causes, and 58.2% was treatable. The RAAB identified that cataract was the major cause of blindness (54.2%) followed by glaucoma (17.5%), other posterior segment disease (6.8%) and non-trachomatous corneal opacities (6.2%). In 2013, there was another survey in Sierra Leone, which examined people's knowledge, attitudes and practices (KAP) around visual impairment and disability. The survey showed that the majority of respondents (84.5%) had high levels of awareness about cataract; however, only 5.1% of respondents showed awareness about glaucoma (6).

Access to eye care services is not always equitable and certain groups of people have been noted as vulnerable to exclusions, for example, women, poor people and people with disabilities (7). Population growth and rapid demographic changes throughout Sierra Leone mean that it is imperative that existing resources (human, financial, infrastructure and equipment) be reviewed and revised in order to effectively target the major avoidable causes of blindness. The National Eye Health Programme (NEHP) realises the importance of up-to-date population-based data for evidence-based eye care planning in the country (8). Moreover,

non-governmental organisations have planned to increase support to eye care activities for successful implementation of eye health programmes in Sierra Leone but can only do so if there is scientifically valid evidence on which to advocate, prioritise and plan.

In addition to visual impairment, a large number of people over the age of 50 years also experience other types of disabilities (9). The 2015 Population and Housing census found that of a total population of 7,092,133 people in the country, 93,129, (1.3%), have a disability (10), although this proportion might be a significant underestimate. The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) states that people with disabilities include those with "long-term physical, mental, intellectual or sensory impairment, which in interaction with various barriers may hinder their full and effective participation in society on an equal basis" (11). It is widely acknowledged that those with disabilities are also further marginalised due to low socio-economic status. Evidence suggests that people with disabilities are often less likely to access the health services they need and it is therefore important to understand how they experience access to eye health services compared to the rest of the population so that appropriate services can be planned to ensure they benefit.

Objectives of this study

The last RAAB in Sierra Leone was conducted in 2010/2011, followed by the Eye Health Systems Assessment (EHSA) in 2013 (12). Since then, no new data is available to guide Sierra Leone policymakers in the development of a new eye care plan. A need was identified for up-to-date and accurate population-based prevalence data for planning and monitoring purposes, including a specific focus on marginalised groups.

The aim of this RAAB was to provide up-to-date data for eye health planning and programmes by the Ministry of Health and its partners in Sierra Leone.

General objective

To estimate the prevalence and causes of blindness and visual impairment among people aged ≥50 years in Sierra Leone.

Specific objectives

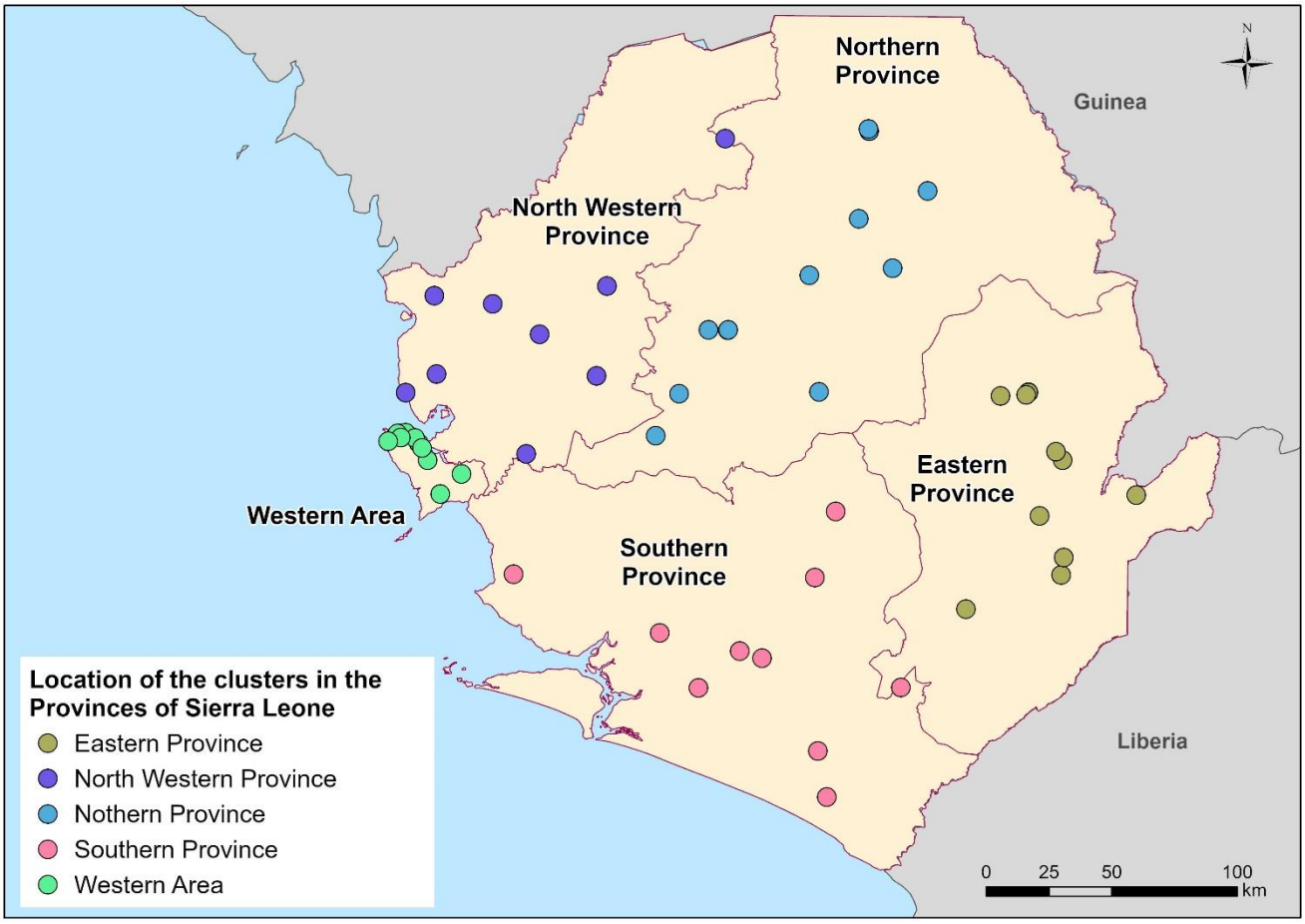
- To determine the prevalence and distribution of blindness and visual impairment in the study population
- To determine the causes of blindness and visual impairment
- To assess access to cataract surgical services by determining cataract surgical coverage and visual outcomes from cataract surgery
- To determine the barriers to uptake of cataract services
- To determine the prevalence of disability among the study population
- To explore the relationship between disability and socio-economic status and eye health

Methods

Study design and population

This RAAB is a descriptive, cross-sectional population-based study. The study was designed to be conducted in all regions of Sierra Leone. These five first-order administrative divisions (Northern, Northwest, Eastern, and Southern Provinces, and the Western Area) are sub-divided into 16 districts at second-order level. The Sierra Leone population was projected to be 8,320,978 in 2021 (10).

Figure 1: Location of study clusters within Sierra Leone



The study population was people aged 50 years and above who live in Sierra Leone. RAAB includes only the 50 and above-age group, as this is where the prevalence of blindness is highest.

Inclusion criteria

The inclusion criteria were:

- Be aged 50 and over
- Have consented to participate
- Have been ordinarily resident in the household for at least six months prior to the survey

Exclusion criteria

The following people were excluded from the study:

- Aged less than 50 years
- Visitors to the household
- Refused to consent

Sample size and strategy

The sample size was calculated using the RAAB (version 6) software package. The following information was used to calculate the sample size:

- Based on the 2015 Population and Housing Census, the total projected population of persons with or without disabilities of all ages is 8,320,978: 4,091,750 males and 4,229,228 females
- Based on the 2010/11 RAAB, expected prevalence of blindness in the sample of 5.9%
- Worst acceptable prevalence: 4.72% (+/- 20%)
- Confidence interval (CI): 95%
- Non-response rate: 10%
- Design effect: 1.5

A minimum sample size of 2,552 persons aged 50 years was required for this study. These persons were selected from 52 clusters of 50 persons aged 50 years and above, which gave a total sample size of 2,600.

Two-stage sampling was used. For the first stage, 52 primary sampling units, villages, were selected from a complete list using probability proportionate to size methodology. Five additional, 'spare' clusters were identified in case any of the original 52 proved inaccessible for any reason. A list of all villages in Sierra Leone with their populations was obtained and verified by Statistics Sierra Leone official website (2015 census using 2021 projections (10)). The complete list of the villages was uploaded to the RAAB software, which has an in-built probability proportionate to size selection tool.

Within each village, 50 eligible participants were enrolled in the study. A cluster informer visited the village a few days before the team arrived and worked with the village leaders in order to identify the border of the village. If the village population was large – exceeding 500 inhabitants – a map was developed with the village leader to segment it into smaller segments. In this case, a segment was chosen at random through numbering them and choosing a number at random.

Once the village/segment boundaries were clear, the cluster informer informed the study team and provided them with a copy of the map. On the day of the study team visit, the team met with the village leader and nominated guide. The study team started at the house in the segment closest to the main road.

After arriving at the house, the team introduced themselves to the head of the household, facilitated through the village guide who was chosen by the leader due to their knowledge of the community. They ascertained how many people were eligible to participate in the study. As well as providing comprehensive information about the study and purpose of the visit, the

team informed the eligible participants of their rights to refuse or withdraw permission to participate, as well of the potential benefits of participation. Written consent was obtained, and in the case where a participant was illiterate, their thumb print was obtained and witnessed by an independent person, not part of the study team.

Within each household, all residents were enumerated, including those temporarily absent. All participants present and consenting underwent visual acuity screening, and the team attempted to revisit the house at the end of the day to capture anyone missing at the time of the initial visit. Basic data about participants unavailable for the visual acuity screening were collected from their family members or neighbours, if possible.

The team then proceeded to the next nearest house until 50 people had been enumerated.

Study instruments

Visual examination

All participants underwent ophthalmic examination by the ophthalmic team. The examination followed the standard RAAB protocol, which is described in the RAAB 6 manual, and included the following steps:

1. Measured presenting visual acuity measurement of each eye (all participants)
2. Measured pinhole visual acuity assessment of each eye presenting <6/12
3. Examined lens of each eye with a torch in a darkened room (all participants)
4. Examined posterior-segment with a direct ophthalmoscope of each eye presenting <6/12 where the principal cause cannot be attributed to refractive error, cataract or corneal scarring
5. Assessed the major cause of visual impairment of each eye presenting <6/12 and in persons where both eyes present <6/12 and the causes are not the same
6. Asked questions regarding cataract surgery where it has taken place
7. Asked 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.

The International Classification of Diseases 11 (2018) classifies distance vision impairment as follows:

- Mild, termed early visual impairment in RAAB, (EVI) – visual acuity worse than 6/12 to 6/18
- Moderate visual impairment (MVI) – visual acuity worse than 6/18 to 6/60
- Severe visual impairment (SVI) – visual acuity worse than 6/60 to 3/60
- Blindness – visual acuity worse than 3/60

The study tool is included in Appendix A.

Disability tool

Disability is a complex concept and there are many ways to define and measure it. In this RAAB we used the Washington Group Short Set – Enhanced disability tool which comprises

12 questions related to an individual's self-perceived difficulties in functioning in certain areas of functioning or 'domains', and which has been used successfully in other RAABs (5). Response options include four categories, allowing respondents to position themselves along a scale of functioning, thus allowing for nuanced analysis of severity of impairment as well as type. Although several approaches to analysis are possible, in this report a binary measure of disability was determined if an individual reported at least a lot of difficulty in at least one functional domain.

The study tool is included in Appendix B.

Sierra Leone Equity Tool

The Sierra Leone Equity Tool (SLET) is an internationally recognised tool designed to evaluate systemic differences between social groups. The economic status of participants is determined by categorising them into one of five quintiles; those who are the poorest and often most marginalised fall into the bottom quintile (quintile 1); those who are the wealthiest are in the top quintile (quintile 5). The SLET is a simple and easy-to-use tool to measure relative wealth. In a short survey, this tool can allow us to compare the wealth of our respondents to the national population or populations in other countries. The current SLET was released in August 2017 and is based on DHS 2013 data (13).

The study tool is included in Appendix C.

Data collection

Each participant enrolled onto the RAAB underwent the following steps: visual examination; disability questions; and SLET questions. Data was collected using an app on a touch-screen smartphone. Precise location of villages was recorded using global positioning system (GPS) coordinates so that cluster level (not individual level) data can be visually mapped and geospatially analysed.

Data was stored in the smartphones and synced at the end of each day with the cloud server which was accessible only to the study team member responsible for data management and analysis. The app itself has in-built checks to minimise errors and ensure data quality. Additionally, submitted data was checked regularly for quality by the study team member responsible for data management and analysis, and errors or inconsistencies were fed back to the teams to maximise data quality.

Five trained and standardised teams collected data; each included:

- An ophthalmologist, or cataract surgeon, to act as team leader
- An ophthalmic nurse
- A cluster informer
- A driver
- A village guide (one in each village)

A certified RAAB trainer conducted a five-day training session prior to data collection. Days one and two focused on RAAB procedures, followed by an inter-observer variation (IOV) test on day three, where teams unfortunately did not meet the levels of agreement necessary to proceed with the fieldwork. The teams spent day four reviewing and practising RAAB

procedures, and reviewing and practising the disability and wealth tools, and on day five they passed a second IOV test with good levels of agreement. A full report on the training is available on request.

As the study took place during the COVID-19 pandemic, a number of steps were taken to ensure the safety of all study team members and participants involved. All study participants were given hand sanitisers before the actual process started. They were further provided with face masks and encouraged to wear them especially when they were in close proximity with the ophthalmologist/lead during further examinations. Similarly, the study team members also wore face masks throughout the process, thus easing misconception of the use of face masks in the communities

Data analysis

The study tools were programmed using CommCare software (14). Data was downloaded in .csv format and uploaded in Stata V15 software for analysis (15).

Results were tabulated, calculating sample prevalence point estimates for each indicator of interest, and 95% confidence intervals surrounding them were estimated. Standard errors were adjusted for clustering using the design effect observed. The age and sex distributions of the sample were reviewed against available census data, and a weighting file was developed and used to create age- and sex-adjusted estimates and confidence intervals of each key indicator.

Following in-depth statistical analyses, key indicators were exported into ArcGIS software for mapping and spatial analyses to understand geographic patterns around prevalence of visual impairment (16).

Ethical considerations

The protocol was approved by the Sierra Leone Ethics and Scientific Review Commission of the Ministry of Health. The study followed all the steps required by the legal and regulatory frameworks of research in Sierra Leone.

Before the administration of the questionnaire, written study information was shared and explained verbally in easily understandable language, and the consent of the participant was collected.

Participants were encouraged to ask questions about the survey and investigators were trained to address such questions in an open and transparent manner. When consent was given, the participants were asked to sign or apply their thumbprint on the consent form attached to the information note. It was made clear to each participant that their participation is voluntary, that they could at any time stop participating in the study or not answer a particular question.

Copies of raw data were stripped of all identifiers (including geographical location of individuals) and remain strictly confidential. The data collection team underwent a one-week training, which included the importance of confidential data collection and management.

All people requiring services were referred as appropriate for possible free or subsidised services.

Results

Study sample and demographic characteristics

Data was collected between 29 November and 10 December 2021. Ultimately, 53 clusters were visited and 2,498 people were examined out of the 2,650 enrolled, a response rate of 94.3% (Table 1). Of those not examined, the majority (4.3%) were unavailable, or refused (1.1%), with only a minority deemed unable to communicate (0.3%).

Table 1: Participant examination status by sex

	Examined	Not available	Refused	Unable to communicate	Total
Male	1,085	69	8	3	1,165
	43.4	61.1	26.7	33.3	44.0
Female	1,413	44	22	6	1,485
	56.6	38.9	73.3	66.7	56.0
Total	2,498	113	30	9	2,650
	94.3	4.3	1.1	0.3	100.0

More females than males (56.6%) were examined in the study, and females were proportionately overrepresented compared to the estimated national population (50.1%) (Table 2). Compared to the estimated national population, younger people – particularly males – were underrepresented and older people were overrepresented. This means the sample results may overstate the magnitude of age-related visual impairment, and age- and sex-adjusted results are important for understanding the true extent of visual impairment in this population.

Table 2: Participants examined by sex and 10-year age group, compared with the total national population (2021 projection)

	Survey participants			National population (2021 projection)		
	Male	Female	Total	Male	Female	Total
50-59	478	643	1,121	212,801	202,366	415,167
	44.1%	45.5%	44.9%	53.3%	50.5%	51.9%
60-69	348	461	809	115,876	109,828	225,704
	32.1%	32.6%	32.4%	29.0%	27.4%	28.2%
70-79	194	199	393	51,190	54,769	105,959
	17.9%	14.1%	15.7%	12.8%	13.7%	13.2%
80+	65	110	175	19,372	33,900	53,272
	6.0%	7.8%	7.0%	4.9%	8.5%	6.7%
Total	1,085	1,413	2,498	399,239	400,863	800,102

	43.4%	56.6%	100.0%	49.9%	50.1%	100.0%

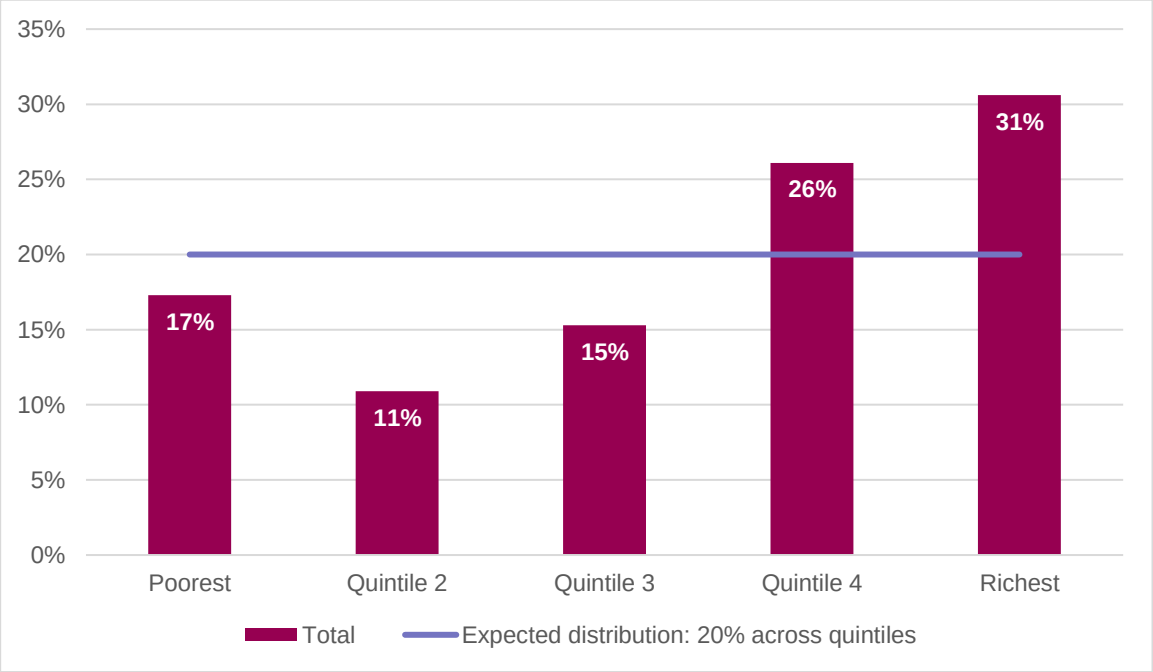
Among those examined, 16.6% were considered disabled (Table 3). Prevalence was higher among females (18.5%) than males (14.2%). Excluding those people who only reported difficulties in the seeing domain, prevalence of disability in other domains was 12.3%, 14.2% among females and 9.7% among males.

Table 3: Disability among examined male and female participants

	Male	Female	Total
Disability: all domains	154	261	415
	14.2%	18.5%	16.6%
Disability: excluding seeing difficulties	105	201	306
	9.7%	14.2%	12.3%

Compared to the national population, the survey population appeared to be relatively wealthier, with more participants falling into the wealthiest two quintiles (57%) than the poorest two (28%) (Figure 2). However, it is worth noting that the national wealth cut-off points used as benchmarks were relatively old (data collected in 2013), and thus the relative wealth observed may be due to overall increases in asset ownership, and not due to the survey population being substantially wealthier.

Figure 2: Household wealth of examined participants



Prevalence of visual impairment

143 participants, 5.7% of the total examined, were bilaterally blind with available correction (Table 4). When a pinhole was used to understand how access to corrective devices might affect VA, 127 people, or 5.1% of people were bilaterally blind. SVI was observed in 72 people (2.9%), MVI in 198 people (7.9%) and EVI in 135 people (5.4%).

Among males and females examined in the sample, there appears to be relatively little difference at all levels of visual impairment (Table 4).

Table 4: Sample prevalence of visual impairment among males and females examined

	Male	Female	Total
Blind: best corrected vision <3/60 in better eye			
	59	68	127
	5.4% [4.2-7.0]	4.8% [3.8-6.1]	5.1% [4.3-6.0]
Blind: presenting vision <3/60 in better eye			
	63	80	143
	5.8% [4.2-7.4]	5.7% [4.1-7.2]	5.7% [4.5-7.0]
Severe visual impairment: better eye can see 3/60 but not 6/60			
	33	39	72
	3.0% [1.9-4.1]	2.8% [1.8-3.7]	2.9% [2.1-3.7]
Moderate visual impairment: better eye can see 6/60 but not 6/18			
	77	121	198
	7.1% [5.4-8.8]	8.6% [7.1-10.0]	7.9% [6.8-9.0]
Early visual impairment: better eye can see 6/18 but not 6/12			
	56	79	135
	5.2% [3.7-6.6]	5.6% [4.3-6.9]	5.4% [4.3-6.5]

Adjusting for age and sex, the prevalence of blindness is estimated to be 5.4%, although based on the 95% Confidence Interval (CI), this could be as high as 6.7% or as low as 4.3% (Table 5). Extrapolating this to the population, it is estimated that there are 43,082 blind people aged 50 years and above in Sierra Leone. In total, it is estimated that 11.4% of eyes of people aged 50 years and above are blind, which translates to 181,969 eyes in total.

Age- and sex-adjusted bilateral SVI affects approximately 22,889 people (2.9%), and 64,873 eyes in total. Age- and sex-adjusted MVI affects 27,789 people (7.2%), and 129,110 eyes. Age- and sex-adjusted EVI affects 40,518 people (5.1%), and 83,796 eyes.

The differences between males and females appear small and may not be significant as the confidence intervals presented at each level of visual impairment overlap significantly.

Table 5: Estimated burden of visual impairment among males and females in Sierra Leone, adjusted for age and sex

	Male	Female	Total
Blind: presenting vision <3/60 in better eye			
Bilateral cases	20,460	22,624	43,082
	5.1% [3.9,6.8]	5.6% [4.3,7.4]	5.4% [4.3,6.7]
All eyes	88,511	93,458	181,969
	11.1% [9.1-13.1]	11.7% [9.7-13.6]	11.4% [9.7-13.0]
Severe visual impairment: better eye can see 3/60 but not 6/60			
Bilateral cases	11,757	11,134	22,889
	2.9% [2.0,4.3]	2.8% [2.0,3.9]	2.9% [2.2,3.8]
All eyes	32,308	32,565	64,873
	4.0% [3.1-5.0]	4.1% [3.2-5.0]	4.1% [3.3-4.8]
Moderate visual impairment: better eye can see 6/60 but not 6/18			
Bilateral cases	24,457	33,330	57,789
	6.1% [4.8,7.9]	8.3% [6.9,9.9]	7.2% [6.2,8.4]
All eyes	59,152	69,958	129,110
	7.4% [5.7-9.1]	8.7% [7.6-9.9]	8.1% [7.0-9.1]
Early visual impairment: better eye can see 6/18 but not 6/12			
Bilateral cases	18,351	22,165	40,518
	4.6% [3.4,6.2]	5.5% [4.4,7.0]	5.1% [4.1,6.3]
All eyes	38,122	45,674	83,796
	4.8% [3.5-6.1]	5.7% [4.6-6.8]	5.2% [4.3-6.2]

Figure 3 shows a map of the mean sample prevalence of all-case bilateral blindness by each province. Prevalence of blindness appears to vary significantly, with the lowest prevalence in Western Area (2.5%), and the highest in North Western (9.4%) and Northern Provinces (7.6%).

Figure 3: Mean prevalence of all-cause bilateral blindness among sample, by province

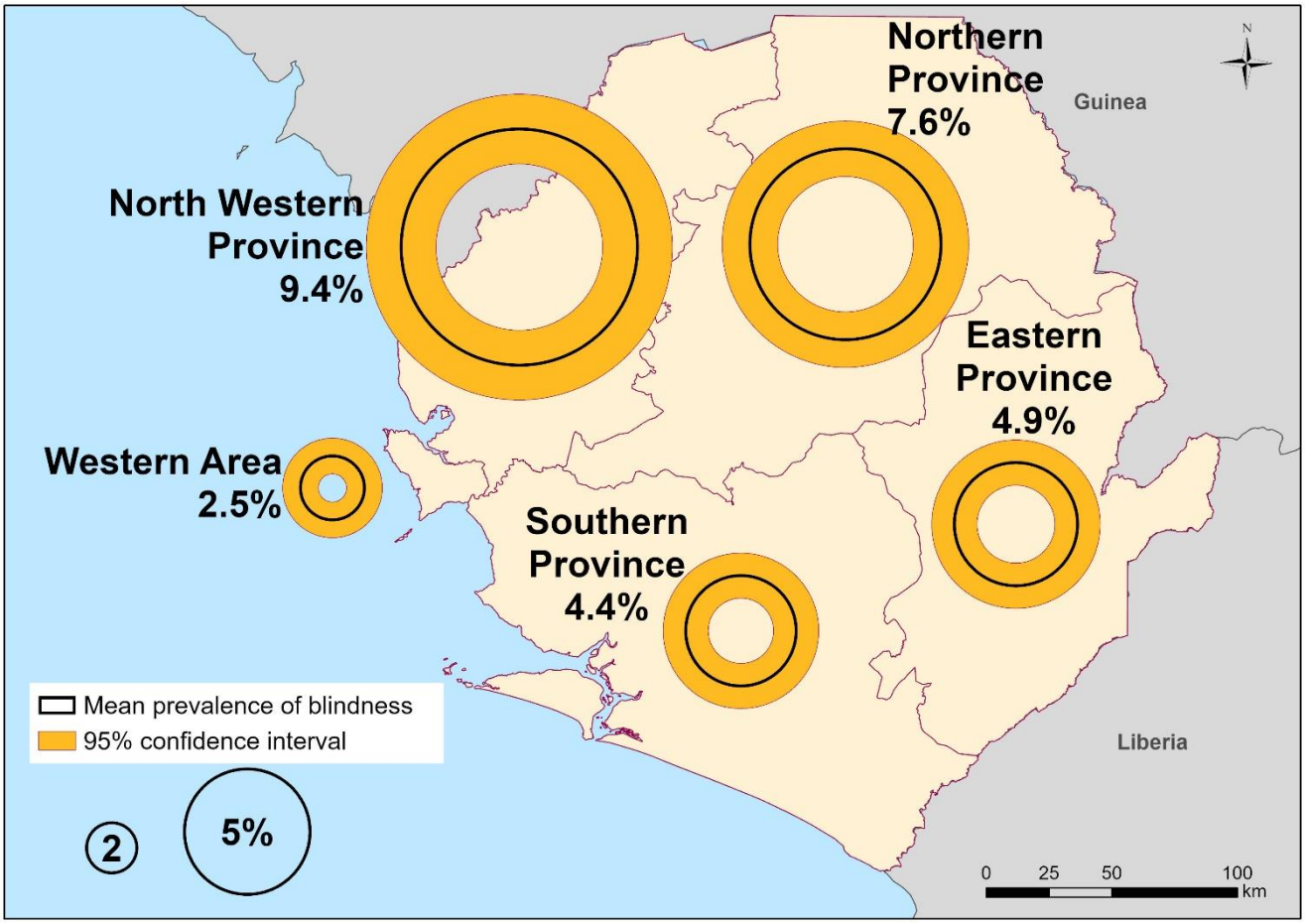
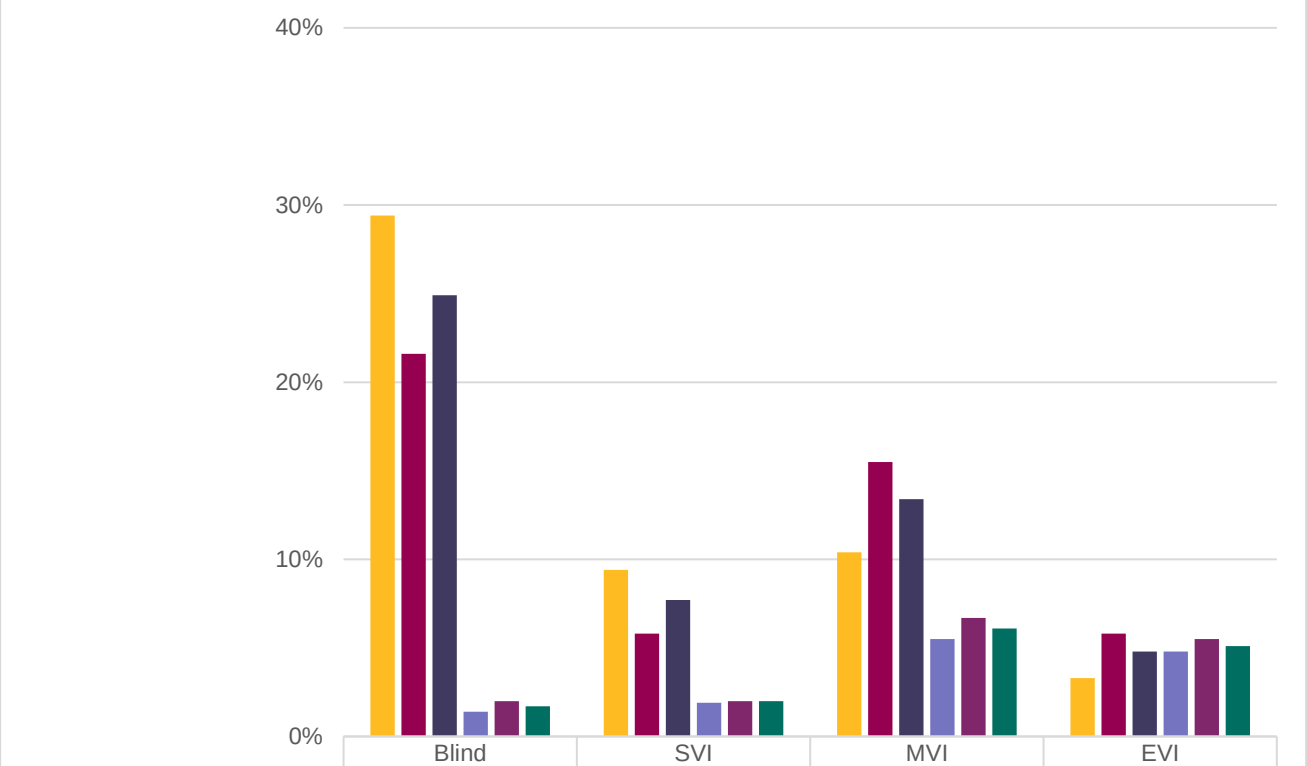


Figure 4 shows how the age- and sex-adjusted prevalence of visual impairment differs by disability and sex. Males and females with disabilities were more likely to have visual impairment than individuals without disabilities, and the differences were more striking for more severe degrees of visual impairment, particularly blindness. For example, 29.4% of men with any type of disability were blind, compared to 1.4% of men without disabilities. The only level of visual impairment, where there were no observable differences between people with and without disabilities, was early visual impairment.

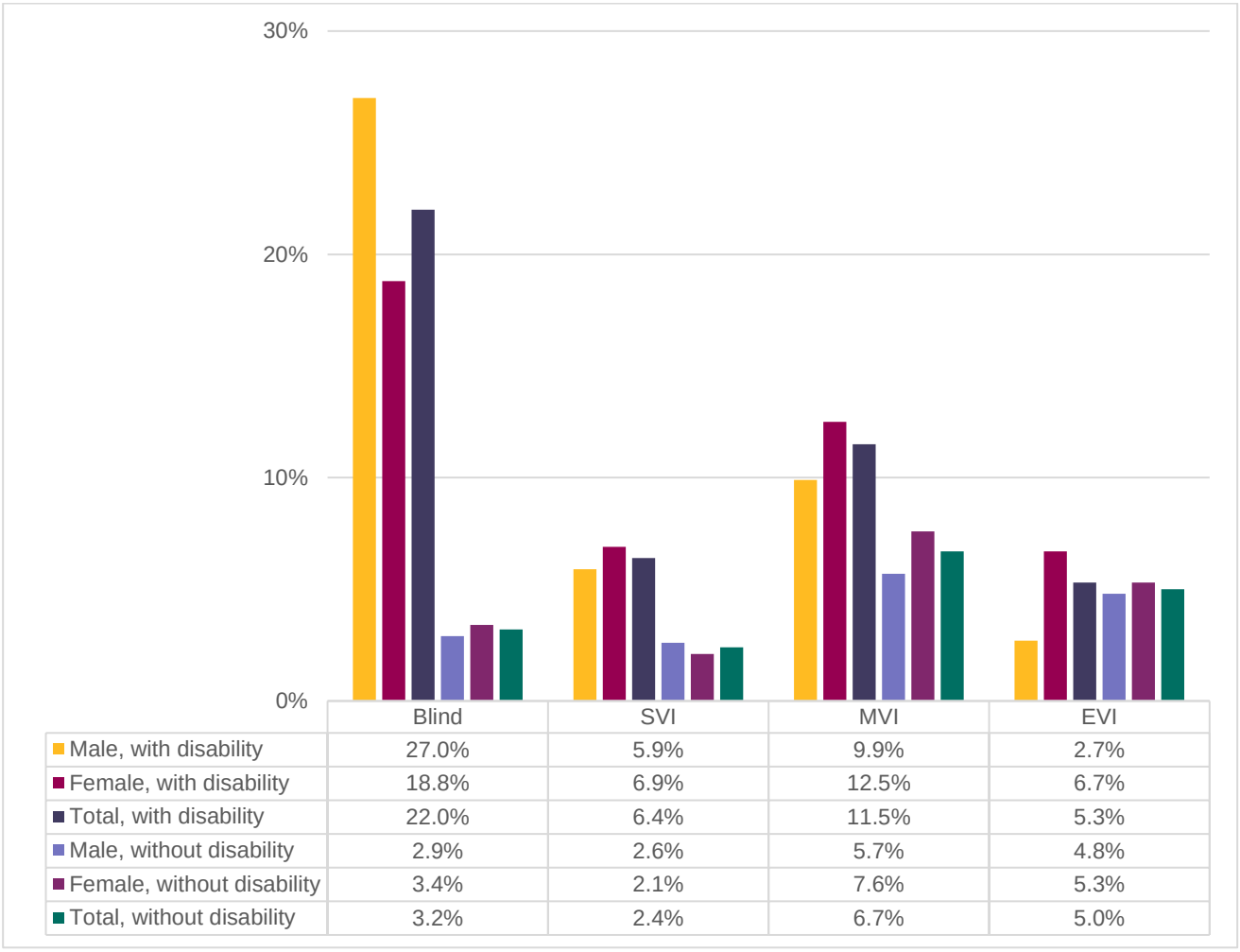
Figure 4: Age- and sex-adjusted prevalence of visual impairment, by disability, all domains



	Blind	SVI	MVI	EVI
Male, with disability	29.4%	9.4%	10.4%	3.3%
Female, with disability	21.6%	5.8%	15.5%	5.8%
Total, with disability	24.9%	7.7%	13.4%	4.8%
Male, without disability	1.4%	1.9%	5.5%	4.8%
Female, without disability	2.0%	2.0%	6.7%	5.5%
Total, without disability	1.7%	2.0%	6.1%	5.1%

Since visual impairment is very likely to be strongly correlated with difficulties in the seeing domain, it is important to explore how visual impairment relates to the other disability domains measured. Figure 5 shows how the age- and sex-adjusted prevalence of visual impairment differs by disability, excluding the seeing domain and sex. Even when excluding the seeing domain from the measure of disability, the relationship between disability and visual impairment is strong, with 27% of men with non-visual disabilities being blind, compared with 2.9% of men without disabilities. As above, the relationship is strongest for the worse levels of visual impairment, and there is almost no difference in levels of EVI.

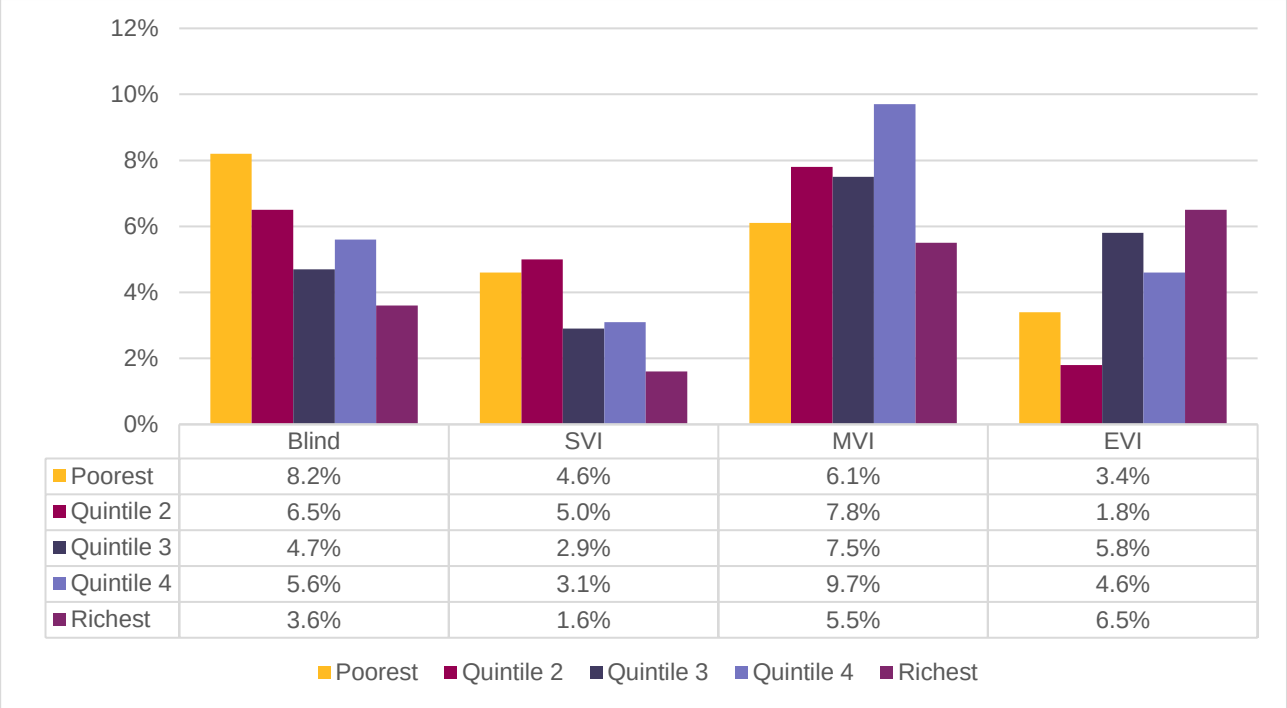
Figure 5: Age- and sex-adjusted prevalence of visual impairment, by disability, excluding seeing domain



	Blind	SVI	MVI	EVI
Male, with disability	27.0%	5.9%	9.9%	2.7%
Female, with disability	18.8%	6.9%	12.5%	6.7%
Total, with disability	22.0%	6.4%	11.5%	5.3%
Male, without disability	2.9%	2.6%	5.7%	4.8%
Female, without disability	3.4%	2.1%	7.6%	5.3%
Total, without disability	3.2%	2.4%	6.7%	5.0%

Figure 6 shows how visual impairment is related to relative wealth. The findings show that people in the poorest economic quintiles were more likely to be blind or severely visually impaired than those in the wealthier quintiles. For example, among people in the poorest economic quintile, 8.2% were blind and 4.6% were severely visually impaired, compared to 3.6% and 1.6%, respectively, among those in the wealthiest quintile. There was no observed relationship between wealth and less severe levels of visual impairment (MVI and EVI).

Figure 6: Age- and sex-adjusted prevalence of visual impairment, by wealth quintile



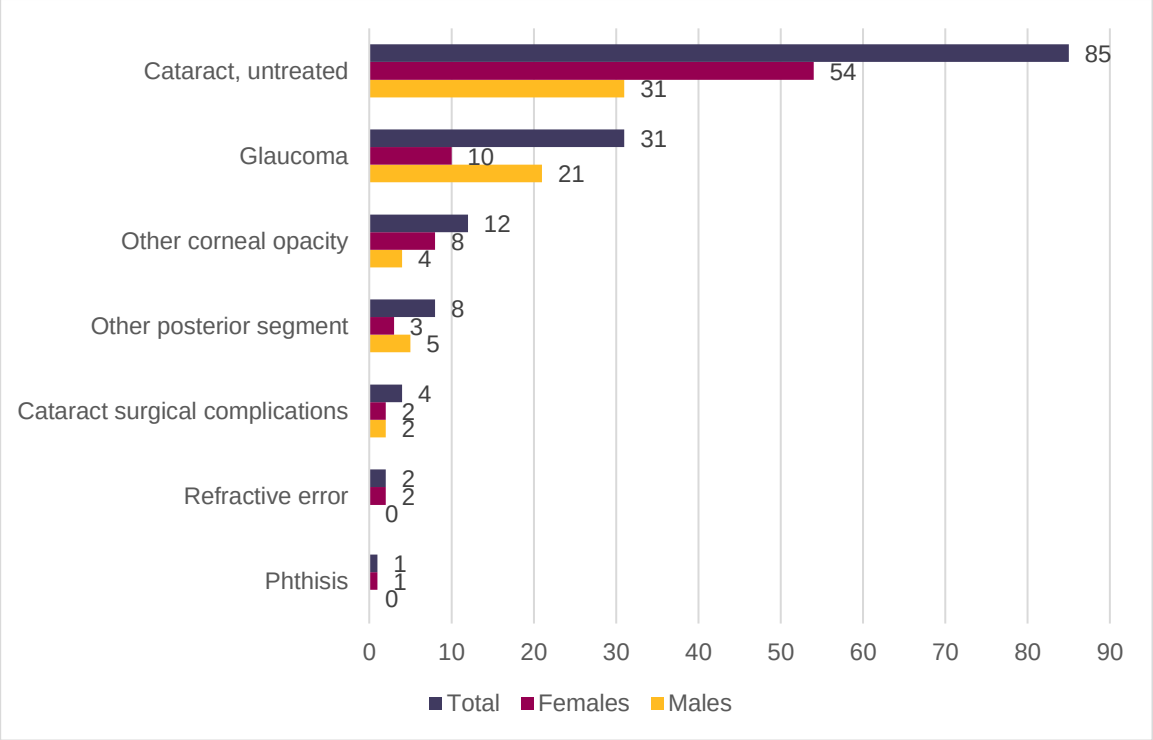
	Blind	SVI	MVI	EVI
Poorest	8.2%	4.6%	6.1%	3.4%
Quintile 2	6.5%	5.0%	7.8%	1.8%
Quintile 3	4.7%	2.9%	7.5%	5.8%
Quintile 4	5.6%	3.1%	9.7%	4.6%
Richest	3.6%	1.6%	5.5%	6.5%

Causes of visual impairment

The most common principal cause of blindness among bilaterally blind individuals was untreated cataract (85; 59.4%), followed by glaucoma (31; 21.7%); and non-trachomatous corneal opacity (12; 8.4%) (Figure 7). Other causes responsible for smaller proportions of the overall burden included ‘other’ posterior segment disease (8; 5.6%), cataract surgical complications (4; 2.8%), uncorrected refractive error (2; 1.4%), and phthisis (1; 0.7%).

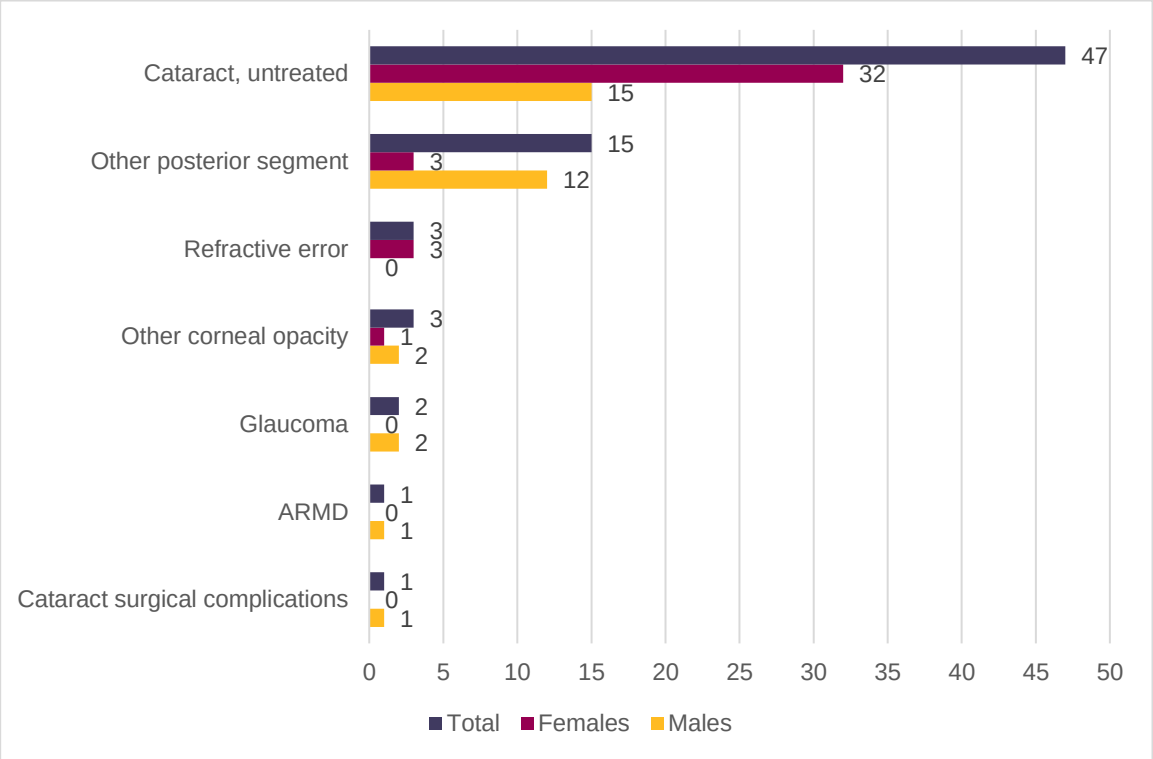
Cataract as the principal cause of blindness affected more women than men (54 female cases versus 31 male cases). The results suggest that males appeared to be more affected by glaucoma (21 male cases versus 10 female cases). However, it is important to remember that the RAAB methodology allows only one cause – the most easily treatable – to be allocated per person. Comparisons between groups must therefore be careful, as the findings do not show the complete distribution of causes of visual impairment in the studied population, particularly where a significant proportion of the population have untreated cataract or unaddressed refractive error, as these causes will most likely be listed as the principal causes of visual impairment, irrespective of co-morbidities. The RAAB ocular examination is also not comprehensive enough for a certain glaucoma diagnosis, and thus these cases are only suspected and require full clinical examination.

Figure 7: Principal causes of blindness among examined males and females



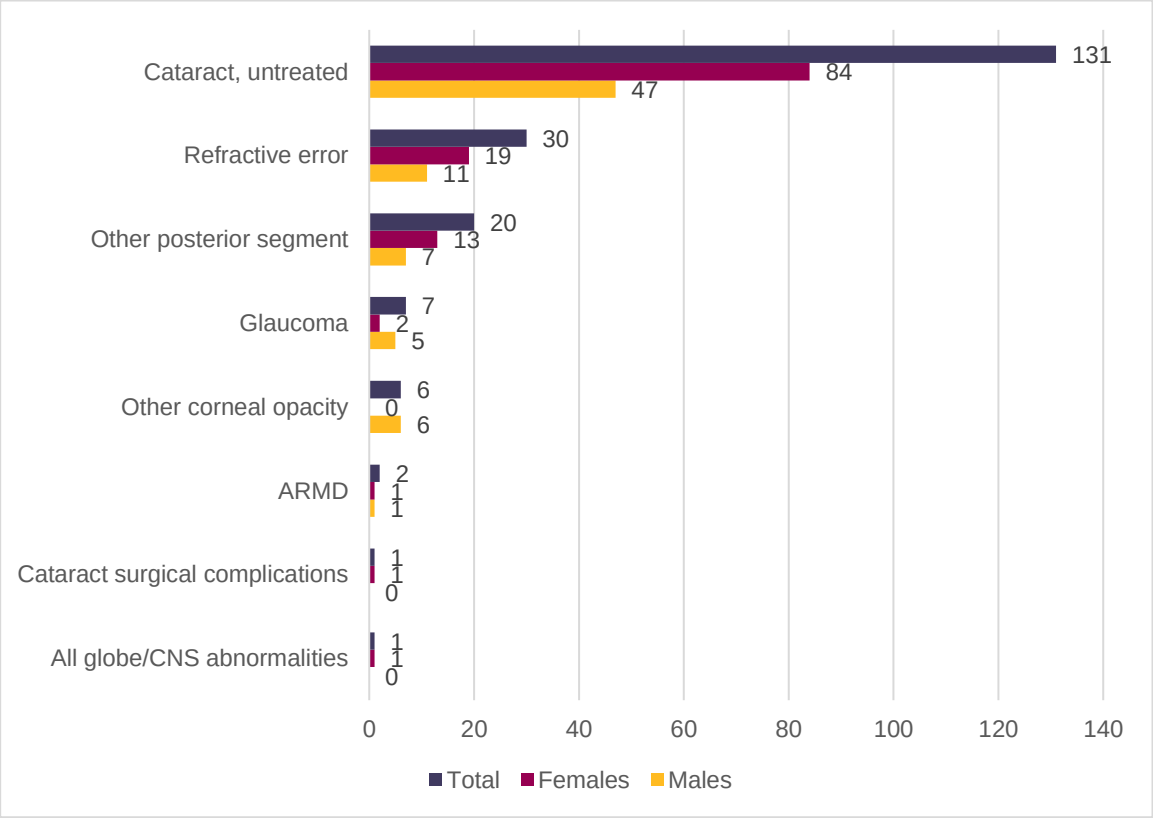
Untreated cataract was also the most common principal cause of bilateral SVI (47; 65.3%), followed by other posterior segment disease (15; 20.8%) (Figure 8). All other causes were each responsible for a relatively small proportion of SVI, and included unaddressed refractive error (3; 4.2%), non-trachomatous corneal opacity (3; 4.2%), glaucoma (2; 2.8%), age-related macular degermation (1; 1.4%), and cataract surgical complications (1; 1.4%).

Figure 8: Principal causes of severe visual impairment among examined males and females



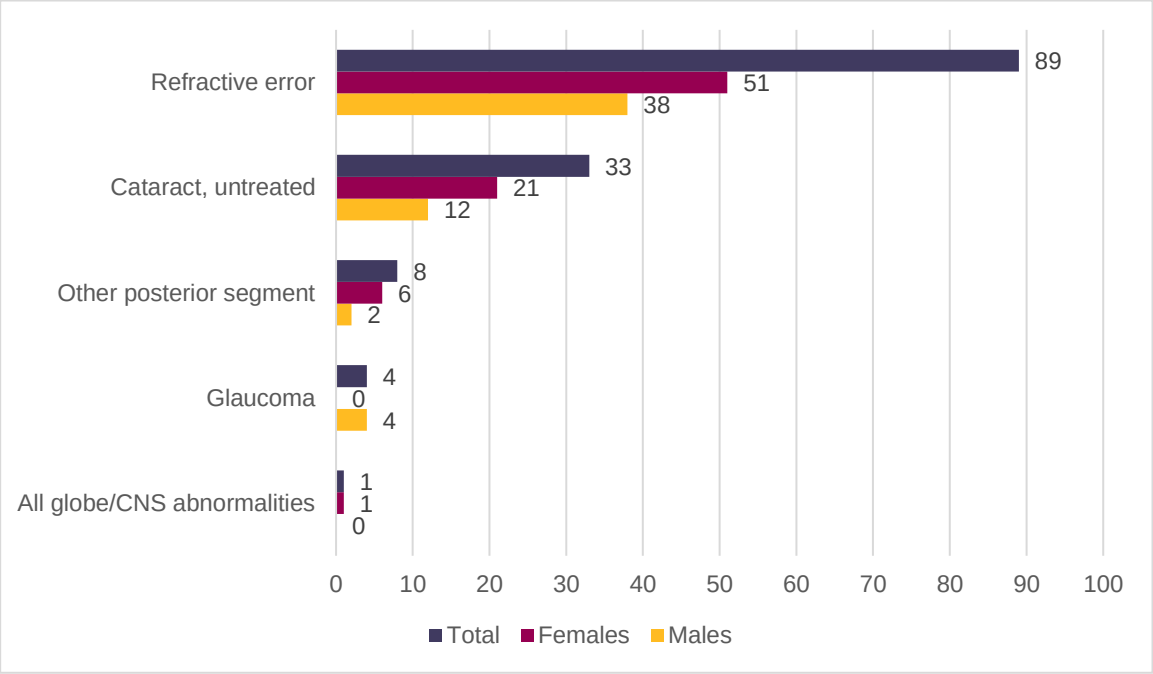
Untreated cataract was the main principal cause of bilateral MVI (131; 66.2%), followed by unaddressed refractive error (30; 15.2%), and other posterior segment diseases (20; 10.1%) (Figure 9). Other causes responsible for MVI included glaucoma (7; 3.5%), non-trachomatous corneal opacities (6; 3.0%), age related macular degeneration (2; 1.0%), cataract surgical complications (1; 0.5%), and glove or CNS abnormalities (1; 0.5%).

Figure 9: Principal causes of moderate visual impairment among examined males and females



Unaddressed refractive error was the main principal cause of bilateral EVI (89; 65.9%) (Figure 10), followed by untreated cataract (33; 24.4%). Other, less significant, principal causes included other posterior segment diseases (8; 5.9%), glaucoma (4; 3.0%), and globe or CNS abnormalities (1; 0.7%).

Figure 10: Principal causes of early visual impairment among examined males and females



Cataract: prevalence, coverage of services, and visual outcomes

Cataract surgical coverage (CSC) was estimated at 50.5% for persons and 29.7% for eyes at VA <3/60 (Table 6). At VA <6/60, the respective estimates were 42.2% and 24.0%. CSC was much higher among men compared to women, 68.3% compared to 33.2% at VA <3/60, and 63.7% compared to 24.8% at VA <6/60. This means that over 63% of men who are blind or severely visually impaired due to cataract have been operated on. Among women, less than one in four (24.8%) patients, who are blind or severely visually impaired due to cataract have been operated on.

Table 6: Cataract surgical coverage adjusted for sex and age

	Males	Females	Total
Cataract surgical coverage (eyes) – percentage			
VA <3/60	37.7	22.3	29.7
VA <6/60	32.9	17.0	24.0
VA <6/18	23.1	11.1	16.2
Cataract surgical coverage (persons) – percentage			
VA <3/60	68.3	33.2	50.5
VA <6/60	63.7	24.8	42.2
VA <6/18	41.9	14.0	25.5

Figure 11 shows the cataract surgical coverage (at VA <6/60) among persons in the sample, by province. The size of the circle indicates the number of persons with cataract – both operated and unoperated – identified. The highest number of people identified as having a cataract (operated or unoperated) was in Northern Province (47 cataracts) where the CSC was 31.9%, and the lowest numbers were in Western Area and Southern Province (18 cataracts each, CSC 66.7% and 44.4%, respectively). The province-specific CSC was highest in Western Area (66.7%), and lowest in North Western Province (15.4%).

Figure 11: Cataract surgical coverage among persons, by province

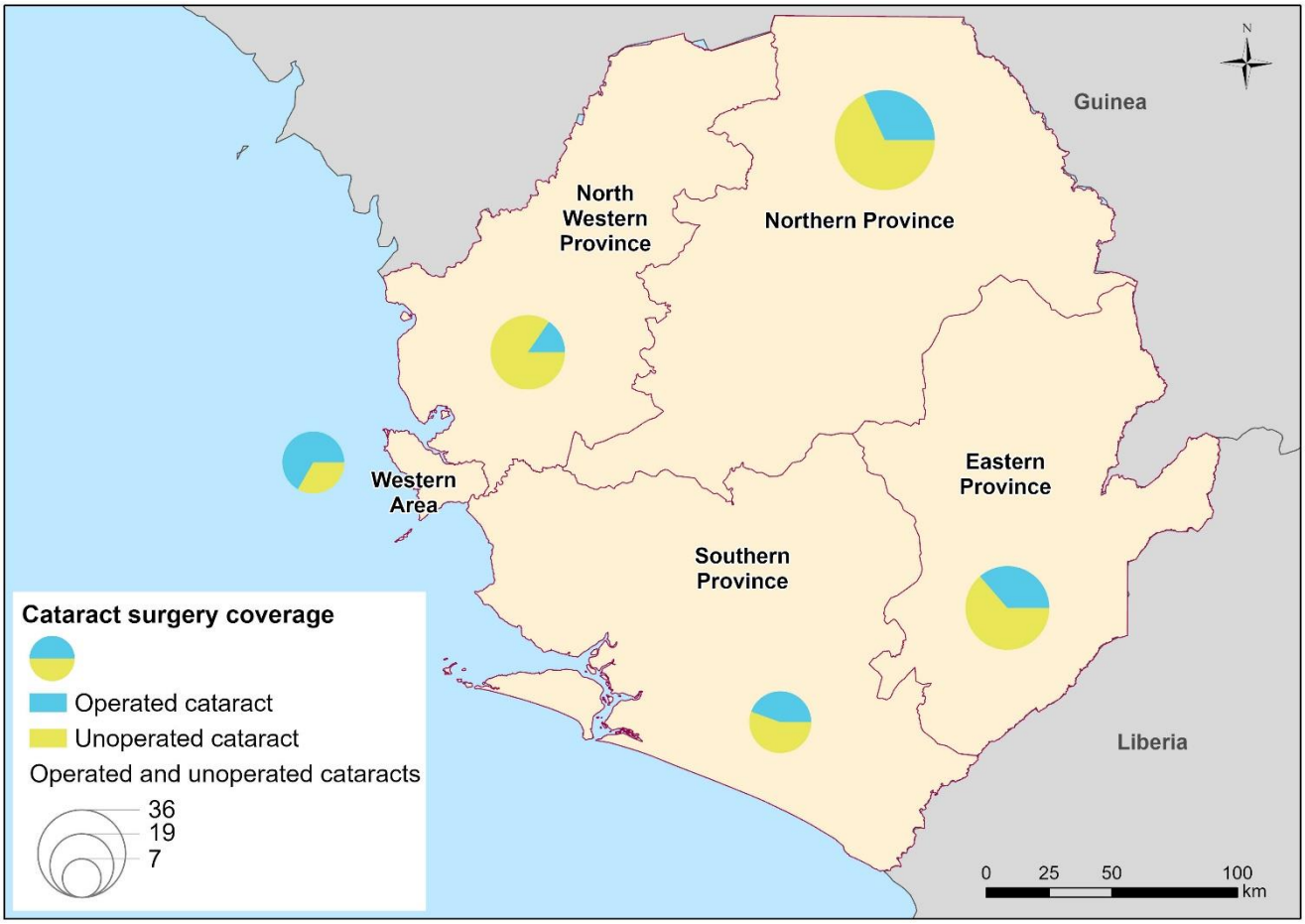


Table 7 shows that around 2.2% (95% CI 1.4; 2.9) of people aged 50+ years in Sierra Leone are bilaterally blind due to cataract, and another 1.1% (95% CI 0.6; 1.6) are severely visually impaired due to the disease. This translates to approximately 17,473 blind and 8,860 severely visually impaired persons across the country.

Significant gender differences in CSC described above have been reflected in cataract-related visual impairment, with women being disproportionately affected by the disease. Prevalence of cataract blindness and SVI was found to be significantly higher among women; and women were estimated to constitute over 68% of all cataract-blind and 79% of all cataract severely visually impaired people in Sierra Leone.

Table 7: Estimated prevalence and numbers of males and females with visual impairment and cataract in Sierra Leone, adjusted for age and sex

	Males	Females	Total

Blind: best corrected vision <3/60 in better eye			
Bilateral cataract	5,533	11,940	17,473
	1.4% [0.6-2.2]	3.0% [2.0-4.0]	2.2% [1.4-2.9]
Unilateral cataract	25,106	25,474	50,580
	6.3% [5.0-7.6]	6.4% [5.3-7.4]	6.3% [5.5-7.2]
Cataract eyes	36,171	49,355	85,526
	4.5% [3.4-5.7]	6.2% [4.9-7.4]	5.3% [4.4-6.3]
Severe visual impairment: better eye can see 3/60 but not 6/60			
Bilateral cataract	1,881	6,979	8,860
	0.5% [0.0-0.9]	1.7% [1.0-2.4]	1.1% [0.6-1.6]
Unilateral cataract	4,708	6,061	10,769
	1.2% [0.5-1.8]	1.5% [1.1-1.9]	1.3% [0.9-1.8]
Cataract eyes	8,470	20,021	28,491
	1.1% [0.5-1.6]	2.5% [1.9-3.1]	1.8% [1.3-2.2]
Moderate visual impairment: better eye can see 6/60 but not 6/18			
Bilateral cataract	11,392	20,864	32,256
	2.9% [1.8-3.9]	5.2% [3.9-6.5]	4.0% [3.2-4.9]
Unilateral cataract	5,310	2,137	7,447
	1.3% [0.5-2.1]	0.5% [0.0-1.2]	0.9% [0.4-1.4]
Cataract eyes	28,094	43,866	71,960
	3.5% [2.4-4.6]	5.5% [4.3-6.7]	4.5% [3.7-5.3]
Early visual impairment: better eye can see 6/18 but not 6/12			
Bilateral cataract	6,941	9,333	16,274
	0.9% [0.0-1.9]	1.2% [0.2-2.1]	1.0% [0.2-1.8]
Unilateral cataract	1,456	410	1,866
	0.2% [0.0-0.9]	0.1% [0.0-0.6]	0.1% [0.0-0.6]
Cataract eyes	15,337	19,075	34,412
	1.9% [1.0-2.8]	2.4% [1.6-3.2]	2.2% [1.4-2.9]

Over 94% of all operated eyes had an intraocular lens (IOL) implanted (Table 8). Among 110 eyes with IOL, over 56% had either very good (45.5%) or good (10.9%) visual outcomes; this increased to 65.4% with best correction. Around 12.7% of eyes had borderline outcomes, and 30.9% had poor visual outcomes (VA <6/60). Among the eyes operated on in the past three years, 61.2% had either very good or good visual outcomes; yet over 30% of eyes had poor visual outcome. The majority of surgeries took place either in a government hospital (46.2%) or in a voluntary hospital (41%). There was little difference in the proportion of eyes with good and poor visual outcomes by the type of facility where surgery took place.

Table 8: Visual acuity in operated eyes: characteristics of surgeries

	Very good: can see 6/12	Good: can see 6/18	Borderline: can see 6/60	Poor: cannot see 6/60	Total
Type of surgery by presenting visual acuity					
IOL	50 (45.5)	12 (10.9)	14 (12.7)	34 (30.9)	110 (94.0)
Non-IOL	0	0	0	3 (100.0)	3 (2.6)
Couching	0	0	0	4 (100.0)	4 (3.4)
Total	**50 (42.7)**	**12 (10.3)**	**14 (12.0)**	**41 (35.0)**	**117**
Type of surgery by best corrected visual acuity					
IOL	67 (60.9)	5 (4.5)	10 (9.1)	28 (25.5)	110 (94.0)
Non-IOL	0	0	0	3 (100.0)	3 (2.6)
Couching	0	0	1 (25.0)	3 (75.0)	4 (3.4)
Total	**67 (57.3)**	**5 (4.3)**	**11 (9.4)**	**34 (29.1)**	**117**
Years since surgery by presenting visual acuity					
3 years	27 (55.1)	3 (6.1)	4 (8.2)	15 (30.6)	49 (41.9)
4-6 years	12 (40.0)	4 (13.3)	7 (23.3)	7 (23.3)	30 (25.6)
7+ years	11 (28.9)	5 (13.2)	3 (7.9)	19 (50.0)	38 (32.5)
Total	**50 (42.7)**	**12 (10.3)**	**14 (12.0)**	**41 (35.0)**	**117**
Clinical setting of surgery by presenting visual acuity					
Government hospital	20 (37.0)	8 (14.8)	10 (18.5)	16 (29.6)	54 (46.2)
Voluntary hospital	26 (54.2)	3 (6.3)	3 (6.3)	16 (33.3)	48 (41.0)
Private hospital	4 (57.1)	0	1 (14.3)	2 (28.6)	7 (6.0)
Eye camp	0	1 (20.0)	0	4 (80.0)	5 (4.3)
Traditional setting	0	0	0	3 (100.0)	3 (2.6)
Total	**50 (42.7)**	**12 (10.3)**	**14 (12.0)**	**41 (35.0)**	**117**
Location of surgery by presenting visual acuity					
In district	26 (38.2)	8 (11.8)	9 (13.2)	25 (36.8)	68 (58.1)
In country, out of district	22	4	5	16	47 (40.2)
Out of country	2	0	0	0	2 (1.7)

Total	**50 (42.7)**	**12 (10.3)**	**14 (12.0)**	**41 (35.0)**	**117**
Causes of visual outcomes less than very good (n=67)					
Surgical complications	-	-	4 (20.0)	16 (80.0)	20 (29.9)
Spectacles	-	11 (57.9)	5 (26.3)	3 (15.8)	19 (28.4)
Sequelae	-	1 (5.9)	4 (23.5)	12 (70.6)	17 (25.4)
Selection	-	-	1 (9.1)	10 (90.9)	11 (16.4)
Total	**-**	**12 (17.9)**	**14 (20.9)**	**41 (61.2)**	**67**

Effective cataract surgical coverage, the proportion of people requiring cataract surgery who have had it and who have achieved a good visual outcome, was 31.2% overall (Table 9). It was higher among males (37.5%) than females (26.2%).

Table 9: Effective cataract surgical coverage in the sample

	Males	Females	Total
Effective Cataract surgical coverage (persons) – percentage			
VA <3/60	37.5%	26.2%	31.2%
VA <6/60	32.1%	18.6%	23.9%
VA <6/18	20.7%	9.8%	13.7%

The most common reason given by study participants for not having had surgery was not feeling a need (40.5%), followed by not being able to afford an operation (21.5%), and being unaware that treatment is possible (14.5%) (Table 10). Women were slightly more likely to report that they were either unaware or feared the surgery.

Table 10: Barriers to cataract surgery (some participants gave more than one reason)

	Male	Female	Total
Need not felt	160 (42.2)	235 (39.4)	395 (40.5)
Fear for surgery or poor result	33 (8.7)	66 (11.1)	99 (10.2)
Cannot afford operation	91 (24.0)	119 (20.0)	210 (21.5)
Treatment denied by provider	6 (1.6)	11 (1.8)	17 (1.7)
Unaware that treatment is possible	45 (11.9)	96 (16.1)	141 (14.5)
No access to treatment	32 (8.4)	56 (9.4)	88 (9.0)
Local reason	12 (3.2)	13 (2.2)	25 (2.6)
Total	**379**	**596**	**975**

Changes in eye health between 2011 and 2021

The RAAB undertaken in Sierra Leone in 2010/2011 aimed to enrol 3,050 people and achieved an enrolment rate of 97.6% (2,976 people). Compared with the 2004 census data, men and younger people were underrepresented in the study sample – similar to the 2021 RAAB (17). It is important therefore to compare the age- and sex-standardised results of the two studies to ensure differences due to sampling are accounted for. The 2011 RAAB did not collect data on early visual impairment, nor data on disability or wealth status.

Table 11 shows the age- and sex-adjusted prevalence of visual impairment in Sierra Leone in 2011 and the estimated numbers of people affected. Figure 12 shows the change in age- and sex-adjusted prevalence between 2011 and 2021. The sample prevalence of blindness was 6.0% although as described above, it is important to use the age and sex adjusted prevalence to account for sampling bias. The estimated prevalence of age and sex adjusted bilateral blindness has increased slightly (from 4.9% to 5.4%), whereas the prevalence of SVI and MVI have decreased slightly (from 3.8% to 2.9%, and 11.0% to 7.2%, respectively). With the exception of the estimates of MVI, all the confidence intervals around the estimates overlap, indicating the differences are not significant. The differences between male and female specific estimates, and for eyes, follow a similar trend.

Despite the relative stability of prevalence of visual impairment, the absolute numbers of people and eyes affected by visual impairment has increased, reflecting an increased older population. The number of bilaterally blind people has increased from 26,671 in 2010/11 by 64% to 43,082 in 2021.

Table 11: Estimated burden of visual impairment among males and females in Sierra Leone, adjusted for age and sex in 2011

	Male	Female	Total
Blind: presenting vision <3/60 in better eye			
Bilateral cases	12,950	13,721	26,671
	5.2% [3.9-6.6]	4.6 [3.3-5.9]	4.9 [3.8-6.0]
All eyes	60,365	61,037	121,402
	12.2 [10.3-14.1]	10.2 [8.4-12.0]	11.1 [9.5-12.7]
Severe visual impairment: better eye can see 3/60 but not 6/60			
Bilateral cases	8,570	12,190	20,760
	3.5 [2.3-4.6]	4.1 [3.0-5.1]	3.8 [3.0-4.6]
All eyes	20,241	32,365	52,606
	4.1 [3.1-5.0]	5.4 [4.5-6.3]	4.8 [4.1-5.5]
Moderately visual impairment: better eye can see 6/60 but not 6/18			
Bilateral cases	24,823	35,426	60,249
	10.0 [8.0-12.1]	11.8 [9.9-13.8]	11.0 [9.4-12.6]
All eyes	57,992	70,500	128,492
	11.7 [9.9-13.5]	11.8 [10.2-13.3]	11.8 [10.5-13.0]

Figure 12: Prevalence of age- and sex-adjusted visual impairment in 2011 and 2021

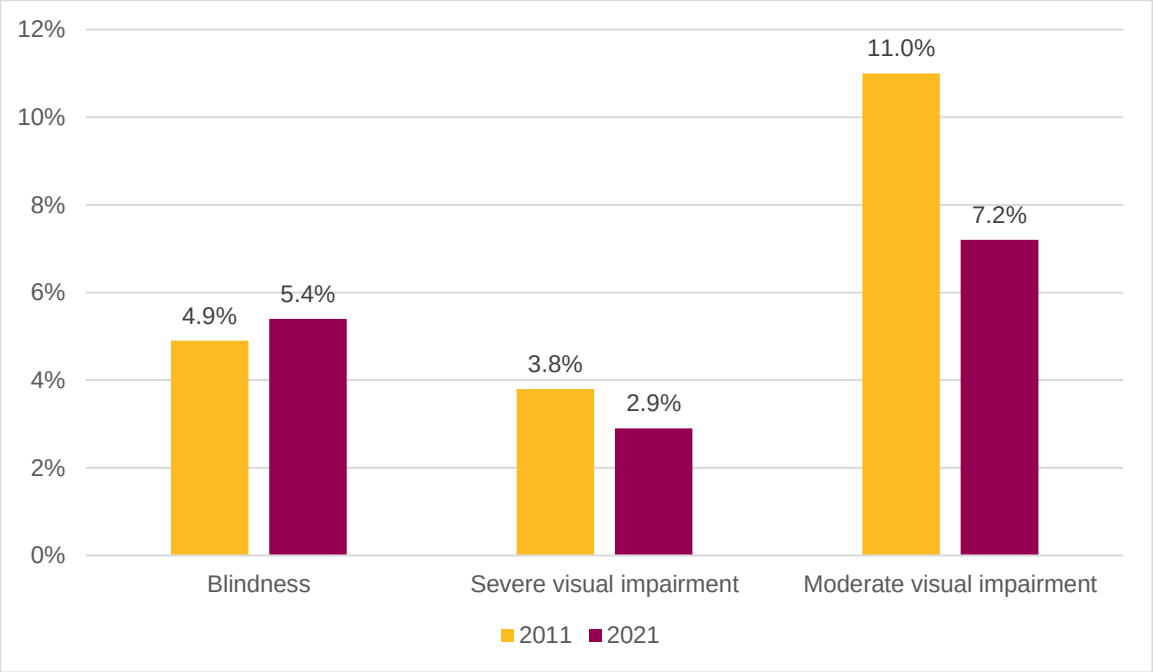
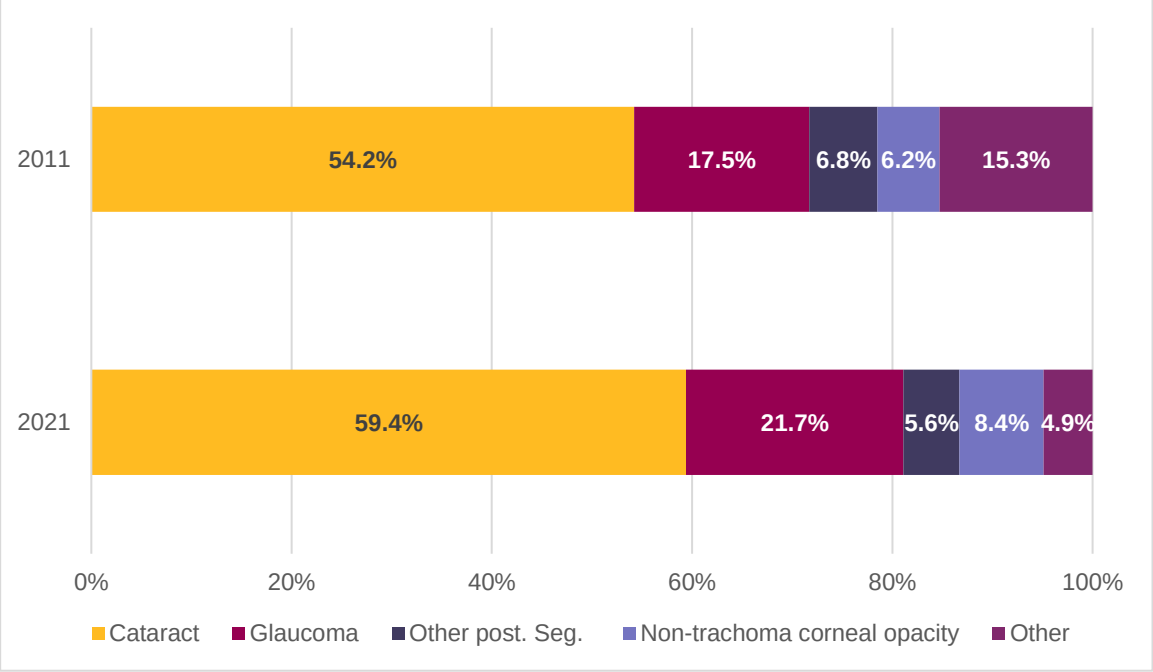


Figure 13 shows that cataract is the most common principal cause of blindness in both 2011 (54.2%) and 2021 (59.4%), and glaucoma the second most common cause (17.5% and 21.7%). Other posterior segment diseases and non-trachoma corneal opacities remain important causes: 6.8% and 6.2% in 2011 and 5.6% and 8.4% in 2011 and 2021, respectively.

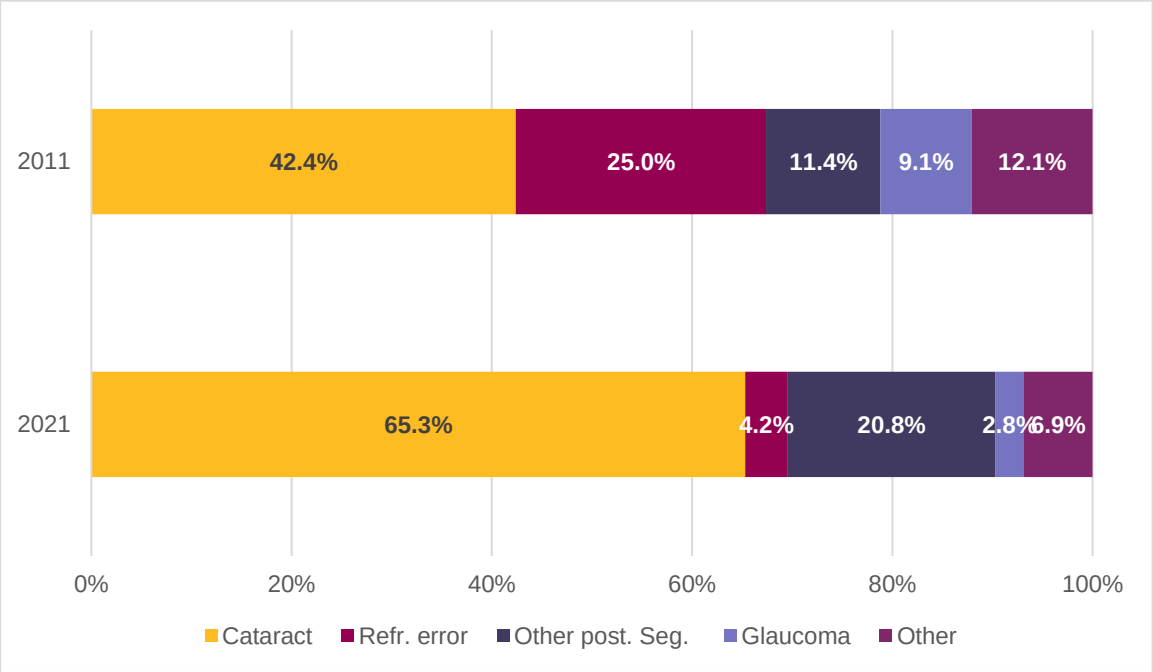
Figure 13: Principal causes of blindness in 2011 and 2021



Cataract is a more significant contributor of SVI in 2021 (65.3%) than 2011 (42.4%), and unaddressed refractive error a less significant contributor (25.0% versus 4.2%) (Figure 14).

Other posterior segment diseases appeared to increase in importance (20.8% in 2021 up from 11.4% in 2011), and glaucoma decreased (2.8% down from 9.1%).

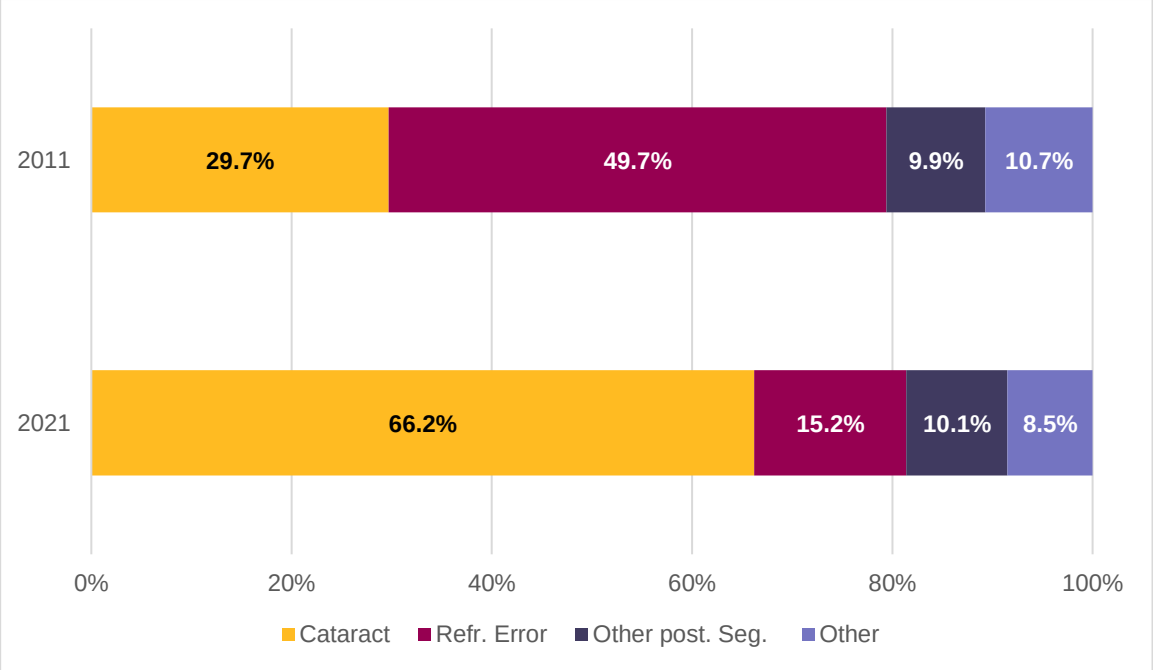
Figure 14: Principal causes of severe visual impairment in 2011 and 2021



In 2011, the main cause of MVI was unaddressed refractive error (49.7%) and the second main cause was cataract (29.7%) (Figure 15). In 2021, although the two causes combined retained a similar overall proportion, they swapped importance, with cataract being the cause of 66.2% of MVI, and unaddressed refractive error being the cause of 15.2%. The reduction of unaddressed refractive error in importance in the MVI category in 2021 may be partly due to the introduction of the new, EVI category that measures visual acuity to 6/12, which wasn't assessed in 2011, and into which many individuals with unaddressed refractive error may fall.

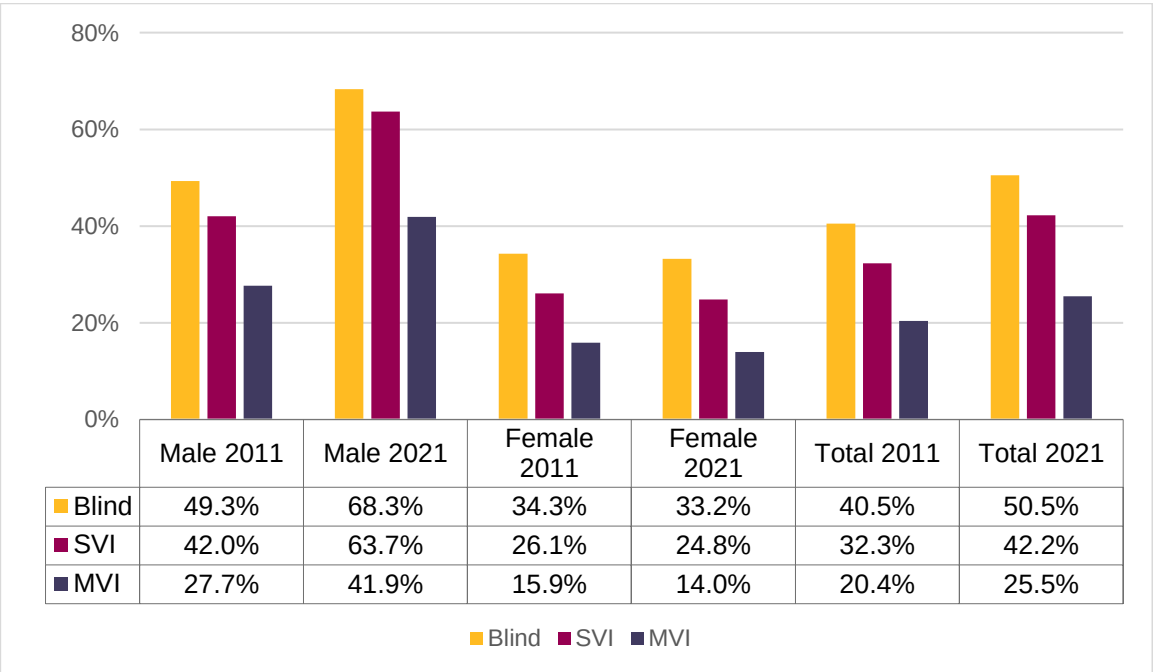
If we were to combine the EVI and MVI categories in 2021, the proportions would be more similar to those in 2011, but still with a greater proportion attributable to cataract: cataract, 49.3%; unaddressed refractive error, 35.7%; other posterior segment, 8.4%; and all other causes, 6.6%.

Figure 15: Principal causes of moderate visual impairment in 2011 and 2021



Overall, there was a 10% increase in the proportion of people with operable cataract, who have had a surgery, from 40.5% in 2011 to 50.5 in 2021 at the 3/60 level, and from 32.3% in 2011 to 42.2% in 2021 at the 6/60 level (Figure 16). On closer inspection, the increase was entirely among males, with the proportion of men needing surgery and receiving it increasing from 49.3% in 2011 to 68.3% in 2021. Among females, the coverage decreased very slightly, from 34.3% in 2011 to 33.2% in 2021.

Figure 16: Cataract surgical coverage between males and females, and at different levels of visual impairment, in 2011 and 2021



	Male 2011	Male 2021	Female 2011	Female 2021	Total 2011	Total 2021
Blind	49.3%	68.3%	34.3%	33.2%	40.5%	50.5%
SVI	42.0%	63.7%	26.1%	24.8%	32.3%	42.2%
MVI	27.7%	41.9%	15.9%	14.0%	20.4%	25.5%

The quality of visual outcomes among operated eyes improved between 2011 and 2021, with the proportion of those with presenting 'good' vision increasing from 38.3% to 53%, and with best correction increasing from 57.9% to 61.6% (Figure 17). Unfortunately, the

proportion with ‘poor’ outcomes continued to be high, with 25.6% of operated patients having ‘poor’ vision, even with best correction in 2011, and increasing to 29.1% in 2021.

Figure 17: Quality of visual outcomes of operated eyes in 2011 and 2021

Discussion

Key study findings

This study found the prevalence of bilateral blindness among people aged over 50 years in Sierra Leone in 2021 to be 5.4%, although this may be as low as 4.3% or as high as 6.7%. Prevalence of SVI is 2.9%, of MVI is 7.2% and of EVI is 5.1%. There was no difference in the overall prevalence of visual impairment at any level of vision between men and women. Compared with results of the RAAB conducted in Sierra Leone in 2011, the prevalence of visual impairment in people 50+ years old has not changed. However, the changing demography of Sierra Leone means there are now more people alive aged over 50 years than in 2011, and the absolute number of people living with visual impairment is considerably higher. For example, the number of people, who are bilaterally blind increased by 64% from 26,671 in 2010/11 to 43,082 in 2021.

Although data on disability and wealth was not collected in 2011, the 2021 results indicate that poorer people and people with additional non-visual disabilities are more likely to experience visual impairment and particularly be blind or severely visually impaired, although data on disability should be interpreted with caution, as there is likely to be an association between severe visual impairment and other difficulties in functioning, such as mobility or mental health distress. The reasons for these inequities can be multiple, however, it does mean that to advance Sierra Leone's progress towards universal eye health, eye care services should be developed with financial, physical and attitudinal accessibility in mind. Cost of cataract surgery is typically $30-40 US dollars. However, in Sierra Leone, people with disabilities are among the groups entitled to free health care services, although the details of how this is financed are not completely clear. Furthermore, although people with disability do not pay for eye surgery, financial barriers may go beyond the cost of surgery to indirect, or non-medical, costs associated with accessing the services, which may be greater for people with additional needs, who may also be among the poorest people in society.

In this study, we also collected data about cluster locations, enabling us to examine geographical differences in the results, although it should be noted that the sample size wasn't powered to identify differences between provinces. Nevertheless, the data on the prevalence of blindness and cataract surgical coverage indicates geographical disparities within Sierra Leone, with the Northern Province less well served than Western and Southern Areas. Despite the generally positive results for the Western Area, it should be noted that this area includes the well-served Freetown urban area, as well as the rural Western Area, and there may exist further disparity within this region. The northern parts of Sierra Leone are among the most geographically isolated in the country, and the population is among the poorest. Historically, the area was underserved by eye health services, with no permanent services and reliant on teams visiting from Freetown, and further afield.

As in 2011, in 2021 cataract is the most common principal cause of visual impairment among bilaterally blind people (59.4% up from 54.2%), people with SVI (65.3% up from 42.4%), and MVI (66.2% up from 29.7%), and the second most common principal cause among people with EVI (24.4%) behind unaddressed refractive error (65.9%). The most common reason given for not having had surgery was not feeling a need (40.5%), followed by not being able to afford an operation (21.5%), and being unaware that treatment is possible (14.5%).

Overall, CSC increased by about 10% between 2011 and 2021, from 40.5% to 50.5%, however, the increase was entirely among males (up to 68.3% from 49.3%) and females experienced a very small decrease (down to 33.2% from 34.3%) at V<3/60. Data from the Vision Atlas, as well as partners in Sierra Leone, indicates that annual cataract surgical rate (CSR, cataract surgeries per million people) in 2015 was 409, increasing to 468 in 2018, 617 in 2019, 289 in 2020, and 575 in 2021. Ignoring the dip in 2020, likely due to COVID-19, this shows a year on year increase in the CSR, although still far lower than the WHO suggested target of 3,000 per year (4). As a result, the gender inequalities in access to cataract services have widened over the past decade. While in 2011, there was 15% difference in CSC between men and women; in 2021 CSC among women was less than half the coverage among men. These gender differences in CSC were reflected in the differences in cataract related prevalence of blindness and severe visual impairment and the absolute number of people and eyes in need of operation between men and women. The finding highlights a need to better understand characteristics of women, who do not access services and the reasons behind it and to urgently develop specific programme strategies for identifying women with cataract and ensuring their uptake of surgery. Particular priorities should be given to women from remote locations with difficult terrain and those who are poor, very old or who may live alone.

Gender inequities are not unique to Sierra Leone, and similar trends have been noted in many countries, although the evidence on the effective approaches to improve women's uptake of cataract services remains very limited (18, 19). Several approaches that have been suggested as being potentially useful for reaching women include surgical awareness campaigns; use of successfully operated persons as champions; removal of patient direct and indirect costs; regular community outreach; and ensuring high quality surgeries (18). These approaches need to be tested and rigorously evaluated in the Sierra Leone context. With regards to the quality of services, the results indicate that, overall, the quality of visual outcomes of operated eyes has improved since 2011: the proportion of operated eyes with 'good' or 'very good' vision in 2021 was relatively high (61.6%) if best correction were available, up from 57.9% in 2011. However, a sizeable proportion (29.1%) still experience 'poor' vision, even with best correction, and the results indicate a relatively even split between surgical complications (29.9%), lack of, or inadequate, spectacles (28.4%), sequelae (25.4%), and selection (16.4%). Although RAAB is not the most appropriate method for assessing post-surgical outcomes and causes, due to the elapsed time between surgery and assessment, the results indicate a study to explore post-surgical outcomes among different types of patients may be useful to identify approaches to improving these results. Another RAAB conducted recently in Mozambique highlighted how RAAB results can be useful to inform improvements to post-surgical outcomes (20). Effective cataract surgical coverage (eCSC) is a recently adopted indicator that marries cataract surgical coverage with visual outcomes, that identifies the proportion of people operated with good visual outcomes, out of those who require cataract surgery. The 2021 World Health Assembly adopted a target of a 30 percentage point increase for all countries by 2030. Based on the eCSC observed here, that would mean increasing eCSC from 31.2% to 61.2%, which would require improvements in both coverage and quality of outcomes.

Glaucoma is the second most common principal cause of blindness (21.7%), and a minor cause to lower levels of visual impairment: 2.8% of SVI, 3.5% of MVI, and 3.0% of EVI. This is likely to be an underestimate of the true burden for several reasons: first, the RAAB diagnostic algorithm allows only one cause to be attributable to each visually impaired eye or

individual, and it must be the cause that is most easily treatable. In a setting like Sierra Leone, where so many cases of visual impairment are due to easily treatable causes, such as unoperated cataract and unaddressed refractive error, people with co-existing glaucoma, and other harder to treat diseases, may have their glaucoma 'hidden' from the data. Second, the RAAB ophthalmic examination does not include measurement of intraocular pressure, or a visual field test, and is instead reliant on a visual examination of the optic nerve with a direct ophthalmoscope. This means that many, if not all, diagnoses of glaucoma in the study are suspected and require confirmation in a clinical setting with the appropriate equipment. Finally, only participants with presenting visual acuity less than 6/12 were assessed for a cause, and the nature of glaucoma means that many individuals with glaucoma may not yet be experiencing visual impairment and will thus be missed by the study. However, despite these limitations, the results indicate that there is likely to be a significant burden of glaucoma within this population, but further studies are needed to ascertain its magnitude and consider strategies for identifying and managing the condition. Given the resource-intensive nature of a population-based glaucoma survey, a facility-based survey among patients presenting for any ocular condition may be a cost-effective approach to understanding the scale and distribution of the disease in the Sierra Leonean population in more detail. Approaches for early identification and treatment of at-risk people should be developed and tested and lessons from studies in other settings should be considered for replication. An example of this could be the recently published trial from Tanzania that recently found selective laser trabeculoplasty to be a superior – and more appropriate – treatment for glaucoma than eye drops, although discussion still remains about long-term implications for patients and health systems (21).

Corneal opacities – particularly non-trachoma – remain a significant cause of visual impairment at all levels. In 2021, the first corneal transplant surgical camp took place in Freetown in conjunction with Duke University. Eight patients were successfully transplanted, including two with bilateral corneal blindness. Although the RAAB did not attempt to understand the cause of scarring, it is known that the vast majority of corneal conditions in West Africa are due to infectious and traumatic events, and in some areas, residual vitamin A deficiency issues. These are not easily amenable to corneal transplants as they are vascularised and the best approach is preventive – which means primary eye care.

Unaddressed refractive errors are a major cause of both moderate and early visual impairment and a contributing cause to poor post-surgical visual outcomes. However, for more than 10 years, the national eye health programme has worked in a coordinated way with a range of partners, such as Vision Aid Overseas, CBM, and Sightsavers to improve these services. Examples of this include developing human resources, such as training more optometry technicians (OTs), supporting four of the OTs in gaining degree level qualifications to enable them to become optometrists and supporting other OTs to provide improved URE services. Furthermore, Vision Centres have been set up and equipped to deliver refractive error services by the newly trained OTs. The NEHP is conducting community outreaches regarding refractive errors, with emphasis on school-aged children – targeting them in schools, particularly in hard-to-reach areas. Following a Sightsavers-supported quality standards assessment, the NEHP has developed a standard operating procedure (SOP) on post-operative refraction, ensuring that all patients who had cataract surgery would have refraction and corrective glasses at some point during the follow-up period.

Implications for programmes and policy in Sierra Leone

- Review existing eye health system and service capacity, including the available human resources and infrastructure to develop costed plans and targets to ensure there is service delivery capacity improvement at strategic locations.
  - Development of human resource capacity, human resource support, management and motivation to fulfil clinical, surgical, and support needs throughout the country
  - Development of primary eye health systems and human resources to meet patient mobilisation needs and improve demand/uptake of services. Review the results of the ongoing study exploring how eye care is integrated into the primary health care system to identify priorities for improvements
  - Review of and additions to infrastructure, upgrades to infrastructure for service delivery as needed. Pay attention to accessibility guidelines and audit materials to improve physical accessibility
- Develop a plan and monitoring approach to improve quality of cataract surgical outcomes. Attention to post-operative refraction and provision of spectacles, and reduction in cataract surgical complications should be prioritised. Facility-based outcome monitoring should be encouraged to promote an improvement-based culture among surgeons.
- Develop a plan to improve and monitor glaucoma diagnosis, management and treatment in Sierra Leone. This may include further research on the magnitude and distribution of glaucoma within the country, as well as to identify effective approaches for dealing with it.
- Develop and monitor a plan to improve the access to services by underserved groups, including women and people with disabilities
  - Engage with organisations representative of, and working with, these groups, and involve them in eye health service planning, delivery and monitoring
  - Collect and analyse data on disability and gender from eye health patients to understand who comes to services and their experiences
  - Identify, develop and rigorously test approaches for improving targeting of women, people with disabilities and poorer people. Draw on existing evidence, including this study and a number of recent reviews, to match problems with known solutions
  - Review and identify an approach to eye care financing that supports the inclusion of underserved groups

References

1. Bourne R, Steinmetz JD, Flaxman S, Briant PS, Taylor HR, Resnikoff S, et al. Trends in prevalence of blindness and distance and near vision impairment over 30 years: an analysis for the Global Burden of Disease Study. The Lancet Global Health. 2021;9(2):e130-e43.
2. Sightsavers. A Rapid Assessment of Avoidable Blindness (RAAB) in Sierra Leone, 2010/2011. 2011.
3. Burton MJ, Ramke J, Marques AP, Bourne RRA, Congdon N, Jones I, et al. The Lancet Global Health Commission on Global Eye Health: vision beyond 2020. The Lancet Global Health. 2021;9(4):e489-e551.
4. World Health Organization. Universal Eye Health: A global action plan 2014–2019 Geneva,; 2013.
5. Mactaggart I, Limburg H, Bastawrous A, Burton MJ, Kuper H. Rapid Assessment of Avoidable Blindness: looking back, looking forward. Br J Ophthalmol. 2019;103(11):1549-52.
6. Sightsavers. Knowledge, attitudes and practices in eye health and disability in Sierra Leone. 2014.
7. Jolley E, Buttan S, Engels T, Gillani M, Jadoon MZ, Kabona G, et al. Prevalence of Visual Impairment and Coverage of Cataract Surgical Services: Associations with Sex, Disability, and Economic Status in Five Diverse Sites. Ophthalmic Epidemiol. 2020:1-9.
8. Dineen B, Gilbert CE, Rabiu M, Kyari F, Mahdi AM, Abubakar T, et al. The Nigerian national blindness and visual impairment survey: Rationale, objectives and detailed methodology. BMC ophthalmology. 2008;8:17-.
9. World Health Organization. World Report on Disability. World Report on Disability 2011. Geneva: World Health Organization; 2011.
10. Statistics Sierra Leone. Sierra Leone 2015 Population and Housing Census: National analytical report. Government of Sierra Leone; 2017.
11. United Nations Department of Field Suport: Geographic Information Section, cartographer CRPD and Optional Protocol Signatures and Ratifications 2017.
12. Potter AL, Vandy, M., Smart, N. Blanchet, K.I.,. Eye Health Systems Assessment (EHSA): Sierra Leone Country Report. Ministry of Health and Sanitation, International Centre for Eye Health, Sightsavers.; 2013.
13. Metrics for Management. Sierra Leone Equity Tool. 2017.
14. Dimagi Inc. CommCare.
15. Statacorp LLC. Stata. 15.1 ed2018.
16. ESRI. ArcGIS. Pro ed2020.
17. Statistics Sierra Leone. 2004 Population and Housing Census. Analytical Report on Population Size and Distribution Age and Sex Structure. 2006.
18. Mailu EW, Virendrakumar B, Bechange S, Jolley E, Schmidt E. Factors associated with the uptake of cataract surgery and interventions to improve uptake in low- and middle-income countries: A systematic review. PLoS One. 2020;15(7):e0235699.
19. Ramke J, Petkovic J, Welch V, Blignault I, Gilbert C, Blanchet K, et al. Interventions to improve access to cataract surgical services and their impact on equity in low- and middle-income countries. Cochrane Database of Systematic Reviews. 2017(11).
20. Jolley E, Cumaio M, Vilanculos A, Hassane I, Kimani K, Ogundimu K, et al. Changes in Eye Health and Service Coverage in Nampula, Mozambique between 2011 and 2018. Ophthalmic Epidemiology. 2021:1-9.

21. Philippin H, Matayan E, Knoll KM, Macha E, Mbishi S, Makupa A, et al. Selective laser trabeculoplasty versus 0.5% timolol eye drops for the treatment of glaucoma in Tanzania: a randomised controlled trial. The Lancet Global Health. 2021;9(11):e1589-e99.

Appendices

Appendix A – Rapid Assessment of Avoidable Blindness Questionnaire

RAPID ASSESSMENT FOR AVOIDABLE BLINDNESS

A. GENERAL INFORMATION

Survey area: _____ Cluster: ☐☐☐ Year - month: ☐☐☐☐ - ☐☐

Name: _____ Sex: Male: O (1) Individual no.: ☐☐

Female: O (2) Age (years): ☐☐

Optional 1: ☐☐

Optional 2: ☐☐

Examination status:

Examined: O (1) (go to B) Refused: O (3) (go to E)

Not available: O (2) (go to E) Not able to communicate: O (4) (go to E)

Always ask: "Did you ever have any problems with your eyes?" Yes: O (1) No: O (2)

If not available - details (availability / tel number / address)

B. VISION

Uses distance glasses: No: O (1) Yes: O (2)

Uses reading glasses: No: O (1) Yes: O (2)

Presenting vision	Right eye	Left eye
Can see 6/12	O (1)	O (1)
Cannot see 6/12 but can see 6/18	O (2)	O (2)
Cannot see 6/18 but can see 6/60	O (3)	O (3)
Cannot see 6/60 but can see 3/60	O (4)	O (4)
Cannot see 3/60 but can see 1/60	O (5)	O (5)
Light perception (PL+)	O (6)	O (6)
No light perception (PL-)	O (7)	O (7)

Pinhole vision	Right eye	Left eye
Can see 6/12	O (1)	O (1)
Cannot see 6/12 but can see 6/18	O (2)	O (2)
Cannot see 6/18 but can see 6/60	O (3)	O (3)
Cannot see 6/60 but can see 3/60	O (4)	O (4)
Cannot see 3/60 but can see 1/60	O (5)	O (5)
Light perception (PL+)	O (6)	O (6)
No light perception (PL-)	O (7)	O (7)

E. HISTORY, IF NOT EXAMINED

(From relative or neighbour)

Believed	Right eye	Left eye
Not blind	O (1)	O (1)
Blind due to cataract	O (2)	O (2)
Blind due to other causes	O (3)	O (3)
Operated for cataract	O (4)	O (4)

F. WHY CATARACT SURGERY WAS NOT DONE

(Mark up to 2 responses, if VA<6/18, not improving with pinhole, with visually impairing lens opacity in one or both eyes)

Need not felt	O (1)
Fear of surgery or poor result	O (2)
Cannot afford operation	O (3)
Treatment denied by provider	O (4)
Unaware that treatment is possible	O (5)
No access to treatment	O (6)
Local reason (optional)	O (7)

C. LENS EXAMINATION

	Right eye	Left eye
Normal lens / minimal lens opacity:	O (1)	O (1)
Obvious lens opacity:	O (2)	O (2)
Lens absent (aphakia):	O (3)	O (3)
Pseudophakia without PCO:	O (4)	O (4)
Pseudophakia with PCO:	O (5)	O (5)
No view of lens:	O (6)	O (6)

D. MAIN CAUSE OF PRESENTING VA<6/12

(Mark only one cause for each eye)

	Right eye	Left eye	Principal cause in person
Refractive error:	O (1)	O (1)	O (1)
Aphakia, uncorrected:	O (2)	O (2)	O (2)
Cataract, untreated:	O (3)	O (3)	O (3) (F)
Cataract surg. complications:	O (4)	O (4)	O (4)
Trachoma corneal opacity:	O (5)	O (5)	O (5)
Other corneal opacity:	O (6)	O (6)	O (6)
Phthisis:	O (7)	O (7)	O (7)
Onchocerciasis:	O (8)	O (8)	O (8)
Glaucoma:	O (9)	O (9)	O (9)
Diabetic retinopathy:	O (10)	O (10)	O (10)
ARMD:	O (11)	O (11)	O (11)
Other posterior segment:	O (12)	O (12)	O (12)
All globe/CNS abnormalities:	O (13)	O (13)	O (13)
Not examined: can see 6/12	O (14)	O (14)	O (14)

G. DETAILS ABOUT CATARACT OPERATION

	Right eye	Left eye
Age at operation (years)	☐☐	☐☐
Place of operation		
Government hospital	O (1)	O (1)
Voluntary / charitable hospital	O (2)	O (2)
Private hospital	O (3)	O (3)
Eye camp / improvised setting	O (4)	O (4)
Traditional setting	O (5)	O (5)
Type of surgery		
Non IOL	O (1)	O (1)
IOL implant	O (2)	O (2)
Couching	O (3)	O (3)
Cost of surgery		
Totally free	O (1)	O (1)
Partially free	O (2)	O (2)
Fully paid	O (3)	O (3)
Cause of VA<6/12 after cataract surgery		
Ocular comorbidity (Selection)	O (1)	O (1)
Operative complications (Surgery)	O (2)	O (2)
Refractive error (Spectacles)	O (3)	O (3)
Longterm complications (Sequelae)	O (4)	O (4)
Does not apply - can see 6/12	O (5)	O (5)

Appendix B: Washington Group Short Set – Enhanced

Preamble to the WG-SS Enhanced:

Interviewer read: "The next questions ask about difficulties you may have doing certain activities because of a HEALTH PROBLEM."

VISION		
VIS_1	[Do/Does] [you/he/she] have difficulty seeing, even when wearing [your/his/her] glasses]?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
HEARING		
HEAR_1	[Do/Does] [you/he/she] have difficulty hearing, even when using a hearing aid(s)]?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
MOBILITY		
MOB_1	[Do/Does] [you/he/she] have difficulty walking or climbing steps?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
COMMUNICATION		
COM_1	Using [your/his/her] usual language, [do/does] [you/he/she] have difficulty communicating, for example understanding or being understood?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
COGNITION (REMEMBERING)		
COG_1	[Do/does] [you/he/she] have difficulty remembering or concentrating?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
SELF-CARE		
SC_SS	[Do/does] [you/he/she] have difficulty with self-care, such as washing all over or dressing?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
UPPER BODY		
UB_1	[Do/Does] [you/he/she] have difficulty raising a 2-litre bottle of water or soda from waist to eye level?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
UB_2	[Do/Does] [you/he/she] have difficulty using [your/his/her] hands and fingers, such as picking up small objects, for example, a button or pencil, or opening or closing containers or bottles?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
AFFECT (ANXIETY AND DEPRESSION)	*Interviewer: If respondent asks whether they are to answer about their emotional states after taking mood-regulating medications, say: "*Please answer according to whatever medication [you were/he was/she was] taking."	

ANX_1	How often [do/does] [you/he/she] feel worried, nervous or anxious?	1. Daily 2. Weekly 3. Monthly 4. A few times a year 5. Never
ANX_2	Thinking about the last time [you/he/she] felt worried, nervous or anxious, how would [you/he/she] describe the level of these feelings?	1. A little 2. A lot 3. Somewhere in between a little and a lot
DEP_1	How often [do/does] [you/he/she] feel depressed?	1. Daily 2. Weekly 3. Monthly 4. A few times a year 5. Never
DEP_2	Thinking about the last time [you/he/she] felt depressed, how depressed did [you/he/she] feel?	1. A little 2. A lot 3. Somewhere in between a little and a lot

Appendix C: Sierra Leone Equity Tool Questionnaire

	Question	Response categories
Q1	Does your household have … electricity	Yes No
Q2	…a television?	Yes No
Q3	…a refrigerator?	Yes No
Q4	…a mobile phone?	Yes No
Q5	Does any member of this household own: a watch?	Yes No
Q6	Does any member of this household have a bank account?	Yes No
Q7	What is the main material the floor is made of in your household?	Earth, sand, dung Cement Other
Q8	What is the main material the exterior walls are made of in your household?	Cane, palm, trunks, dirt Cement Other
Q9	What is the main material the roof is made of in your household?	Metallic sheets Other
Q10	What type of fuel does your household mainly use for cooking?	Charcoal Wood Other

Sightsavers holds Independent Research Organisation (IRO) status. We conduct high-quality research to ensure our programmes are effective and meet the needs of the people they are designed to serve.

Visit our research centre:
www.research.sightsavers.org

@Sightsavers_Pol

www.sightsavers.org

Registered charity numbers 207544 and SC038110

Sightsavers