Rapid Assessment of Avoidable Blindness: Liberia, 2024

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Sightsavers

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Executive summary

In 2020 among 7.8 billion people globally, an estimated 43.3 million were blind and 295.0 million had moderate or severe visual impairment. 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 sub-groups, such as people living in poverty conditions and people with disabilities.

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. RAAB focuses on people aged 50 years and above due to the fact that the majority of blindness and visual impairment is found in this age group. In June 2024, Sightsavers supported the Ministry of Health in Liberia to conduct a RAAB to assess the prevalence and causes of blindness and visual impairment in the country. Internationally comparable measures of self-reported functional impairments and relative household wealth were also used to better understand the associations between eye health outcomes, poverty and disability.

We recruited 3,999 individuals aged 50 years and over, of whom 3,868 were examined (a 96.7% response rate). After adjusting for age and sex, the prevalence of blindness was 4.4% (measured as presenting visual acuity in the better eye), which was slightly higher than the 3.8% observed in the RAAB conducted in 2012. 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 41.6%, down from 66.7% in 2012, and the decrease is wider among women (down to 30.4% from 62.2%) at VA<3/60. In terms of surgical outcomes, 31.8% of all operated eyes had good or very good vision if best correction were available, which represents a decrease from 40.8% in 2012. However, the proportion of those experiencing ‘poor’ vision, even with the best correction, dropped from 35.6% in 2012 to 25.2% in 2024.

Unaddressed refractive errors (URE) are a major cause of both blindness and all levels of visual impairments, and a contributing cause to poor post-surgical visual outcomes.

The 2024 RAAB findings indicate a mixed picture in terms of the change in eye health status and coverage since 2012. This is perhaps to be expected given the evolving nature of Liberia's healthcare system and the changing demography in the country's population. This data will support the strengthening and ongoing monitoring of the national eye health system and service delivery.

Contents

Abbreviations

ARMD	Age-related macular degeneration
CI	Confidence interval
CNS	Central nervous system
CSC	Cataract surgical coverage
CVA	Corrected visual acuity
eCSC	Effective cataract surgical coverage
eREC	Effective refractive error coverage
EVI	Early vision impairment
ICD-11	International Classification of Disease, 11th revision
IOL	Intraocular lens
IOV	Inter-observer variation
LET	Liberia equity tool
MVI	Moderate visual impairment
NEHP	National Eye Health Programme
NREB	National Research Ethics Board
PVA	Presenting visual acuity
RAAB	Rapid Assessment of Avoidable Blindness
SEP	Socio-economic position
SVI	Severe visual impairment
UCVA	Uncorrected visual acuity
URE	Unaddressed refractive error
VA	Visual acuity
VI	Visual impairment
WHA	World Health Assembly
WHO	World Health Organisation

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Introduction

Visual impairment globally and in Liberia

In 2020, an estimated 43.3 million people globally were blind (1). An additional 553 million people had mild, moderate or severe visual impairment (VI). Among older adults, the all-age-standardised prevalence of blindness decreased by 28.5% between 1990 and 2020, and yet the estimated number of blind people increased by 50.6%, mainly due to population growth and ageing (2). Older people are disproportionately affected: 77.7% of blind people are aged over 50 years; while 91.8% of people who are blind live in low- and middle-income countries, and 55% are women (1). There is limited data on how people with other disabilities are affected by VI, but what exists suggests that they are at higher risk than people without other disabilities (3). Globally, more than 75% of VI is either preventable or treatable.

To reduce the burden of VI, the World Health Organisation (WHO) recommends strengthening eye care services through 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 surgical coverage (4). 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 VI and achieving quality of life for all citizens.

As part of the Vision 2020 initiative, and supported by the 2019 World Report on Vision, many countries developed national plans for the elimination of avoidable blindness (5). In developing countries, a major constraint in the implementation of these national plans and policies has been the absence of country-specific epidemiological data. To resolve this issue, the WHO recommends conducting periodic population-based studies, such as Rapid Assessments of Avoidable Blindness (RAAB) to provide data for decision-making and programme planning. RAAB is a standard methodology for obtaining reliable results for people aged 50 years and above with the highest prevalence of VI (6).

Liberia conducted the first RAAB in 2012 to provide baseline data for programme planning and informed decision-making. The lack of a national eye health policy and strategic plan led to an uncoordinated and fragmented implementation of eye health activities without proper monitoring and supervision. However, the first National Eye Health Policy and Strategic Plan were launched in late 2023, focusing on moving towards universal eye health coverage (7).

According to the 2012 RAAB report, the prevalence of blindness in the sample population aged 50+ years was 4.1%, and 3.8% after it was adjusted for the age and sex structure of the population. Adjusted prevalence of blindness was slightly higher among females (4.2%, 95%CI 3.1-5.3%) than males (3.5%, 95%CI 2.3-4.6%), although this was not significant. Unoperated cataract was the major cause of blindness (accounting for 60.4%), followed by glaucoma (accounting for 16.0%). Unoperated cataract was also the major cause of severe VI at 62.6%, followed by 'other' posterior segment at 17.8% ('other' indicating not glaucoma, diabetic retinopathy or age-related macular degeneration). Refractive error was the leading cause of moderate VI, accounting for 46.4% of cases, followed by unoperated cataract, accounting for 35.2%.

Access to eye care services is limited, especially in rural areas, among the urban poor and among people with disabilities. The 2012 RAAB indicated that at that time, coverage of cataract services was 63.6% (at the 3/60 level): 68% among males and 60.6% among females. Population growth and rapid demographic changes throughout Liberia mean that it is important that existing resources (human, financial, infrastructure and equipment) be reviewed and revised to effectively target the major avoidable causes of blindness.

In addition to VI, a large number of people over the age of 50 also experience other types of disabilities (8). 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" (9). It is widely acknowledged that those with disabilities are also further marginalised due to low socio-economic status (10). Evidence suggests that people with disabilities are often less likely to access the health services they need. Therefore, it is 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 Liberia was conducted in 2012 and was followed by a series of civil, political and health emergencies, resulting in a lack of a coordinated system for eye health delivery in the country. Since then, no new data has been available to guide 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.

This RAAB aims to provide up-to-date data for eye health planning and programmes by the Liberian Ministry of Health and its partners, and to understand what changes have occurred since the last study was conducted in 2012.

General objective

To assess the eye health status, unmet eye health needs and eye health service coverage among people aged 50 years and above in Liberia, identify factors associated with low coverage of services, and compare this with the situation in 2012.

Specific objectives

1. To determine the prevalence and distribution of blindness and VI in the study population.
2. To determine the causes of blindness and VI.
3. To assess the coverage of cataract surgical services and visual outcomes from cataract surgeries by determining the effective cataract surgical coverage (eCSC).
4. To determine the barriers to uptake of cataract services.
5. To assess the effective refractive error coverage (eREC).
6. To determine the prevalence of disability among the study population.
7. To explore the relationship between disability, socioeconomic status and VI.
8. To analyse the changes in the prevalence and causes of blindness and visual impairment, and the coverage of cataract surgical services since 2012.

Methods

Study design and population

RAAB is a standardised research methodology, which has been reported elsewhere (11). This RAAB is a descriptive, cross-sectional, population-based study, designed to be conducted in all regions of Liberia (Figure 1). Liberia has a population of 5.2 million people with 15 geo-political sub-divisions called counties, which are further subdivided into 106 administrative districts (12).

Figure 1: Location of study clusters within Liberia

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

Inclusion criteria

1. Be aged 50 and over.
2. Have consented to participate.
3. Have been ordinarily resident in the household for at least six months before the survey took place.

Exclusion criteria

The following people were excluded from the study:

1. Aged less than 50 years.
2. Visitors to the household.
3. Unable or unwilling to provide consent.

Sample size and strategy

The sample size was calculated using the RAAB (version 7) software package. The following information was used to calculate the sample size:

- Based on the 2022 Population and Housing Census, the total projected population of persons with or without disabilities of all ages is 5,248,621.
- Based on the 2012 RAAB, the expected prevalence of blindness in the sample of 3.8%.
- Worst acceptable prevalence: 3.04% (+/- 20%)
- Confidence interval (CI): 95%
- Non-response rate: 10%
- Design effect: 1.5

A minimum sample size of 4,034 persons aged 50 years and above was required for this study. These persons were selected from 81 clusters of 50 persons aged 50 years and above, which gave a total sample size of 4,050 (Figure 1).

Two-stage sampling was used. For the first stage, 81 primary sampling units (villages) were selected from a complete list using probability proportionate to size methodology. A list of all villages in Liberia with their populations (2023 census) (12) was obtained and verified by the Liberia Statistics Agency. The complete list of villages was uploaded to the RAAB software, which has an inbuilt 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 village leaders to identify the village border. If the village population was large, exceeding 500 inhabitants, a map was developed with the village leader to divide it into smaller segments. In this case, a segment was chosen at random by numbering them and choosing a number, also 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 a 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. This was 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 the purpose of the visit, the team informed the eligible participants of their rights to refuse or withdraw permission to participate, as well as the potential benefits of participation. Written consent was obtained and, in the case where a participant was illiterate, their thumbprint was obtained and witnessed by an independent person, who was not part of the study team.

Within each household, all eligible residents were enumerated, including those temporarily absent. All participants present and consenting underwent visual examination (described further, below) 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 unavailable participants for the visual acuity screening was 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 7 manual, and included the following steps:

1. Asking if the individual habitually uses distance or near spectacles, and for how long they had them (all participants).
2. Measured uncorrected visual acuity (UCVA) (all participants) in each eye separately. Participants are prompted to remove distance correction before measuring UCVA.
3. Measured corrected visual acuity (CVA) (participants with distance spectacles).
4. Measured pinhole visual acuity assessment of each eye presenting <6/12.
5. Examined the lens of each eye with a torch in a darkened room (all participants).
6. 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.

7. Assessed the major cause of VI of each eye presenting <6/12 and in persons where both eyes present <6/12 and the causes are not the same.
8. Asked questions regarding cataract surgery, such as where it has taken place.
9. Asked questions regarding why cataract surgery has not taken place, where it is indicated.

Categorisation of visual acuity

Presenting VA (PVA) is a secondary variable derived from UCVA and CVA, if recorded. Participants without distance correction will have a PVA the same as their UCVA. Participants wearing distance spectacles will have a PVA equivalent to their CVA. PVA is used to determine the participants' vision status.

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

The WHO International Classification of Diseases (ICD-11) classifies distance vision impairment as follows:

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

The study tool is included in Appendix A.

Categorisation of post-operative visual outcomes

Eyes found to have been operated for cataract were categorised according to their post-operative visual acuity. Eyes seeing VA≥6/12 were considered to have '**good'** post operative visual outcomes; eyes seeing 6/60>VA≥6/12 were considered to have '**borderline'** post-operative visual outcomes; and eyes seeing VA<6/60 were considered to have '**poor'** post-operative visual outcomes.

Effective cataract surgical coverage and effective refractive error coverage

Effective cataract surgical coverage (eCSC) is a measure of the number of people in a population who have been operated on for cataract and had a good outcome (at least 6/12

post-operative PVA), as a proportion of all people operated on or still requiring surgery. This WHO standard indicator describes services access (i.e. cataract surgical coverage – CSC, adjusted for quality). CSC and eCSC are reported at four cataract surgical thresholds.

The gap between CSC and eCSC values are considered as quality gap; the relative quality gap is calculated as (total CSC-total eCSC)/total CSC, with lower values reflecting better quality of cataract surgical services.

In this study, refractive error is defined as UCVA worse than 6/12 which improves to 6/12 with spectacle or pinhole. This includes people with corrected refractive error but who have a need for an ongoing refractive service, as well as those without correction who are yet to access the services.

Effective refractive error coverage (eREC) for distance measures the number of people in a population in need of distance optical correction who have received correction and had a good outcome (i.e. can see at least 6/12 corrected) as a proportion of all people in need of optical correction who have accessed correction or still require it.

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 or 'domains', and which has been used successfully in other RAABs (13). Response options include four categories, allowing respondents to position themselves along a scale of functioning, thus allowing for a nuanced analysis of the 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.

Liberia equity tool

The Liberia equity tool (LET) 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 LET 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 other populations in other countries. The current LET was released in December 2022 and is based on DHS 2019-20 data (14).

The study tool is included in Appendix C.

Self-reported socio-economic position tool

The self-reported socio-economic position (SEP) tool is also recommended for integration into rapid vision impairment surveys and was found to be simple and easy to administer. This tool identifies the socio-economic position of individuals or groups (such as households or communities) and categorises them into different social strata based on their experience on income, education, occupation, assets, nutrition or housing.

The study tool is included in Appendix D.

Data collection

Each participant available to be examined on the RAAB underwent the following steps: visual examination, disability questions, LET questions and SEP questions. Data was collected using an app on a touchscreen smartphone.

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

Four 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 and trainee 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 the IOV results in more detail and practising RAAB procedures and different scenarios and reviewing and practising the disability and wealth tools. On day five they practised in a live cluster, with trainers observing their procedures and how they work as a team in the field.

Data analysis

The study tools were programmed using PEEK software (15). Data was automatically analysed using the PEEK software system and raw data was additionally downloaded for further analysis of the equity and SEP questions in Stata version 18.5.

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 the prevalence of visual impairment (16).

Ethical considerations

The protocol was approved by the Liberia National Research and Ethics Board (NREB). The study followed all steps required by the legal and regulatory frameworks of research in Liberia.

Before the administration of the questionnaire, written study information was shared and explained verbally in easily understandable language, and the consent of the participants was collected. Participants unable to sign their name provided a thumbprint, which was witnessed by another member of the community who was literate.

Participants were encouraged to ask questions about the survey, and investigators were trained to address such questions in an open and transparent manner. It was made clear to each participant that their participation is voluntary, and 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 the 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 17 June and 31 July 2024. In the end, 80 clusters were visited and 3,868 people were examined out of the 3,999 enrolled, a response rate of 96.7% (Table 1). Of those not examined, the majority (2.9%) were unavailable, with only a small proportion refusing (0.4%) or unable to communicate (0.1%).

Table 1: Participant examination status by sex

	Examined	Not available	Refused	Unable to communicate	Total
Male	1,801	51	7	0	1,859
	96.9%	2.7%	0.4%	0.0%	100.0%
Female	2,067	64	7	2	2,140
	96.6%	3.0%	0.3%	0.1%	100.0%
Total	3,868	115	14	2	3,999
	96.7%	2.9%	0.4%	0.1%	100.0%

More females (53.5%) than males were examined in the study, and females were proportionately overrepresented compared to the estimated national population (

Table 2). Compared to the estimated national population, younger people – particularly males – were overrepresented and older people were marginally equally represented. 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 ten-year age group, compared with the total national population (2022 census)

	Survey participants			National population (2021 projection)		
	Female	Male	Total	Female	Male	Total
50-59	1,142	1,051	2,193	119,650	144,173	263,823
	55.2%	58.5%	56.7%	51.1%	54.1%	52.7%
60-69	576	448	1,024	63,656	74,176	137,832
	27.8%	24.9%	26.5%	27.2%	27.9%	27.5%
70-79	223	222	455	30,229	30,705	60,934
	11.3%	12.3%	11.8%	12.9%	11.5%	12.2%
80+	119	77	196	20,662	17,216	37,878
	5.7%	4.3%	5.1%	8.8%	6.5%	7.6%
Total	2,070	1,798	3,868	234,197	266,270	500,467
	53.5%	46.5%	100.0%	46.8%	53.2%	100.0%

Among those examined, 10.5% self-reported a disability (reporting a lot of difficulty or more in at least one domain of functioning) (Table 3). Prevalence was higher among females (11.3%) than males (9.6%). Excluding those people who only reported difficulties in the seeing domain, the prevalence of disability in other domains was 6.5% (6.9% among females and 6.0% among males).

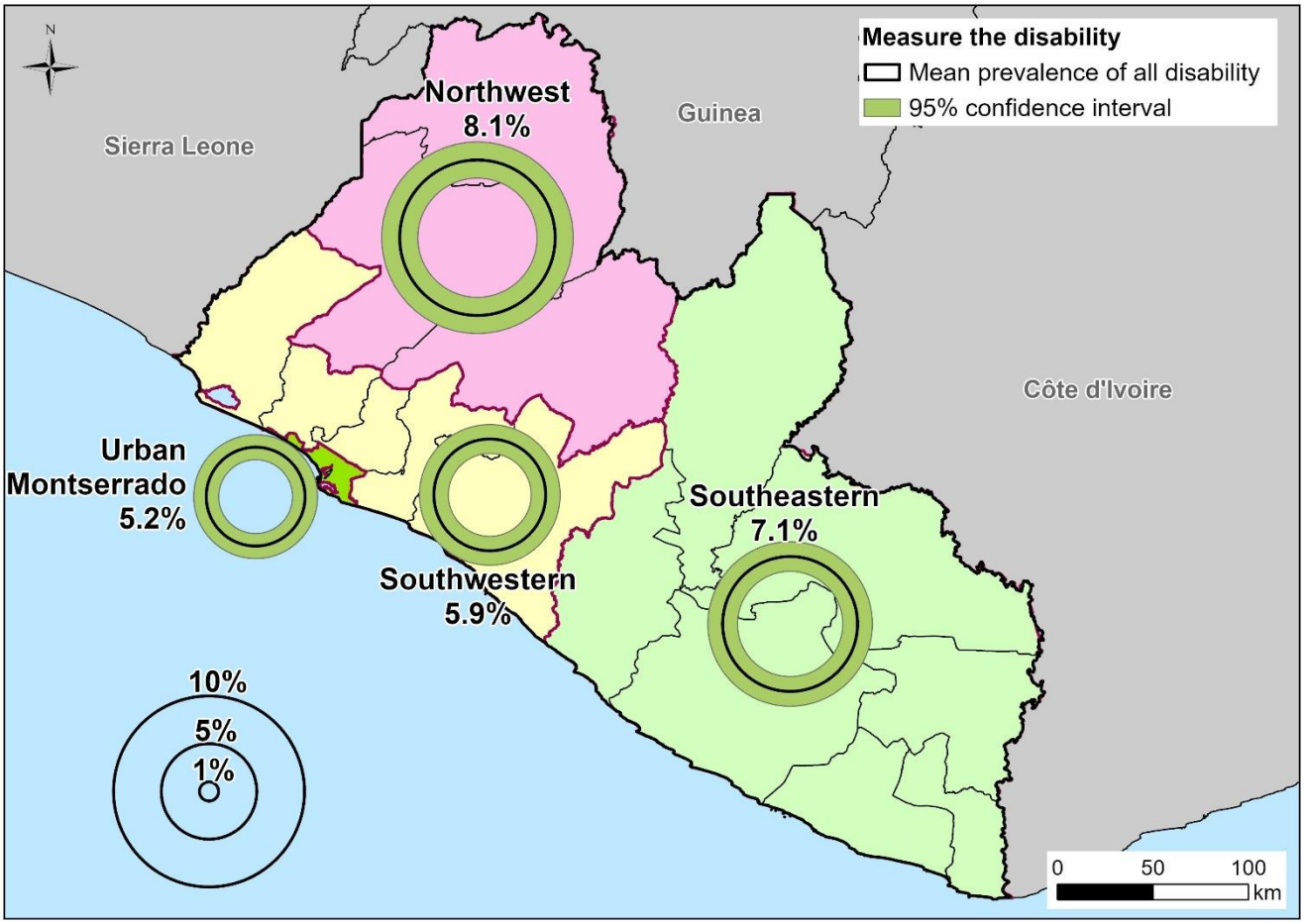
Table 3: Disability among examined female and male participants

	Male	Female	Total
Disability: all domains	173	234	407
	9.6%	11.3%	10.5%
Disability: excluding seeing difficulties	108	142	250

	6.0%	6.9%	6.5%

Figure 2 illustrates that the prevalence of disability (excluding seeing difficulties) appeared to differ by region, with the highest prevalence (8.1%) observed in the North west, and the lowest in urban Montserrado (5.2%).

Figure 2: Map of sample prevalence of disability (excluding seeing difficulties) by region



Compared to the national population, the survey population appeared to be slightly poorer, with 28.7% of participants falling into the lowest quintile (

Table 4). There were no substantial differences between males and females with respect to wealth as measured by the equity tool. With respect to household wealth, the majority of participants reported less than adequate food levels (57.4%) and not enough income (63.1%) (Table 5). Gender differences were observed, with more females reporting less than adequate food and not enough income compared to males.

Table 4: Relative wealth of examined participants

	Male	Female	Total
Equity tool: national quintiles			
1 (poorest)	492	618	1,110
	27.3%	29.9%	28.7%
2	408	363	771
	22.7%	17.6%	19.9%
3	249	280	529
	13.8%	13.5%	13.7%
4	249	336	585
	13.8%	16.3%	15.1%
5 (wealthiest)	403	470	873
	22.4%	22.7%	22.6%
Total	1,801	2,067	3,868
	100.0%	100.0%	100.0%

Table 5: Household wealth of examined participants

	Male	Female	Total
Household food levels			
Less than adequate	939	1,282	2,221
	52.1%	62.0%	57.4%

Just or more than adequate	862	785	1,647
	47.9%	38.0%	42.6%
Household income			
Not enough	1,043	1,397	2,440
	57.9%	67.6%	63.1%
Just enough or enough	758	670	1,428
	42.1%	32.4%	36.9%

Prevalence of distance visual impairment

The prevalence of distance VI in the sample population is reported using the PVA in the better eye. The PVA is visual acuity measured with correction, if available.

155 participants, 4.0% of the total examined, were bilaterally blind with available correction (Table 6). SVI was observed in 61 people (1.6%), MVI in 631 people (16.3%) and EVI in 425 people (11.0%). Among males and females examined in the sample, there appears to be relatively little difference at all levels of visual impairment.

Table 6: Sample prevalence of visual impairment among males and females examined

	Female	Male	Total
Blind: presenting vision <3/60 in better eye			
	97	58	155
	4.7% [3.3-6.1]	3.2% [2.2-4.3]	4.0% [3.4-4.7]
Blind: best corrected vision <3/60 in better eye			
	73	53	126
	3.5% [2.8-4.4]	2.9% [2.3-3.8]	3.3% [2.7-3.9]
Severe visual impairment: better eye can see 3/60 but not 6/60			
	37	24	61
	1.8% [1.1-2.4]	1.3% [0.9-1.0]	1.6% [1.2-2.0]
Moderately visual impairment: better eye can see 6/60 but not 6/18			
	365	266	631
	17.7 [15.8-19.7]	14.8 [12.6-16.8]	16.3% [15.2-17.5]
Early (mild) visual impairment: better eye can see 6/18 but not 6/12			
	270	155	425
	13.1% [11.4-14.4]	8.6% [7.4-10.1]	11.0% [10.0-12.0]

Adjusting for age and sex, the prevalence of blindness is estimated to be 4.4%, although based on the 95% Confidence Interval (CI), this could be as high as 5.4% or as low as 3.5%. Extrapolating this to the population, we can estimate that there are 21,776 blind people aged 50 years and above in Liberia (

Table 7).

Age and sex-adjusted bilateral SVI affects approximately 8,677 people (1.7%), MVI affects 86,940 people (17.4%) and age and sex-adjusted EVI affects 54,498 people (10.9%).

The differences between males and females are small and not significant, except in the case of EVI as the confidence intervals overlap significantly.

Table 7: Estimated burden of visual impairment among males and females in Liberia, adjusted for age and sex

	Female	Male	Total
Blind: presenting vision <3/60 in better eye			
Bilateral cases	12,625	9,151	21,776
	5.4% [4.2,7.0]	3.4% [2.5,4.7]	4.4% [3.5,5.4]
Severe visual impairment: better eye can see 3/60 but not 6/60			
Bilateral cases	4,922	3,755	8,677
	2.1% [1.4,3.0]	1.4% [0.9,2.1]	1.7% [1.3,2.3]
Moderate visual impairment: better eye can see 6/60 but not 6/18			
Bilateral cases	44,747	42,193	86,940
	19.1% [17.3,21.1]	15.8% [13.8,18.1]	17.4% [15.8,19.0]
Early visual impairment: better eye can see 6/18 but not 6/12			
Bilateral cases	30,941	23,557	54,498
	13.2% [11.8,14.7]	8.8% [7.5,10.3]	10.9% [9.9,11.9]

Figure 3 shows the mean prevalence of all-cause blindness by region, showing some variation by region.

Figure 3: Mean prevalence of all-cause bilateral blindness among the sample by region

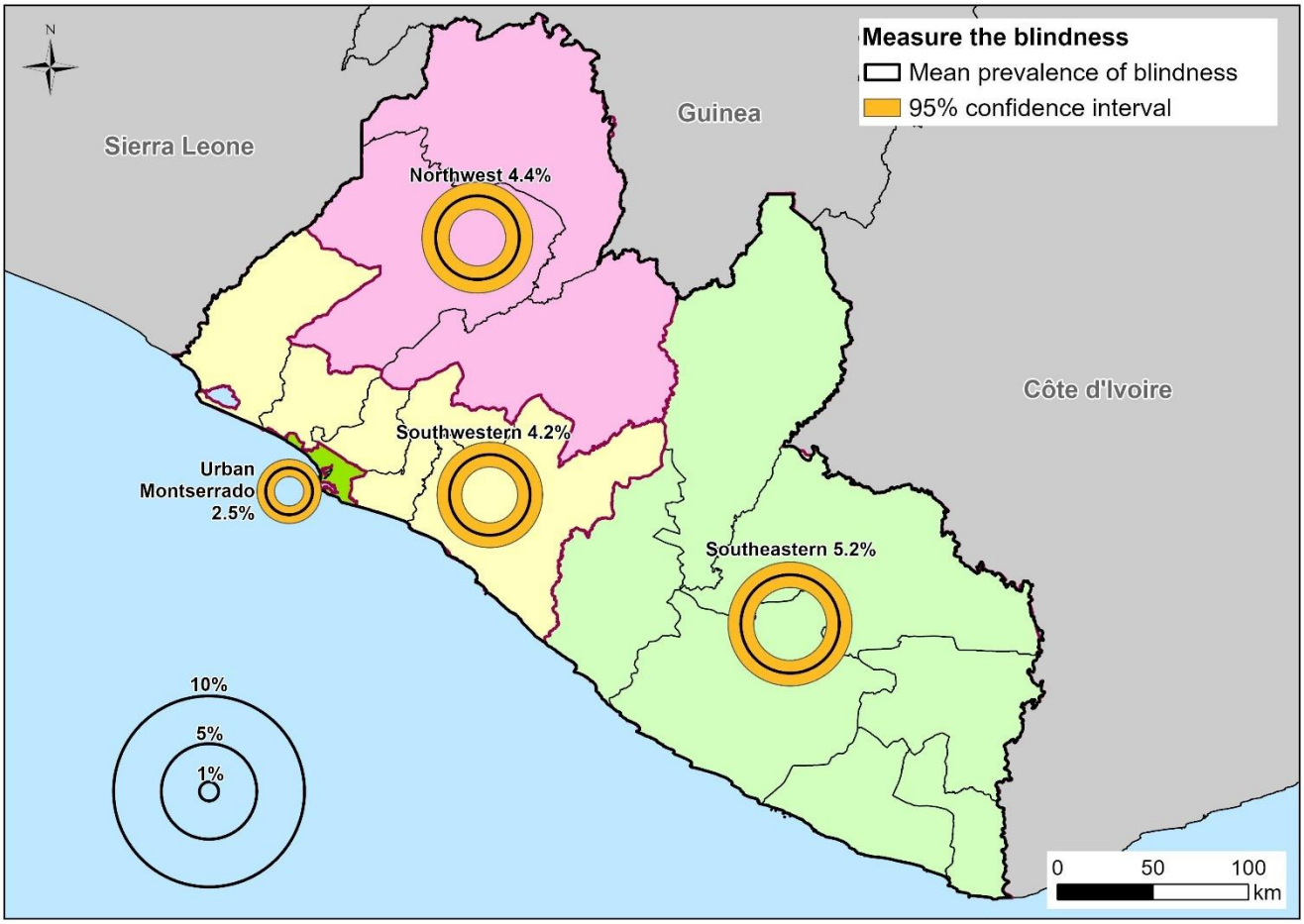
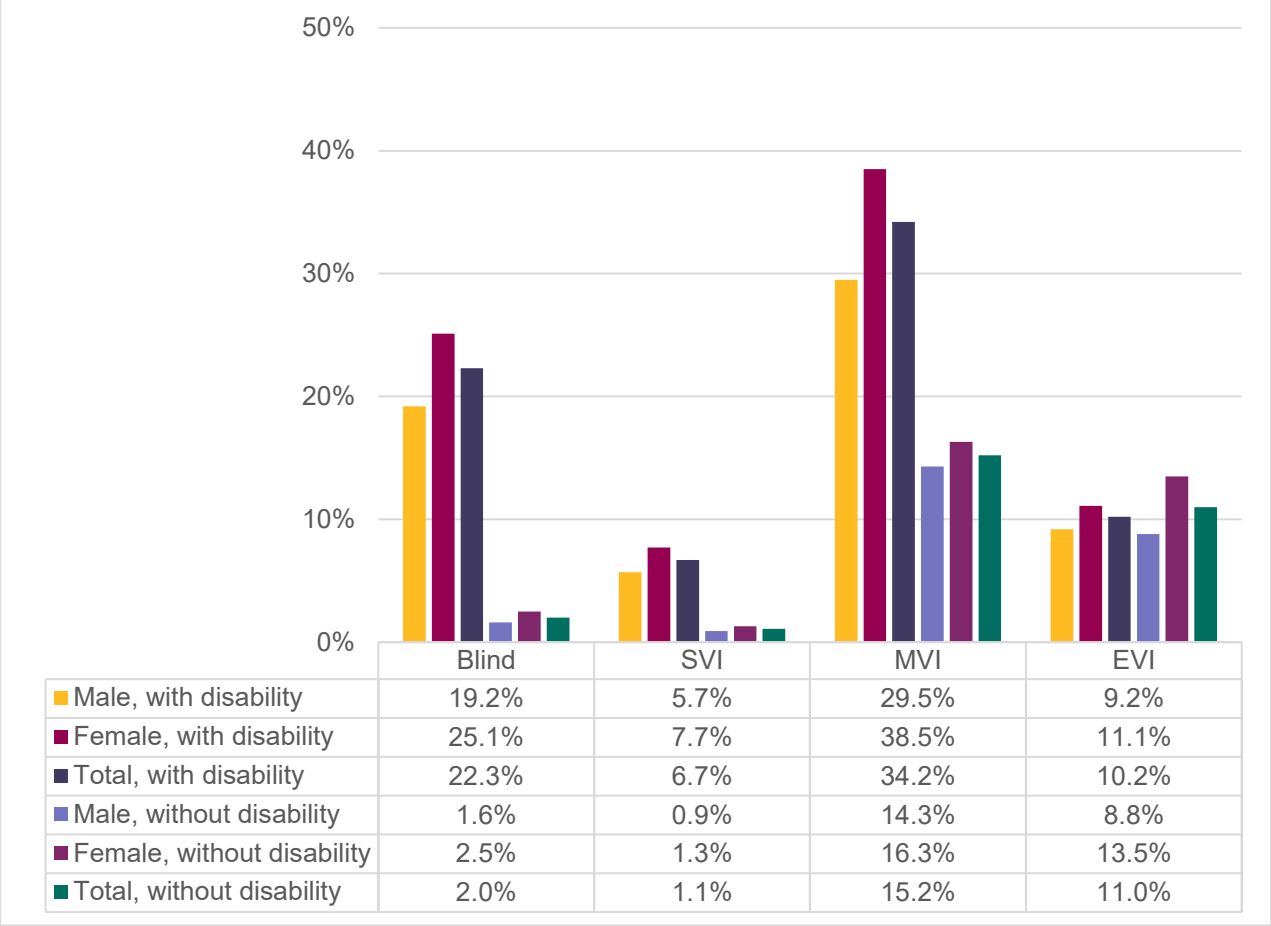


Figure 4 shows the age and sex-adjusted prevalence of visual impairment by disability and sex. Males and females with disabilities were more likely to have visual impairment than individuals without disabilities, and the differences were more striking for more severe degrees of visual impairment, particularly blindness. For example, 19.2% of males and 25.1% of females with any type of disability were blind, compared to 1.6% of males and 2.5% of females without disabilities. The only level of visual impairment where there were no observable differences between males and females with and without disabilities was EVI.

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

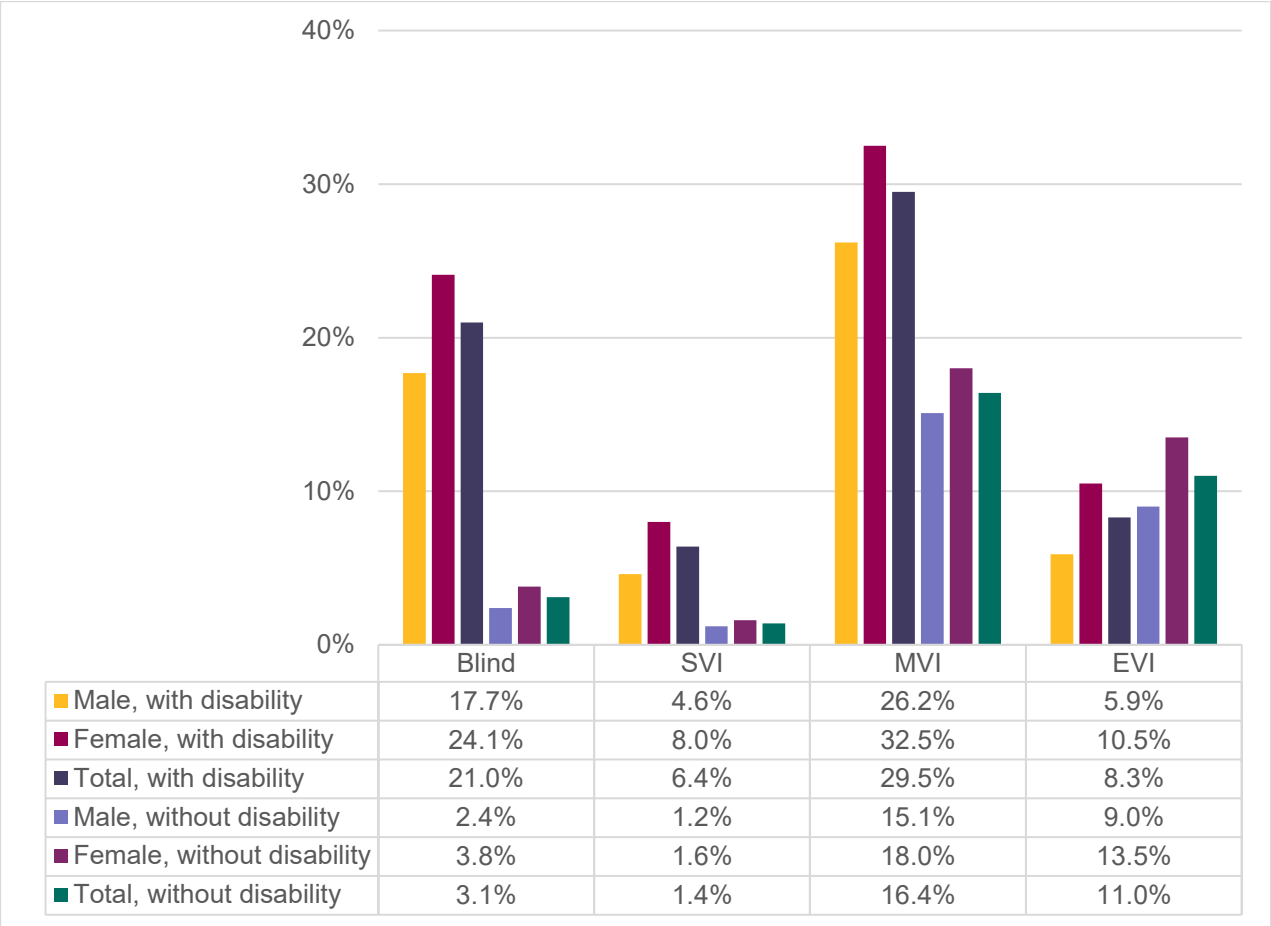


	Blind	SVI	MVI	EVI
Male, with disability	19.2%	5.7%	29.5%	9.2%
Female, with disability	25.1%	7.7%	38.5%	11.1%
Total, with disability	22.3%	6.7%	34.2%	10.2%
Male, without disability	1.6%	0.9%	14.3%	8.8%
Female, without disability	2.5%	1.3%	16.3%	13.5%
Total, without disability	2.0%	1.1%	15.2%	11.0%

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 17.7% of males and 24.1% of females with non-visual disabilities being blind, compared with 2.4% of males and 3.8% of females 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.

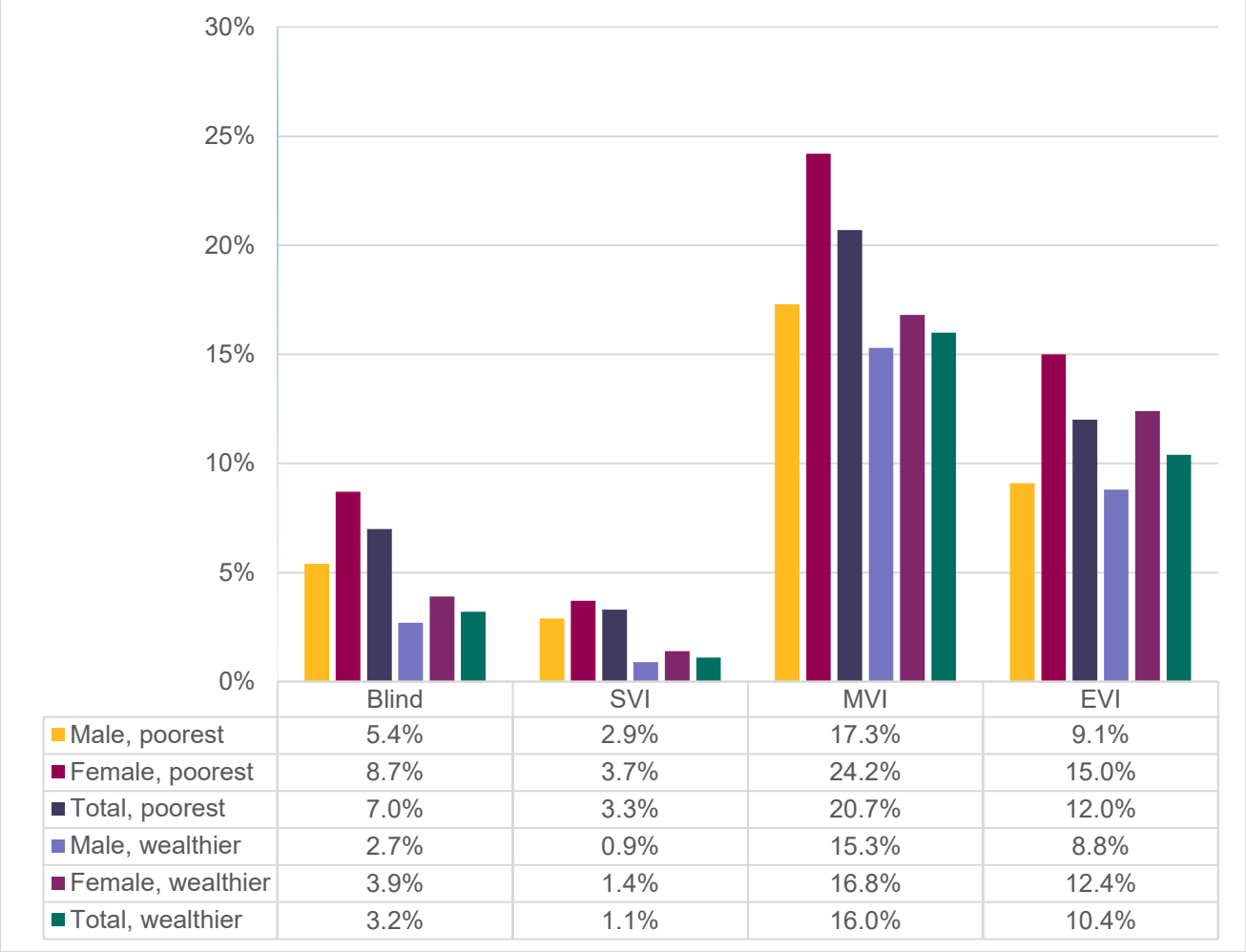
Figure 5: Age- and sex-adjusted prevalence of visual impairment, by disability, excluding seeing domain



	Blind	SVI	MVI	EVI
Male, with disability	17.7%	4.6%	26.2%	5.9%
Female, with disability	24.1%	8.0%	32.5%	10.5%
Total, with disability	21.0%	6.4%	29.5%	8.3%
Male, without disability	2.4%	1.2%	15.1%	9.0%
Female, without disability	3.8%	1.6%	18.0%	13.5%
Total, without disability	3.1%	1.4%	16.4%	11.0%

Error! Reference source not found. shows how adjusted visual impairment is related to equity (relative wealth). There was an association between VI and wealth, with 5.4% of males and 8.7% of females who were in the lowest quintile of the equity tool being blind, compared with 2.7% of males and 3.9% of females who were in quintiles 2-5. This relationship persisted for the other levels of visual impairment, except for EVI in males, where the prevalence of EVI was similar in those in quintile 1 compared to those in quintiles 2-5 of the equity tool.

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



	Blind	SVI	MVI	EVI
Male, poorest	5.4%	2.9%	17.3%	9.1%
Female, poorest	8.7%	3.7%	24.2%	15.0%
Total, poorest	7.0%	3.3%	20.7%	12.0%
Male, wealthier	2.7%	0.9%	15.3%	8.8%
Female, wealthier	3.9%	1.4%	16.8%	12.4%
Total, wealthier	3.2%	1.1%	16.0%	10.4%

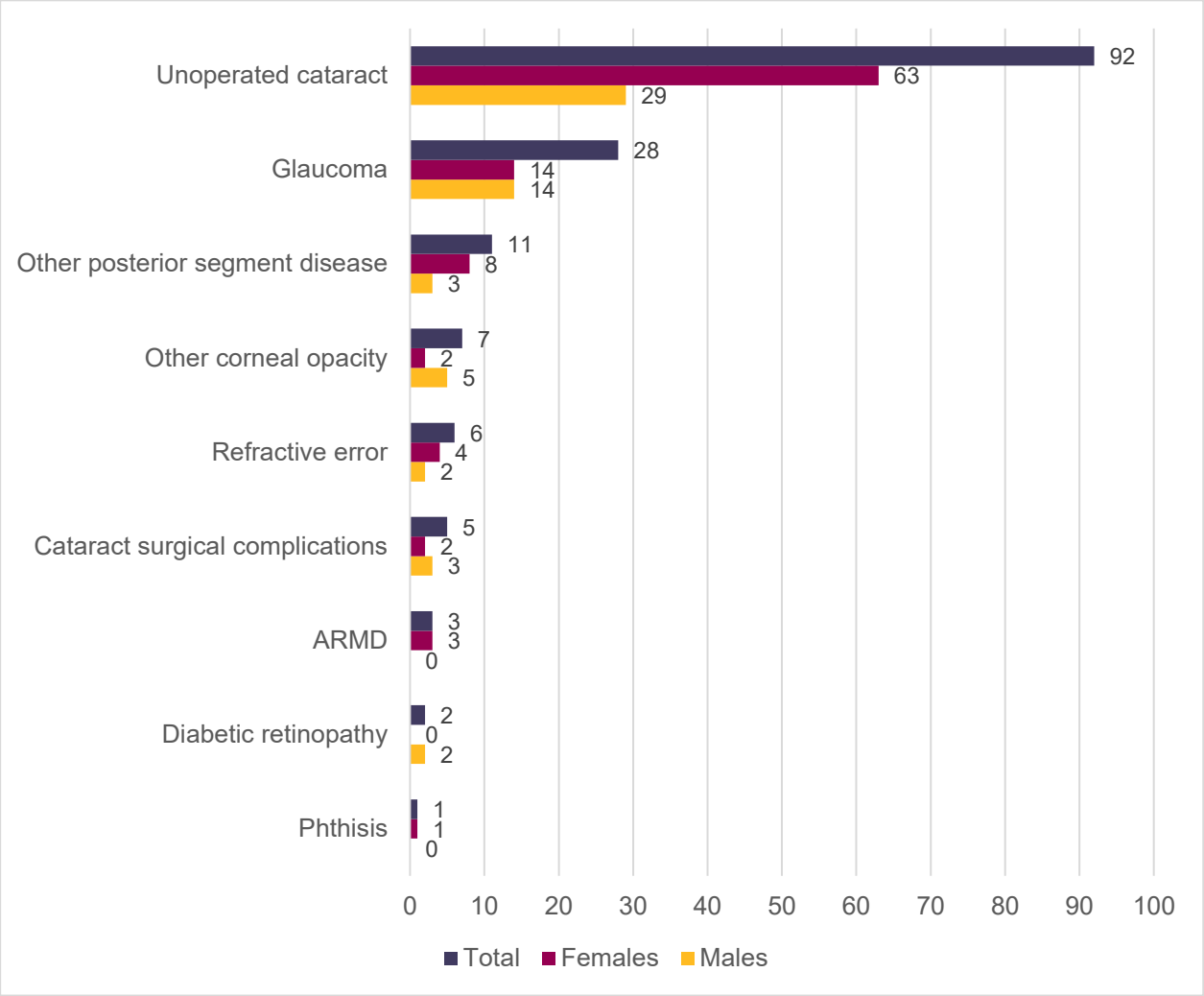
Causes of visual impairment

The most common principal cause of blindness among bilaterally blind individuals was unoperated cataract (92; 59.4%), followed by glaucoma (28; 18.1%), other posterior segment disease (11; 7.1%) and non-trachomatous corneal opacity (7; 4.5%) (**Error! Reference source not found.**). Other causes responsible for smaller proportions of the overall burden included uncorrected refractive error (6; 3.9%), cataract surgical complications (5; 3.2%), age-related macular degeneration (3; 1.9%) and diabetic retinopathy (2; 1.3%).

Cataract as the principal cause of blindness affected more women than men (63 female cases versus 29 male cases). Glaucoma is equally affecting females and males (14 each). 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 unoperated cataract or unaddressed refractive error, as these causes will

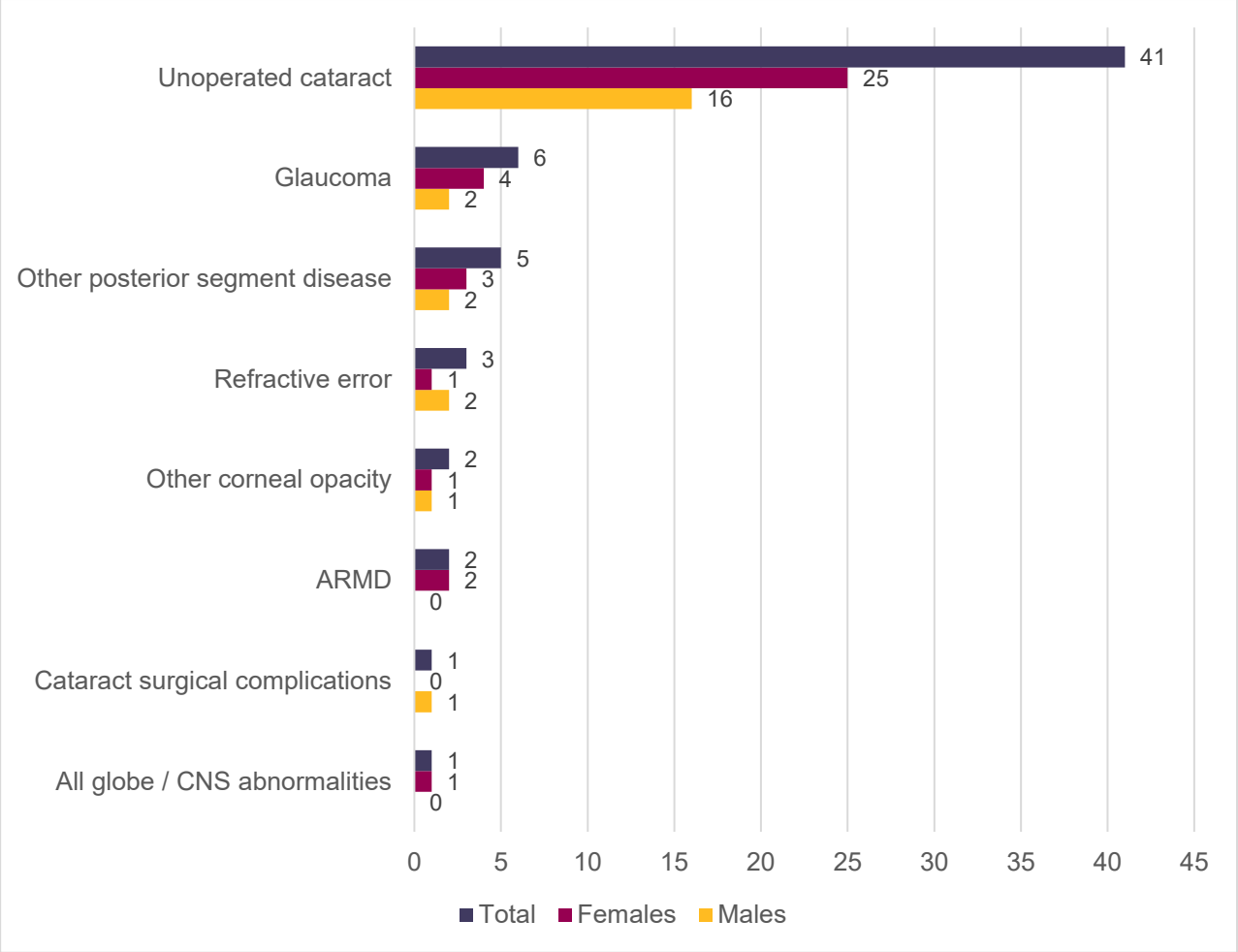
most likely be listed as the principal causes of VI irrespective of co-morbidities. The RAAB ocular examination is also not comprehensive enough for a certain glaucoma diagnosis, therefore these cases are only suspected and require full clinical examination.

Figure 7 Principal causes of blindness among examined males and females



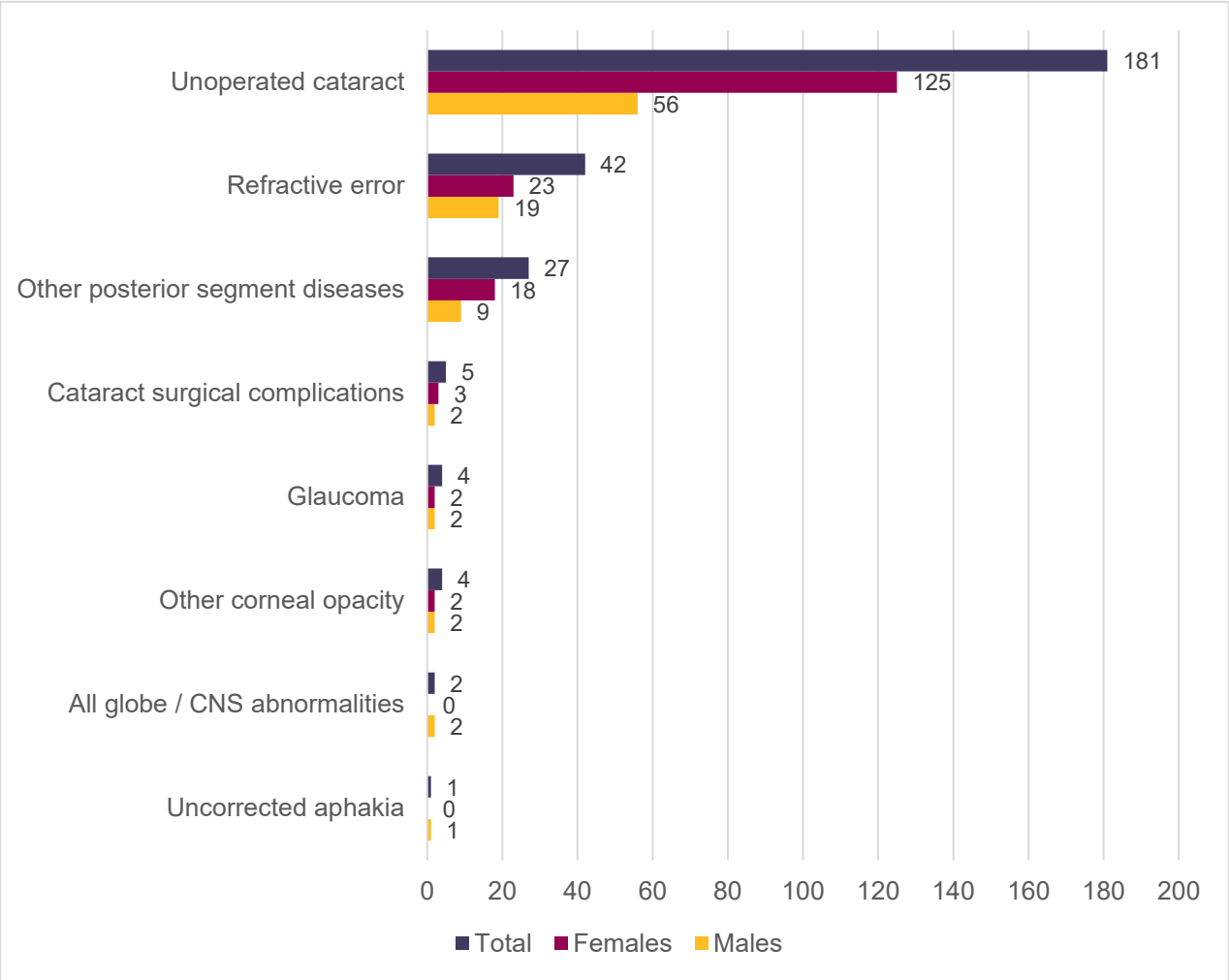
Unoperated cataract was also the most common principal cause of bilateral SVI (41; 67.2%), followed by glaucoma (6; 9.8%), and other posterior segment disease (5; 8.2%) (**Error! Reference source not found.**). All other causes were each responsible for a relatively small proportion of SVI and included unaddressed refractive error (3; 4.9%), non-trachomatous corneal opacity (2; 3.3%), age-related macular degeneration (2; 3.3%) and cataract surgical complications (1; 1.6%).

Figure 8 Principal causes of severe visual impairment among examined participants



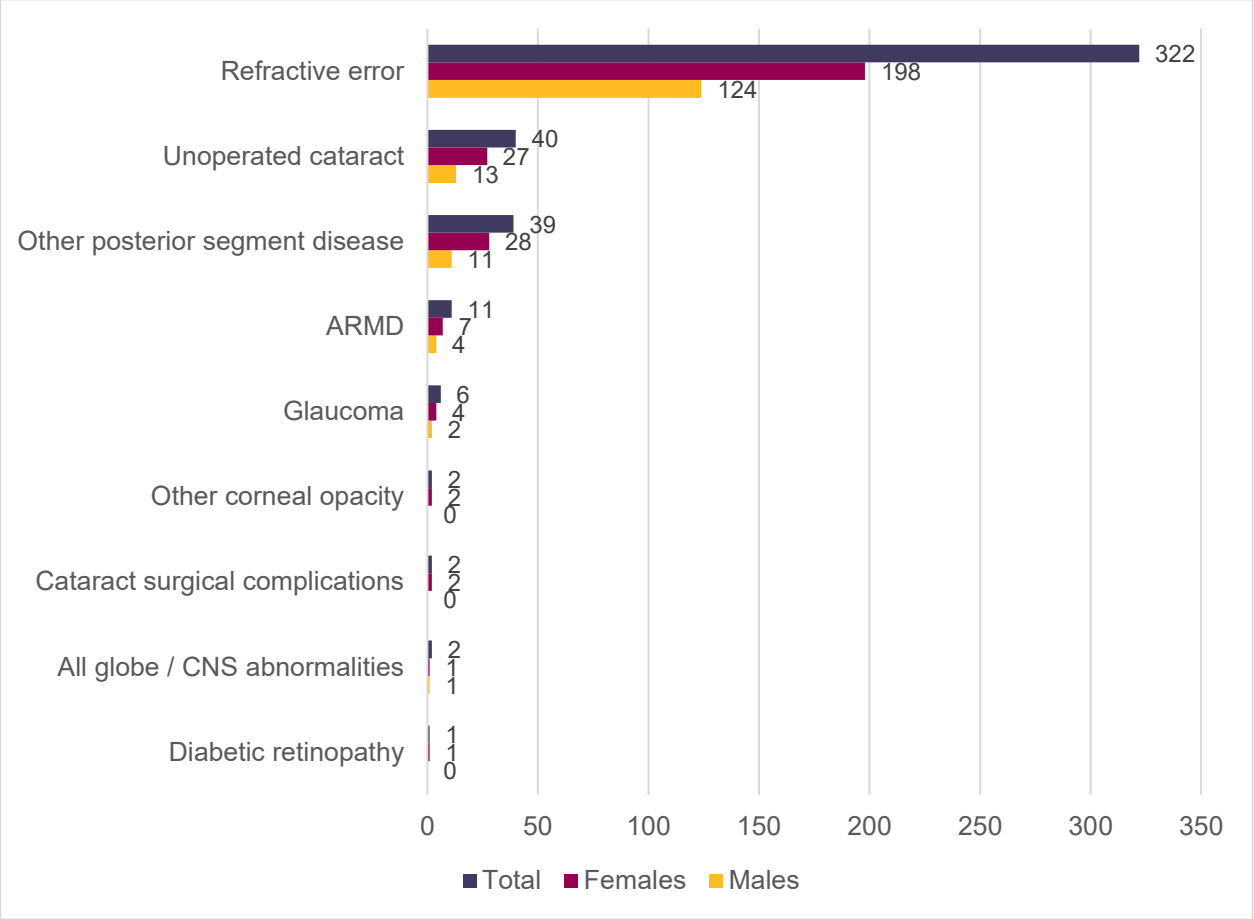
Unoperated cataract was the main principal cause of bilateral MVI (276; 43.7%), followed by unaddressed refractive error (177; 28.1%) and other posterior segment diseases (114; 18.1%) (**Error! Reference source not found.**). Other causes responsible for MVI included glaucoma (26; 4.1%), age-related macular degeneration (25; 4.0%), non-trachomatous corneal opacities (4; 0.6%), cataract surgical complications (8; 1.3%) and trachomatous corneal opacity (1; 0.2%).

Figure 9 Principal causes of moderate visual impairment among examined participants



Unaddressed refractive error was the main principal cause of bilateral EVI (322; 75.8%) (**Error! Reference source not found.**), followed by untreated cataract (40; 9.4%) and other posterior segment disease (39; 9.2%). Other, less significant principal causes included age-related macular degeneration (11; 2.6%), glaucoma (6; 1.4%), other corneal opacity (2; 0.5%), cataract surgical complications (2; 0.5%), other globe or CNS abnormalities (2; 0.5%) and diabetic retinopathy (1; 0.2%).

Figure 10 Principal causes of mild visual impairment among examined participants



Cataract: prevalence, coverage of services and visual outcomes

shows that around 1.9% (95% CI 1.4;2.5) of people aged 50 years and above in Liberia are bilaterally blind due to cataract and another 2.5% (95%CI 1.9; 3.1) are severely visually impaired due to the disease. This translates to approximately 9,539 blind and 12,587 severely visually impaired persons due to cataract across the country.

Table 8 Estimated prevalence and numbers of males and females with visual impairment and cataract in Liberia, adjusted for age and sex

	Females	Males	Total
Blind: best corrected vision <3/60 in better eye			
Bilateral cataract	6,334	4,345	9,539
	2.7% [1.9 – 3.5]	1.6% [1.1 - 2.1]	1.9% [1.4 - 2.5]
Unilateral cataract	10,264	13,035	23,299
	4.4% [3.5 – 5.3]	4.9% [3.9 – 5.9]	4.7% [3.9 – 5.4]
Severe visual impairment: better eye can see 3/60 but not 6/60			
Bilateral cataract	8,328	5,400	12,587
	3.6% [2.6 – 4.5]	2.0% [1.5 – 2.6]	2.5% [1.9 – 3.1]
Unilateral cataract	11,388	14,057	25,446
	4.9% [3.9-5.8]	5.3% [4.3-6.3]	5.1% [4.3-5.8]
Moderate visual impairment: better eye can see 6/60 but not 6/18			
Bilateral cataract	27,903	21,690	46,565
	11.9% [9.5 – 14.3]	8.1% [6.4 – 9.9]	9.3% [7.5 – 11.1]
Unilateral cataract	16,140	20,312	36,452
	6.9% [5.9-7.9]	7.6% [6.6-8.6]	7.3% [6.5-8.9]
Early visual impairment: better eye can see 6/18 but not 6/12			
Bilateral cataract	32,528	27,150	55,017
	13.9% [11.2-16.6]	10.2% [8.2-12.2]	11.0% [8.9-13.1]
Unilateral cataract	15,834	22,178	38,012
	6.8% [5.6-7.9]	8.3% [7.1-9.6]	7.6% [6.6-8.5]

Cataract surgical coverage (CSC) was estimated at 41.6% for persons at VA<3/60 (

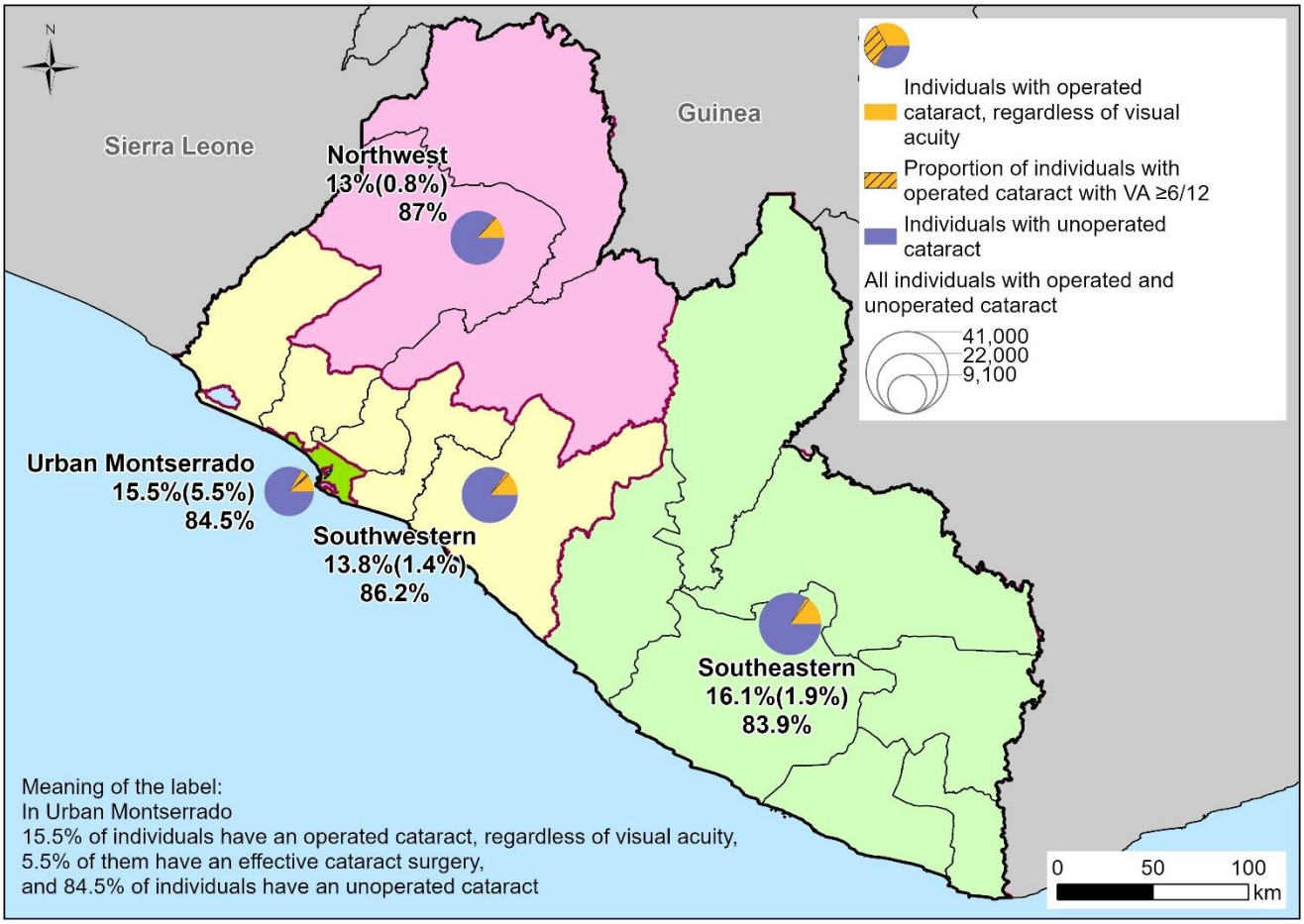
Table 9). At VA<6/60, the estimate was 37.9%. CSC was much higher among men compared to women; 53.3% compared to 30.2% at VA<3/60 and 51.3% compared to 25.1% at VA<6/60. This means that over 51% of men who are blind or severely visually impaired due to cataract have been operated on. However, only one in four women (25%), who are blind or severely visually impaired due to cataract have been operated on.

Table 9: Cataract surgical coverage adjusted for sex and age

	Females	Males	Total
Cataract surgical coverage (persons) – percentage			
VA < 3/60	30.2	53.3	41.6
VA < 6/60	25.1	51.3	37.9
VA < 6/18	11.9	24.4	17.5
VA < 6/12	10.6	21.1	15.4

Error! Reference source not found. shows the CSC (at VA<6/60) among persons in the sample, by region.

Figure 11 Cataract surgical coverage at VA<6/60 among persons, by region



The large gender differences in CSC described above have been reflected in cataract-related visual impairment, with women being disproportionately affected by the disease. The prevalence of cataract blindness and SVI was found to be significantly higher among women, and women were estimated to constitute over 64.9% of all cataract-blind in Liberia.

Over 97.0% of all operated eyes had an intraocular lens (IOL) implanted and 3.0% had no IOL (**Error! Reference source not found.**). Among all 138 operated eyes (with and without IOL), 16 (11.6%) had good visual outcomes; this increased to 31.3% with pinhole correction. Around 56.5% of eyes had borderline outcomes and 31.9% had poor visual outcomes (VA<6/60).

The majority of surgeries took place either in a government or private hospital, with different proportions of visual outcomes (**Error! Reference source not found.**). 44.7% of all reported surgeries were at a government hospital, with 11.9% achieving good outcomes, compared to 31.1% of all surgeries conducted in private facilities, of which 12.2% had good outcomes.

Table 10 Presenting visual acuity in operated eyes

	Good: can see 6/12	Borderline: can see 6/60	Poor: cannot see 6/60	Total
All operated eyes	16 (11.6%)	78 (56.5%)	44 (31.9%)	138 (100.0%)
Gender				
Male	8 (10.5%)	45 (59.2%)	23 (30.3%)	76 (55.1%)
Female	8 (12.9%)	33 (53.2%)	21 (33.9%)	62 (44.9%)
By type of surgery				
Non-IOL	0 (0%)	1 (25.0%)	3 (75.0%)	4 (3.0%)
IOL implant	15 (11.7%)	76 (59.4%)	37 (28.9%)	128 (97.0%)
By years since surgery				
0-3 years	10 (12.7%)	48 (60.8%)	21 (26.6%)	79 (59.8%)
4-7 years	1 (3.3%)	20 (66.7%)	9 (30.0%)	30 (22.7%)
8+ years	4 (17.4%)	9 (39.1%)	10 (43.5%)	23 (17.4%)
By place of surgery				
Government hospital	7 (11.9%)	33 (55.9%)	19 (32.2%)	59 (44.7%)
Charitable hospital	0 (0%)	6 (66.7%)	3 (33.3%)	9 (6.8%)
Private hospital	5 (12.2%)	21 (51.2%)	15 (36.6%)	41 (31.1%)
Improvised setting	3 (13.0%)	17 (73.9%)	3 (13.0%)	23 (17.4%)
Cause of borderline and poor post-op VA				
Comorbidity	-	22 (71.0%)	9 (29.0%)	31 (23.5%)
Surgical complications	-	11 (44.0%)	14 (56.0%)	25 (18.9%)
Refractive error	-	25 (100.0%)	0 (0%)	25 (18.9%)
Long-term complications	-	19 (52.8%)	17 (47.2%)	36 (27.3%)

Effective cataract surgical coverage – the proportion of people requiring cataract surgery who have had it and who have achieved a good visual outcome (at least 6/12 post-operative presenting VA) – was 2.3% overall at the VA< 6/12 level (**Error! Reference source not found.**). It was higher among males (3.3%) than females (1.5%). At the VA<3/60 level, eCSC was 7.4% overall, with a similar gap between males (9.5%) and females (5.4%).

Table 11 Cataract surgical coverage and effective cataract surgical coverage (persons, percentage) adjusted for age and sex

	Females	Males	Total	Relative quality gap
VA < 3/60				
CSC	30.2%	53.3%	41.6%	82.1%
eCSC	5.4%	9.5%	7.4%	
VA < 6/60				
CSC	25.1%	51.3%	37.9%	82%
eCSC	4.5%	9.2%	6.8%	
VA < 6/18				
CSC	11.9%	24.4%	17.5%	83.6%
eCSC	1.8%	4.0%	2.8%	
VA< 6/12				
CSC	10.6%	21.1%	15.4%	84.2%
eCSC	1.5%	3.3%	2.3%	

The most common reason given by study participants for not having had surgery was not having access to surgery (30.7%), followed by cost (28.7%) and being unaware that treatment is possible (16.8%) (**Error! Reference source not found.**). Women were slightly more likely to report that they were either unaware or feared the surgery.

Table 12 Barriers to cataract surgery (some participants gave more than one reason)

	Female	Male	Total

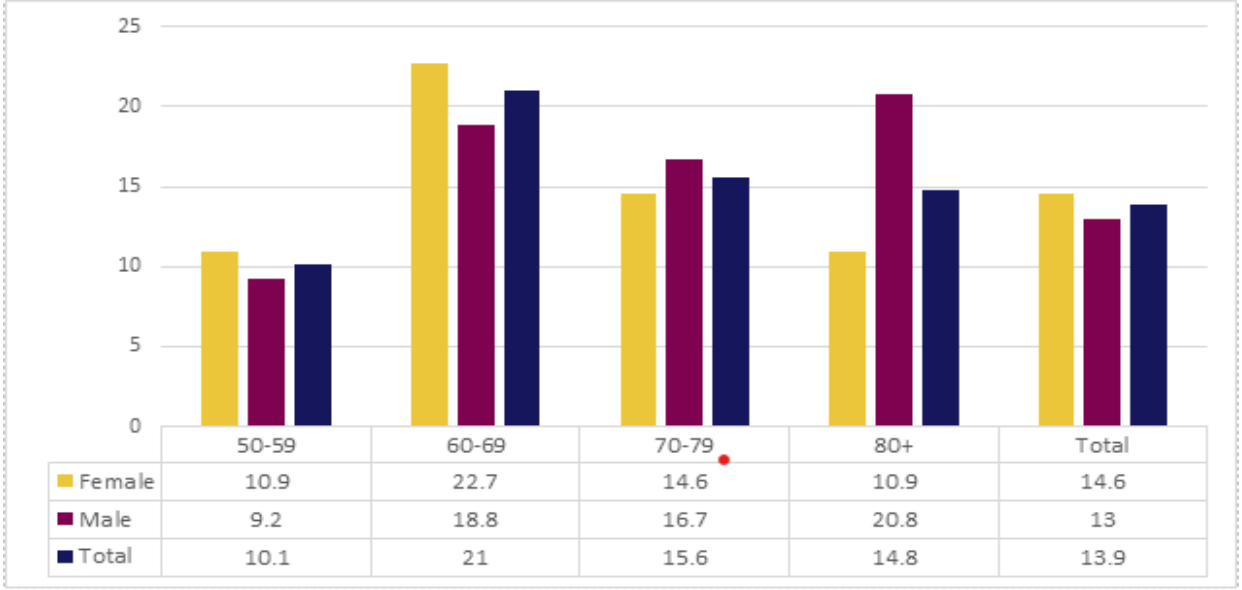
Cannot access surgery	21 (30.9%)	10 (30.3%)	31 (30.7%)
Cost	19 (27.9%)	10 (30.3%)	29 (28.7%)
Unaware of treatment	13 (19.1%)	4 (12.1%)	17 (16.8%)
Felt not needed	8 (11.8%)	3 (9.1%)	11 (10.9%)
Fear	5 (7.4%)	2 (6.1%)	7 (6.9%)
Other	2 (2.9%)	4 (12.1%)	6 (5.9%)
Surgery denied by provider	-	-	-
Total	**68 (100.0%)**	**33 (100.0%)**	**101 (100.0%)**

Prevalence of distance refractive error

The prevalence of refractive error in the survey population is reported as UCVA worse than 6/12 improving to 6/12 with spectacle correction or pinhole. These include people with corrected refractive error who still have a need for refractive error services, as well as those people without correction and who are yet to access services.

A total of 537 people aged 50 years and above in the sample population were identified with refractive error, accounting for 13.9% of the sample population. **Error! Reference source not found.** shows the crude prevalence of distance refractive error by age and gender. The prevalence is observed to be higher among females (14.6%) than males (13.0%).

Figure 12 Prevalence of distance refractive error, by age and gender



Spectacle use

The crude prevalence of distance spectacle use is 0.7% and for near use is 8.5% in the sample population. **Error! Reference source not found.** shows the prevalence of spectacle use by gender with males having higher distance usage (0.9%) and women (0.5%) and

12.3% in men and 5.2% in women for near spectacle use. Distance spectacle ownership is disaggregated by the length of time (in years) since the current spectacles were acquired. Not all participants with correction had a need for correction, according to the standard definition in the eREC calculation.

Table 13 Prevalence of distance and near-vision spectacle use by gender

	Female	Male	Total
Distance vision spectacles	11	16	27
	0.5%	0.9%	0.7%
<2 years	6	6	12
	54.6%	37.5%	44.4%
2-5 years	4	5	9
	36.4%	31.3%	33.3%
>5 years	1	5	6
	9.1%	31.5%	22.2%
Near-vision spectacles	102	228	330
	5.2%	12.3%	8.5%

The effective refractive error coverage (eREC) for distance vision among the samples requiring distance optical correction and who have received it with good outcomes was reported at 2.2%. However, the relative quality gap between refractive error coverage (REC) and eREC was 38.9%.

Changes in eye health between 2012 and 2024

The RAAB undertaken in Liberia in 2012 aimed to enrol 3,700 people aged 50 years and above and achieved an enrolment rate of 96.6% (3,544 participants). Results from the 2012 RAAB were standardised with the 2008 National Population and Housing Census (17) data to determine and adjust for age and sex prevalences and the magnitude of blindness in Liberia. The 2012 RAAB did not collect data on early visual impairment, nor data on disability or socio-economic status.

Table 14 shows the age and sex-adjusted prevalence of visual impairment in Liberia in 2012, and the estimated number of people affected. Figure 13 shows the change in age and sex-adjusted prevalence between 2012 and 2024. The estimated prevalence of bilateral blindness has increased slightly (from 3.9% to 4.4% - CI 3.4-5.4), 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 the prevalence of visual impairment, the absolute number 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 14: Prevalence of blindness and visual impairment among males and females in Liberia, in 2012

	Male	Female	Total
Blind: presenting vision <3/60 in better eye			
Bilateral cases	59	85	144
	3.7%	4.3%	4.1%
All eyes	320	372	692
	10.1%	9.5%	9.8%
Blind: best corrected vision <3/60 in better eye			
Bilateral cases	46	61	107
	2.9%	3.1%	3.0%
All eyes	280	295	575
	8.8%	7.5%	8.1%
Severe VI: better eye can see 3/60 but not 6/60 with available correction			
Bilateral cases	53	54	107
	3.3%	2.8%	3.0%
All eyes	120	151	271
	3.8%	3.9%	3.8%
Moderate VI: better eye can see 6/60 but not 6/18 with available correction			
Bilateral cases	149	181	330
	9.4%	9.2%	9.3%
All eyes	344	382	726
	10.8%	9.8%	10.2%

Figure 13: Prevalence of age and sex-adjusted visual impairment in 2012 and 2024

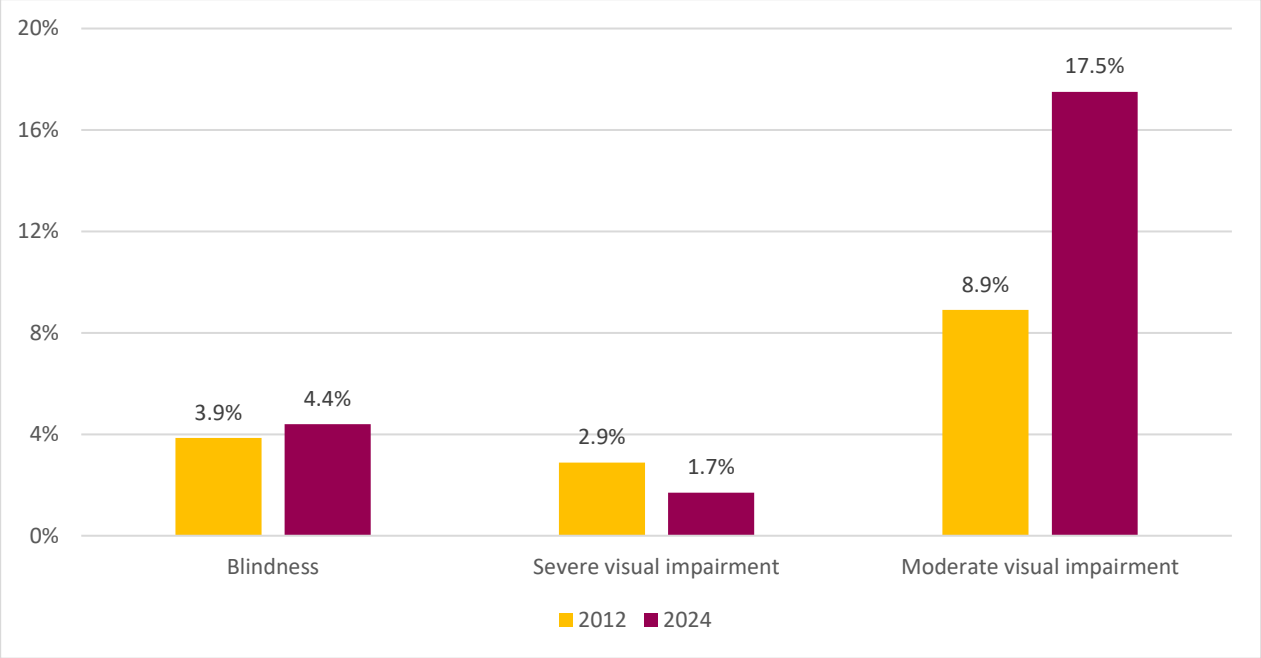
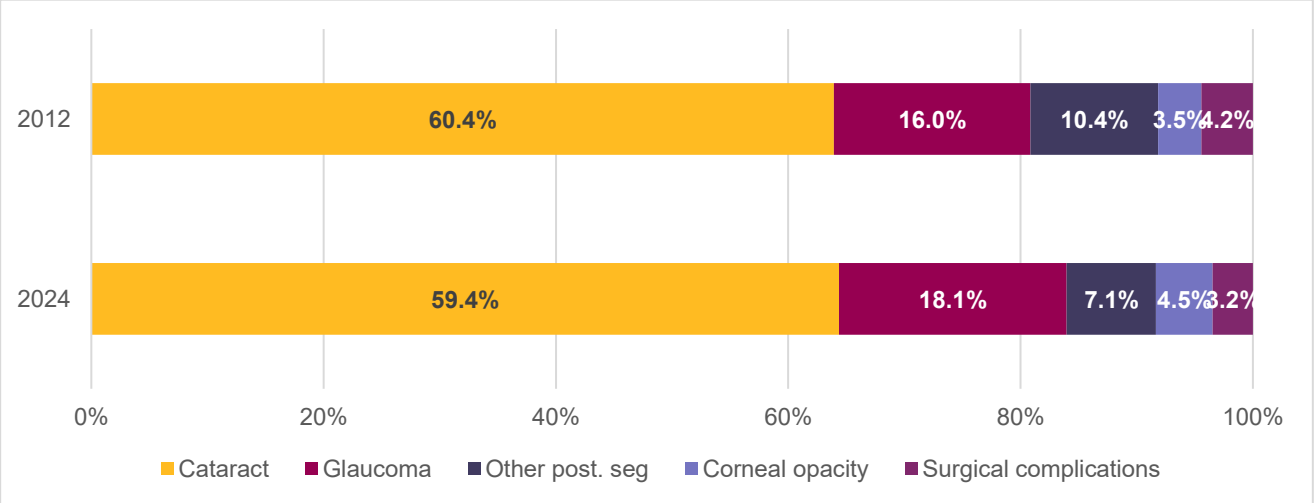


Figure 14 shows that unoperated cataract is the most common principal cause of blindness in both 2012 (60.4%) and 2024 (59.4%), with glaucoma the second most common cause (16.0% and 18.1%). Other posterior segment diseases and non-trachoma corneal opacities remain important causes: 10.4% and 7.1% and 3.5% and 4.5% in 2012 and 2024 respectively. Unaddressed refractive error was not a cause of blindness in 2012 but did account for 8.4% of SVI and 46.4% of MVI (EVI was not measured in 2012). Unaddressed refractive error was found to be a major contributor to blindness (3.9%) and SVI (4.9%) in 2024.

Figure 14: Principal causes of blindness in 2012 and 2024

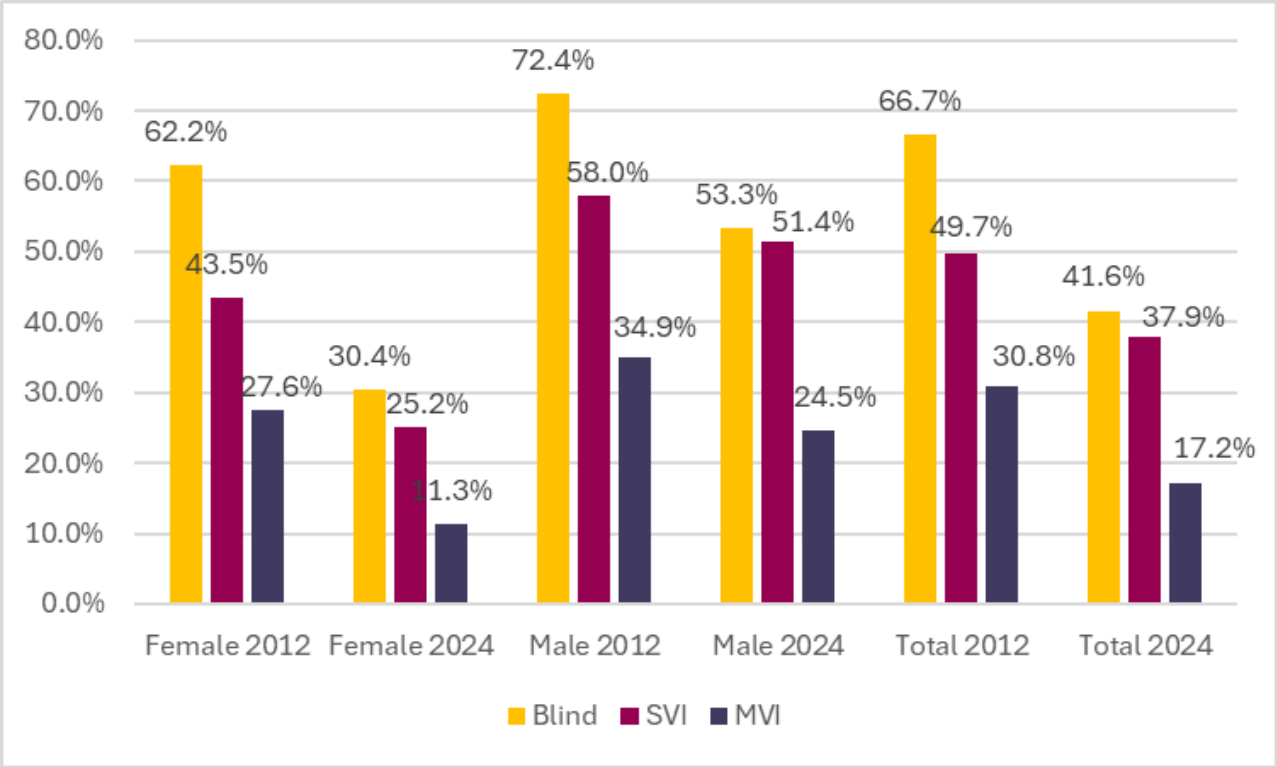


Unoperated cataract is responsible for a slightly higher share of SVI in 2024 (67.2%) than in 2012 (62.6%) and unaddressed refractive error is responsible for a slightly smaller share (4.9% versus 8.4%) (Figure 15). The share of SVI due to glaucoma has remained relatively

stable (18.1% in 2024 up from 16.0% in 2012) as has other posterior segment diseases (7.1% in 2024 compared to 10.4% in 2012).

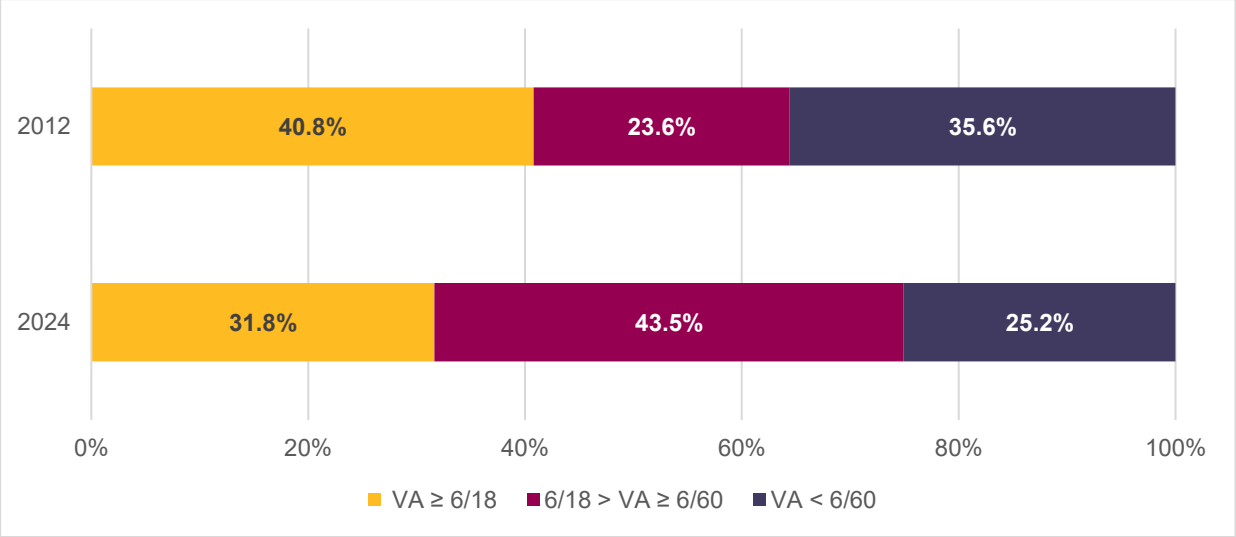
Overall, there was a 25% decrease in the proportion of people with operable cataract, who have had surgery (cataract surgical coverage, CSC), from 66.7% in 2012 to 41.6% in 2024 at the 3/60 level, and from 49.7% in 2012 to 37.9% in 2024 at the 6/60 level. While both males and females experienced a decrease in CSC, the largest decrease was among females (30.4% in 2024 and 62.4% in 2012 at the 3/60 level).

Figure 15: Cataract surgical coverage between females and males, and at different levels of visual impairment, in 2012 and 2024



The cut-off definitions for good visual outcome changed since 2012 and was measured as visual acuity at 6/12. The quality of visual outcomes among operated eyes slightly changed between 2012: 40.8% in 2012 and 31.8% in 2024 (Figure 16). The proportion with borderline outcomes increased from 23.6% in 2012 to 43.5% in 2024 and for 'poor' outcomes reduced from 35.6% in 2012 to 25.2% in 2024.

Figure 16: Quality of visual outcomes of operated eyes in 2012 and 2024


2012
40.8%
23.6%
35.6%
2024
31.8%
43.5%
25.2%
0%
20%
40%
60%
80%
100%
VA ≥ 6/18
6/18 > VA ≥ 6/60
VA < 6/60

Discussion

Key study findings

This study found the prevalence of bilateral blindness among people aged over 50 years in Liberia in 2024 to be 4.4%, although this may be as low as 3.4% or as high as 5.4%. The prevalence of SVI is 1.7%, MVI is 17.5% and EVI is 10.9%. Higher prevalences were observed in women at all levels of vision impairments than in men. Compared with the results of the RAAB conducted in Liberia in 2012, the prevalence of visual impairment in people 50+ years old has increased from 3.9% in 2012 to 4.4% in 2024. This could be attributed to the changing demography of Liberia, indicating that there are now more people alive aged over 50 years than in 2012, and the absolute number of people living with visual impairment is considerably higher. For example, the number of people who are bilaterally blind increased nearly by 50% from 11,943 in 2012 to 21,902 in 2024. This also suggests that the rate of surgeries being performed is not keeping pace with the growing ageing population.

Data on disability and relative wealth was not collected in 2012; however, the 2024 results indicate that people with additional non-visual disabilities are more likely to experience visual impairment and particularly be blind or severely and moderately visually impaired. Data on disability should be interpreted with caution, as there is likely to be an association between severe VI and other difficulties in functioning, e.g. mobility or mental health conditions. This is in line with findings from other countries in sub-Sahara Africa. The reasons for these inequities can be multiple, however it does mean that to advance progress towards universal eye health, the Liberian eye care services should be developed with financial, physical and attitudinal accessibility in mind. Cataract surgery is typically meant to be free in the public health system and the average cost is around 150 USD. However, financial barriers may go beyond the cost of surgery to direct 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.

As in 2012, cataract is the most common principal cause of VI in the 2024 study among bilaterally blind people (59.4% from 60.4%), people with SVI (67.2% from 62.6%) and people with MVI (43.7% from 35.2%). The second most common principal cause among people with bilateral blindness is glaucoma, accounting for 18.1% (from 16.0%). Unaddressed refractive error was not a cause of blindness and visual impairment in the 2012 study but was found to be a principal cause of blindness (3.9%), SVI (4.9%) and MVI (28.9%). We also calculated

the prevalence of distance refractive error, defined as UCVA worse than 6/12 but improving to 6/12 with spectacle correction or pinhole. This enables us to determine the magnitude and service gap in URE services since the definition also includes people with corrected refractive errors who will have an ongoing need for RE services as well as those without any correction.

The most common reason given for not having had surgery was not having access to the surgery (30.6%), followed by the cost of the surgery (28.6%) and being unaware that treatment is possible (17.3%). The lack and inadequate distribution of eye health facilities, and the bad roads and terrain are major contributors to this finding in Liberia.

Cataract surgical coverage (CSC) decreased by about 25% between 2012 and 2024 (from 66.7% to 41.6%) and the decrease is wider among women (down to 30.4% from 62.2%) at v<3/60. Data from Vision Atlas, as well as partners in Liberia, indicates that the annual cataract surgical rate (CSR, cataract surgeries per million people) in 2014 was 157, which increased to 486 in 2022. This compares with a recommended average in the WHO AFRO region of 500, indicating that the number of surgeries being conducted in Liberia is too low for population needs. This confirms the increase in the prevalence of blindness and growing absolute numbers of blind people in the country. Cataract surgeries in Liberia are usually performed by ophthalmologists and cataract surgeons, who are ophthalmic nurses trained to perform cataract surgeries. The current of number of active ophthalmologists is five (5), which falls short of the WHO recommended one (1) ophthalmologist per 250,000 people. This indicates that Liberia needs 11 ophthalmologists to meet the population's needs and address the cataract backlog in the country.

In 2012, there was a 10% difference in CSC between men and women. In 2024, the CSC among women was 23% less than men. These gender differences in CSC were reflected in the differences in cataract-related prevalence of blindness and severe VI and the absolute number of people and eyes in need of operation between men and women. Past research suggests that reasons for low uptake among women are manifold, and include them being less likely to know about eye care services than men, less likely to seek care when they need it due to household decision-making roles or responsibilities at home, and being less likely to reach care as they are less likely to have the resources or confidence to make the journey to services. The finding highlights a need to better understand the 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 improving their uptake

of surgery. Priority should be given to women from remote locations with difficult terrain, and those who are poor, very old, have additional functional difficulties, or who live alone.

Gender inequities are not unique to Liberia, and similar trends have been noted in many countries, although the evidence on 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; the use of successfully operated persons as champions; removal of patient direct and indirect costs; regular community and targeted outreach; and ensuring high-quality surgeries (18). These approaches need to be tested and rigorously evaluated in the context of Liberia.

With regards to the quality of services, the results indicate that overall, the quality of visual outcomes of operated eyes has not significantly changed since 2012: the proportion of operated eyes with 'good' or 'very good' vision in 2024 was relatively lower (31.8%) if best correction were available, from 40.8% in 2012. This is likely due to a change in the threshold for measuring good outcomes as recommended by the WHO from 6/18 to 6/12. This implies that the observed good outcomes in 2012 may have included those that would have been counted as 'borderline' in the new threshold. However, the proportion of those experiencing 'poor' vision, even with the best correction, dropped from 35.6% in 2012 to 25.2 in 2024.

Effective cataract surgical coverage (eCSC) is a recently adopted indicator that marries cataract surgical coverage with visual outcomes, and which 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 7.4% to 37.4%, which would require improvements in both coverage and quality of outcomes.

The reported high rates of poor outcomes may be attributed to insufficient pre-operative preparations, including biometry to determine the correct IOL power and inadequate provision of spectacles during the post-operative period. However, following a Sightsavers-supported quality standards assessment, the National Eye Health Programme (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. Similarly, the SOP for pre-operative clinical assessment highlights the need to ensure all patients undergoing cataract surgery would undergo

biometry and that the calculated IOL is available to ensure good visual outcome post-operatively.

Glaucoma is the second most common principal cause of blindness (18.1%), with a similar trend for SVI (9.8%), MVI (4.1%) and EVI (1.4%). The prevalence is likely to be an underestimate of the true burden of the disease 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 Liberia, where so many cases of VI 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 Liberian 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 (20).

Corneal opacities, particularly non-trachoma, remain a significant cause of VI at all levels. Although the RAAB did not attempt to understand the cause of scarring, it is known that most 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 any surgery,

including corneal transplants, as they are vascularised and the best approach is preventive services through primary eye care.

Unaddressed refractive errors are a major cause of both blindness and all levels of visual impairments, and a contributing cause to poor post-surgical visual outcomes. However, the NEHP has worked over the years in a coordinated way with different partners – such as LV Prasad Eye Institute and Sightsavers – to improve these services. Examples of this include developing human resources, such as training more optometry technicians (OTs) to provide improved URE services. In addition, vision centres have been set up and equipped in collaboration with the One Sight Essilor Luxotica Foundation to deliver refractive error services by the newly trained OTs in hard-to-reach areas of Liberia. The NEHP is conducting community outreaches integrated with refractive error services, along with the School Health Integrated Programme (SHIP), with an emphasis on school-aged children and targeting them in schools and communities, particularly in hard-to-reach areas.

This study has several limitations common to all RAAB surveys, including the difficulty of detecting posterior segment diseases in the field with a direct ophthalmoscope, and that only a single cause (the easiest to treat) can be attributed to each eye or person, leading to an underestimation of the prevalence of posterior segment diseases and other eye diseases. 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 women in Liberia (though non-coverage weights were used to compensate for this weakness).

Implications for programmes and policy in Liberia

1. Review the existing eye health system with a focus on the available human resources and the infrastructure required to deliver quality and accessible eye health services for the control of blinding eye diseases.

- There is a growing need to deliver quality cataract surgeries closer to the people to address the over 9,539 blind people and 12,587 severely visually impaired due to cataract across Liberia. This calls for an urgent review of the existing system to understand the available human resource capacity to deliver quality surgeries, as well as the equipment and infrastructure necessary for the provision of safe, high-quality and affordable cataract surgeries.

- Stakeholders should consider supporting eye care teams in the country to provide regular, affordable outreach services in the hard-to-reach areas until more ophthalmologists and equipment become available for deployment.
- The primary eye care system needs to be developed using the globally recommended framework for developing the primary healthcare system to meet the needs for mobilising patients, strengthening the referral system and improving the demand and uptake of services.
- Given the burden of URE and presbyopia, the provision of refractive services for the population should be strengthened. The establishment of vision centres at district-level hospitals, currently ongoing with Sightsavers and other development partners, should be extended to primary healthcare centres, with corresponding task shifting to empower primary eye care workers to deliver coordinated refractive error services.
- A glaucoma services review should be undertaken to align with evolving perspectives on glaucoma management in Africa. A public health-oriented approach to glaucoma management should be employed in Liberia by training primary and community health workers, as well as ophthalmic nurses in case identification and referrals. The toolkit for glaucoma management in sub-Saharan Africa can serve as a useful resource in establishing a foundation for glaucoma management in the country.

2. Technology and medical supplies

    - All outreach teams, whether resident or visiting the country, should ensure that biometry equipment is available and that biometry is performed in outreach facilities, centres or camps, along with a provision of a range of IOL stocks. This could decrease the proportion of poor outcomes associated with the surgeries. Additional equipment is also necessary in some district hospitals to reduce the risk of transporting fragile equipment to every outreach location. Spectacles should be made available as standard at six weeks post-operatively or in line with approved SOP.
    - SOPs for cataract and URE services should be developed to complement the existing clinical treatment guidelines and provide a uniform process for pre- and post-operating cataract surgical management across the country. This should be followed with a monitoring system to ensure compliance to the SOPs.

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Appendices

A – RAAB tool

Enumeration and Demographics			
1. Participant Number	✍ 2 digit number 01 – 50 (autoincremented)		
2. Current Location - Description	✍ text		
3. Current Location - GPS (optional)	Auto-Recorded	Latitude	Longitude
4. Age	✍ maximum 3 digit number 50-120		
5. Gender	☒ Select one	☐ Male ☐ Female	
6. Examination Status	☒ Select one	☐ Now ☐ Not Available ☐ Refused ☐ Not able to communicate	
Note: If form saved incomplete, participant first and last name captured and stored on local device for mop up until form is finalised			
7. Subjective Socioeconomic Position (optional) 7a. Household Food Adequacy	☒ Select one	☐ Less than adequate ☐ Just adequate ☐ More than adequate	
7b. Household Income Sufficiency	☒ Select one	☐ Not enough, must borrow ☐ Not enough, use savings ☐ Just enough ☐ Enough, save a little ☐ Enough, build savings	
8. Additional editable optional questions (1 or 2 possible) e.g., ethnicity, urban/rural location	☒ Select one	☐ A ☐ B ☐ C ☐ D	

Distance Visual Acuity		
1. Distance Spectacles	☒ Select one	☐ Yes ☐ No
2. Age of Current Distance Spectacles	☒ Select one	☐ Less than 2 years ☐ 2 to 5 years ☐ More than 5 years
3. Near Spectacles	☒ Select one	☐ Yes ☐ No
4. Acuity Test Method	☒ Select one	☐ Peek Acuity ☐ E Chart

5. Uncorrected visual acuity	Auto-Recorded LogMAR result or radio button by threshold	R	L
6. Corrected visual acuity	Auto-Recorded LogMAR result or radio button by threshold, if distance glasses used	R	L
7. Pinhole visual acuity	Auto-Recorded LogMAR result or radio button by threshold, if presenting* VA <6/12	R	L

*Presenting VA recorded as composite variable: UCVA if no correction worn, or CVA if correction worn. Pinhole only collected if presenting VA<6/12

Lens Examination and Cause of VA <6/12

1. Lens Status	Examine with torch or direct ophthalmoscope ☒ Select one	**R** ☐ Normal/ minimal lens opacity ☐ Obvious lens opacity ☐ Lens absent (surgical aphakia, including couching) ☐ Lens absent (non-surgical aphakia) ☐ Pseudophakia without PCO ☐ Pseudophakia with PCO ☐ No view of lens	**L** ☐ Normal/ minimal lens opacity ☐ Obvious lens opacity ☐ Lens absent (surgical aphakia, including couching) ☐ Lens absent (non-surgical aphakia) ☐ Pseudophakia without PCO ☐ Pseudophakia with PCO ☐ No view of lens
2. Main cause of presenting vision <6/12	Examine with torch or direct ophthalmoscope ☒ Select one	**R** ☐ Not examined: can see 6/12 ☐ Refractive error ☐ Aphakia, uncorrected ☐ Cataract, untreated ☐ Cataract surgical Complications ☐ Trachoma corneal opacity ☐ Other corneal opacity ☐ Phthisis ☐ Onchocerciasis ☐ Glaucoma ☐ Diabetic retinopathy ☐ ARMD ☐ Other posterior segment ☐ All globe/CNS abnormalities Optional causes: ☐ Myopic degeneration ☐ Pterygium ☐ Other surgical complication ☐ Anterior uveitis	**L** ☐ Not examined: can see 6/12 ☐ Refractive error ☐ Aphakia, uncorrected ☐ Cataract, untreated ☐ Cataract surgical Complications ☐ Trachoma corneal opacity ☐ Other corneal opacity ☐ Phthisis ☐ Onchocerciasis ☐ Glaucoma ☐ Diabetic retinopathy ☐ ARMD ☐ Other posterior segment ☐ All globe/CNS abnormalities Optional causes: ☐ Myopic degeneration ☐ Pterygium ☐ Other surgical complication ☐ Anterior uveitis
3. Principal cause of presenting vision <6/12 in person	Examine with torch or direct ophthalmoscope only ☒ Select one	☐ Not examined: can see 6/12 ☐ Refractive error ☐ Aphakia, uncorrected ☐ Cataract, untreated ☐ Cataract surgical Complications ☐ Trachoma corneal opacity ☐ Other corneal opacity ☐ Phthisis	

		☐ Onchocerciasis ☐ Glaucoma ☐ Diabetic retinopathy ☐ ARMD ☐ Other posterior segment ☐ All globe/CNS abnormalities Optional causes: ☐ Myopic degeneration ☐ Pterygium ☐ Other surgical complication ☐ Anterior uveitis

Details about cataract operation (if previously operated)			
1. Age at Operation	✍ maximum 3 digit number 50-120	**R**	**L**
2. Place of Operation	☒ Select one	**R** ☐ Govt hospital ☐ Voluntary/charitable hospital ☐ Private hospital ☐ Eye camp/improvised setting ☐ Traditional setting	**L** ☐ Govt hospital ☐ Voluntary/charitable hospital ☐ Private hospital ☐ Eye camp/improvised setting ☐ Traditional setting
3. Type of Surgery	☒ Select one	**R** ☐ No IOL ☐ IOL Implant ☐ Couching ☐ No view of lens	**L** ☐ No IOL ☐ IOL Implant ☐ Couching ☐ No view of lens
4. Cause of VA<6/12 after cataract surgery (if the case)	☒ Select one	**R** ☐ Ocular comorbidity (Selection) ☐ Operative complications (Surgery) ☐ Refractive error (Spectacles) ☐ Long-term complications (Sequelae) ☐ Does not apply, vision acceptable	**L** ☐ Ocular comorbidity (Selection) ☐ Operative complications (Surgery) ☐ Refractive error (Spectacles) ☐ Long-term complications (Sequelae) ☐ Does not apply, vision acceptable

Barriers to cataract surgery		
1. Barriers to cataract surgery	☒ Select up to two if unoperated cataract present in either eye	☐ Need not felt ☐ Fear of surgery or poor result ☐ Cannot afford operation ☐ Treatment denied by provider ☐ Unaware that treatment is possible ☐ No access to treatment ☐ Other

B – Washington Group Short-Set Enhanced Question

**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 if using a hearing aid]?	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

C – Liberia Equity Tool

	Question	Option 1	Option 2	Option 3
Q1	Does your household have electricity that is connected?	Yes	No	
Q2	a television?	Yes	No	
Q3	a cupboard?	Yes	No	
Q4	Does any member of this household have a watch?	Yes	No	
Q5	(I don't want to know the amount, but) does any member of this household have a bank account?	Yes	No	
Q6	What type of fuel does your household mainly use for cooking?	Fire coal / charcoal	Wood	Other type of fuel
Q7	What is the main material of the floor of your dwelling?	Natural floor – earth / sand / mud	Other material	
Q8	What is the main material of the wall of your dwelling?	Finished walls – cement	Other material	
Q9	What kind of toilet facility do members of your household usually use?	Flush to septic tank (not shared with any other households)	Other kind of toilet facility	

D - Self-reported socio-economic position Questions

Food adequacy	'When you think about the food in your household would you say you have (1) Less than adequate food for the needs of your household, (2) Just adequate food for the needs of your household or (3) More than adequate food for the needs of your household'.
Income sufficiency	'When you think about the income in your household would you say it is (1) Not enough to cover our needs, we must borrow, (2) Not enough to cover our needs, we use savings, (3) Just enough to cover our needs, (4) Enough to cover our needs, we are able to save a little or (5) Enough to cover our needs, we are building savings'.

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