Study report: Epidemiology of blindness in people aged 50 and above in the Sikasso and Segou regions of Mali

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Sightsavers

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List of abbreviations

BCVA	Best corrected visual acuity
CI	Confidence interval
CSV	Comma-separated values
CSC	Cataract surgical coverage
eCSC	Effective cataract surgical coverage
EHSA	Eye health systems assessment
eREC	Effective refractive error coverage
EVI	Early visual impairment
GPS	Global Positioning System
HICs	High income countries
IOL	Intraocular lens
IOV	Interobserver variability
LMICs	Low and middle income countries
MET	Mali equity tool
MHSD	Ministry of Health and Social Development
MICS	Mali multiple indicators cluster survey
MVI	Moderate visual impairment
NECHS	National Ethics Committee for Health and Life Science
NTD	Neglected tropical diseases
PVA	Presenting visual acuity
RAAB	Rapid assessment of avoidable blindness
SVI	Severe visual impairment
UK	United Kingdom
UNCRPD	United Nations Convention on the Rights of Persons with Disabilities
VA	Visual acuity
VI	Visual impairment
WGSS-ED	Washington Group Short Set - Enhanced Disability
WHO	World Health Organization
WHA	World Health Assembly

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1 Summary

A lack of country-specific epidemiological data is a major constraint on the development of national health plans and policies in low to middle income countries (LMICs). To address this issue, the World Health Organization (WHO) recommends the use of rapid assessment of avoidable blindness (RAAB) studies to provide data for planning blindness and visual impairment (VI) prevention programmes.

RAAB is a standard methodology for obtaining reliable data on the prevalence of VI in people aged 50 years and over (the highest-risk category). A RAAB conducted in Koulikoro in Mali in 2011 found the prevalence of blindness among people in this age group to be 7.1%. Since 2011, no new data has been produced to guide Malian decision-makers in developing a new eye care action plan, or in planning programmes. Therefore, this study was conducted in the regions of Segou and Sikasso, where the Ministry of Health and Sightsavers are about to embark on a new partnership to deliver eye health services.

Results

Prevalence and causes of visual impairment.

The age- and sex-adjusted prevalence of blindness was identical in both regions: 3.1% 95% confidence interval (CI) [2.4-4.0%]. Extrapolating the results to the estimated total population, this means that there are approximately 8,634 blind people aged 50 and over in Segou and 9,750 blind people aged 50 and over in Sikasso. Severe visual impairment (SVI) is estimated to affect 9,242 people in the Segou region and around 7,847 people in the Sikasso region.

The main cause of blindness was cataracts that had not been operated on in both regions (67.1% in Segou and 57.8% in Sikasso), followed by glaucoma (18.8% in Segou and 16.9% in Sikasso).

Cataract services

The rate of cataract surgical coverage (CSC) was 26.1% (33.5% for men and 21.2% for women) in Segou and 31.3% (36.7% for men and 28.2% for women) in Sikasso. In Segou, 45.4% of eyes operated on had good visual acuity (VA) (≥5/10) and 24.3% had limited vision of between 1 and 5/10. Finally, 30.3% had poor vision (<1/10). 12.9% of eyes had undergone traditional cataract removal, and 92.9% of these had poor vision. In Sikasso, 42.3% of the eyes operated on had good VA (≥5/10), 32.3% had limited vision of between 1 and 5/10, and 22.7% had poor vision (<1/10). 6.7% of eyes underwent traditional cataract reduction, 85.7% of whom had poor vision.

2 Introduction

According to the 2021 World Health Organization (WHO) global report, at least 2.2 billion people worldwide suffer from visual impairment or blindness, of whom at least 1 billion have an impairment that could have been treated or is not always treated (1). About 90% of visual impairment (VI) is found in LMICs and about 90% of it is preventable or treatable (2). The leading cause of blindness is cataract, with about 17 million cases, followed by uncorrected refractive defects (3.7 million), glaucoma (3.6 million), age-related macular degeneration (1.8 million) and diabetic retinopathy (1.1 million) (2, 3). In terms of regional differences, it is estimated that the prevalence of blindness exceeds 30 cases per 1,000 in LMICs compared to less than five cases per 1,000 people in high-income countries (4).

In Mali, the prevalence of blindness was estimated in the mid-90s at 1.2%, based on the results of four surveys carried out in the regions of Kayes in 1984 (1.1%), Sikasso in 1992 (1.3%), Segou in 1991 (1.5%) and Mopti in 1984 (0.97%) (5). To date, there has been no national survey in Mali to determine the prevalence of blindness. The most recent general population survey of visual impairment (VI) available in Mali was carried out in the Koulikoro region in 2011 with financial support from Sightsavers. This survey used the rapid assessment of avoidable blindness (RAAB) methodology and estimated the prevalence of blindness in people aged 50 and over at 7.1% (6).

Population growth and ageing are expected to increase the absolute number of people living with visual impairment. To reduce the burden of VI, the World Health Organization (WHO) advocates an approach focused on strengthening comprehensive, quality eye care services, including at the community level, through integrated, patient-centred eye care integrated into the general health system (7).

In 2021, the 74th World Health Assembly adopted ambitious new targets for eye health, and countries must now seek to establish baseline figures for two eye health indicators, and revise or develop national eye health plans to achieve these targets by 2030 (8). The two indicators – effective cataract surgical coverage (eCSC) and effective refractive errors coverage of (eREC) – are designed to serve as proxy indicators to monitor progress towards universal eye health coverage and to guide country actions to improve the availability and quality of eye health services. Countries are expected to achieve a 30% increase in eCSC by 2030 and a 40% increase in eREC, although many do not currently have baseline figures to measure progress against (8).

3 Aims of the study

To assess the prevalence of VI among people aged 50 and above in the Sikasso and Segou regions. The specific objectives were:

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 cataract surgical services by determining cataract surgical coverage and visual outcomes from cataract surgery.
4. To determine the barriers to uptake of cataract services.
5. To determine the prevalence of disability among the study population.
6. To explore the relationship between disability and socio-economic status and eye health.

4 Methods

4.1 Type of study

We carried out a RAAB, which is a descriptive cross-sectional population-based study. This took place between October 2022 and March 2023.

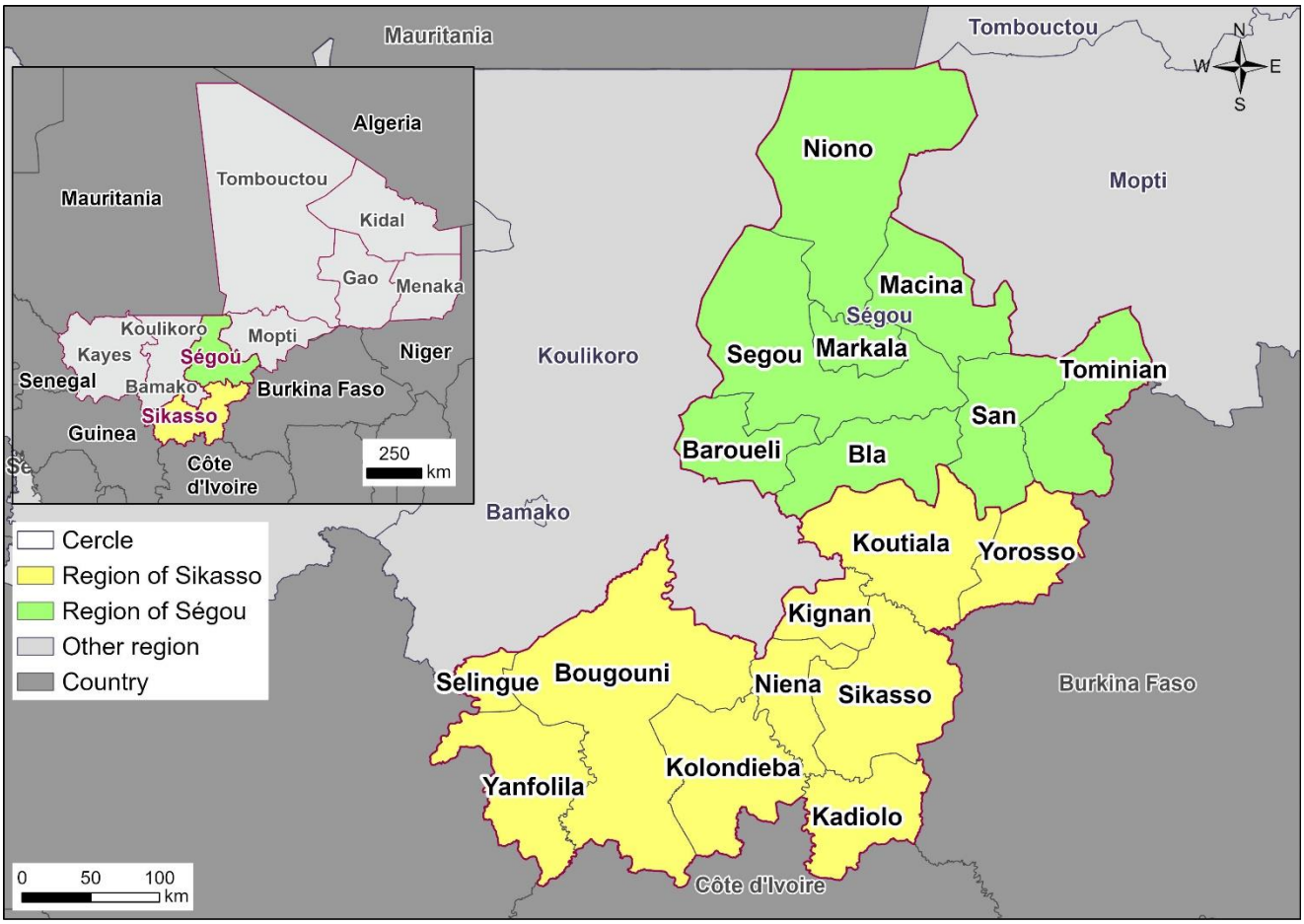
4.2 Location of the study

The study was carried out in the Sikasso and Segou regions of Mali. The framework of the study did not take into account the new administrative division that subdivides Mali into 19 regions instead of 10 (Figure 1). For this purpose, the former boundaries of the Sikasso and Segou regions were considered.

The Sikasso region is located in the extreme south of Mali and covers an area of 71,790 km^2. It is bordered to the north-west by the Koulikoro region, to the north-east by the Ségou region, to the east by Burkina Faso, to the south by Côte d'Ivoire and to the west by Guinea.

According to projections by the National Directorate of Population, the population of Sikasso in 2022 is estimated at 3,947,305 (9). The Segou region is located in the centre of Mali, covering an area of 64,947 km^2, around 5% of the national territory. It is bordered to the south by the Sikasso region, to the south-east by Burkina Faso, to the east by the Mopti region, to the north by Mauritania and the Timbuktu region, and to the west by the Koulikoro region. Its estimated population in 2022 will be 3,492,074 (9).

Figure 1: Map showing the Segou and Sikasso regions, and the districts within them.



4.3. Sampling base and excluded areas

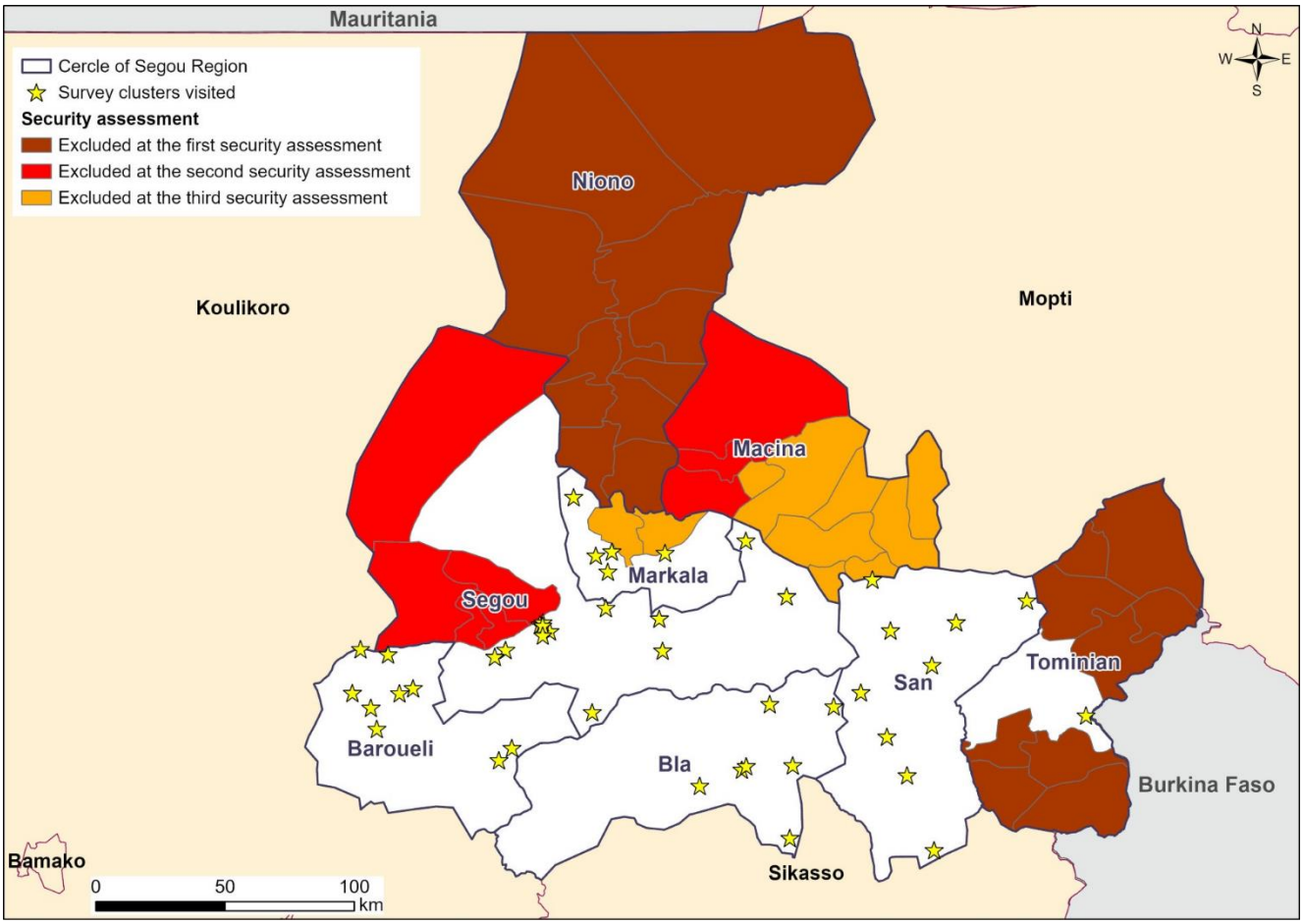
For each region, a sampling frame, which listed all the villages, and their respective populations was constructed. This data was obtained from the planning officers within the regional offices of the Ministry of Health of Segou and Sikasso who provided the 2022 health maps.

Due to ongoing security issues in Mali, and to ensure the safety and security of the study teams, all locations were risk assessed. The risk assessments considered both security threats such as terrorism and crimes, and safety issues such as flooding and inaccessible roads. These risk assessments were conducted by Sightsavers' security staff based in Mali and the UK, supported by information from the regional and district Ministry of Health offices. Based on these assessments, a number of villages were considered to be unsafe or inaccessible and had to be removed from the sampling frames. The detailed process for the changes introduced in the two sampling frames is explained below.

In Segou, there were three rounds of risk assessments. During the first assessment, the entire district of Niono was excluded from the sampling frame due to its proximity to Mopti in the northern part of the country which is known to be extremely insecure (Figure 2). During the second and third security assessments, several villages of Macina, Tominian and Segou districts were also excluded for the same reasons.

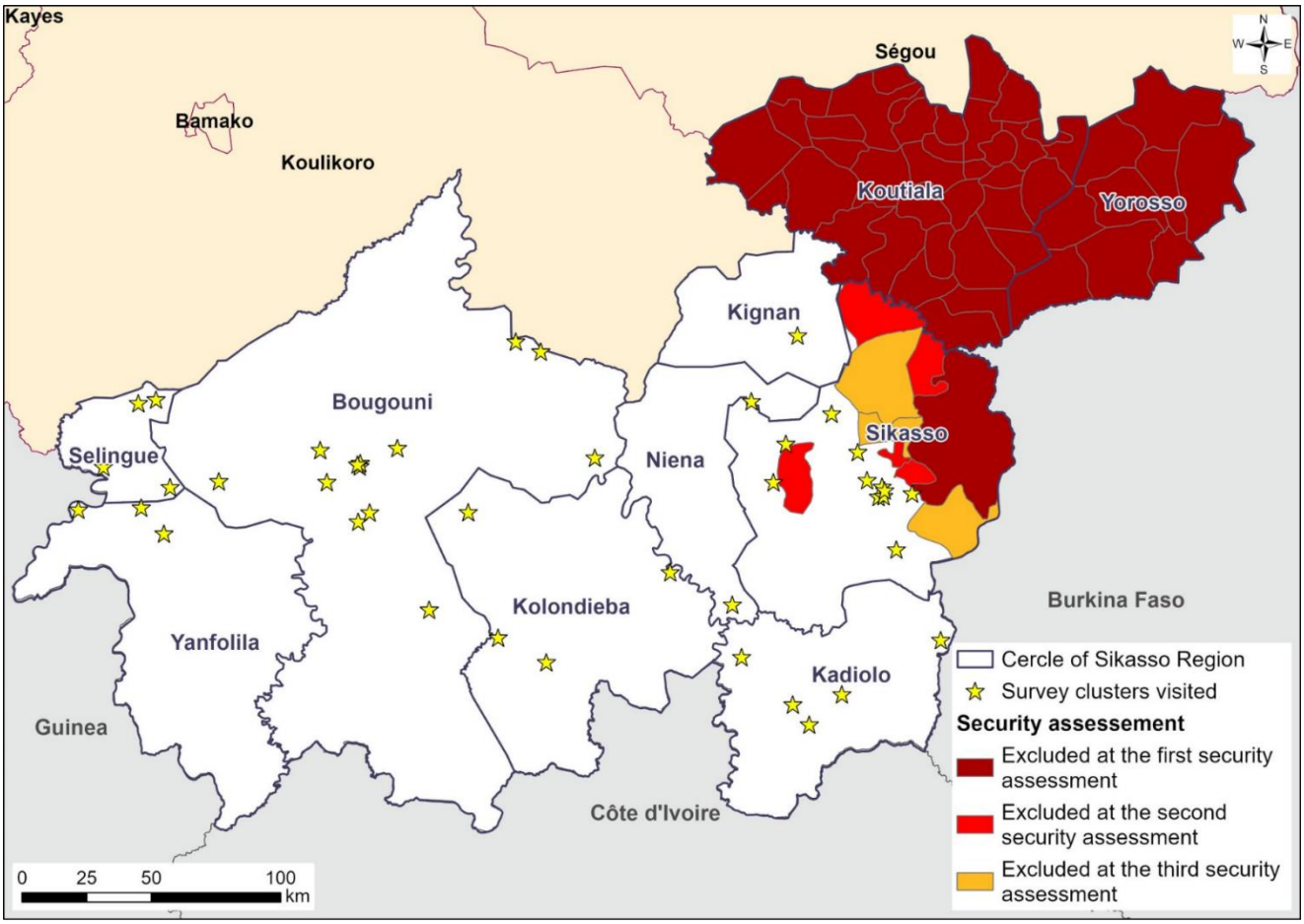
The final sampling frame for Segou included two whole districts (San and Bla) and the secure parts of Segou, Baroueli, Macina and Tominian districts. The final clusters included in the sampling frame were predominantly in the southern part of the region and had a population of 2,611,986, which represents 74.8% of the total population of the Segou region.

Figure 2: Map of final clusters and excluded areas in the Segou region.



Building on the experiences in Segou, only one security assessment was conducted in Sikasso. Based on this assessment, Koutiala and Yorosso districts and parts of Sikasso districts (primarily alongside the Burkina Faso border) were removed from the sampling frame. The final sampling frame in this region was made up of four whole districts (Bougouni, Kolondieba, Kadiolo and Yanfolila), and part of the Sikasso district (Figure 3), which are predominantly in the western part of the region and have a population of 2,609,765, which represents 66.1% of the total population of the Sikasso region.

Figure 3: Map of final clusters and excluded areas in the Sikasso region.



4.4 Sample size

The sample size was calculated using the RAAB software (version 6). This software calculates the sample size using the Schwartz formula (10). The following information in Table 1 was used to calculate the sample size:

Table 1: Parameters used to calculate the sample size in the Sikasso and Segou regions.

Articles	Segou	Sikasso
Total population in 2021 projection from the national population directorate	3,492,074	3,947,305
Predicted prevalence of blindness (RAAB de Koulikoro, 2011)	7.1%	7.1%
Acceptable accuracy around the estimate: +/- 20%	[5.7% - 8.5%]	[5.7% - 8.5%]
Confidence intervals	95%	95%
Refusal rate	10%	10%
Design effect (assuming cluster sizes of 50)	1.5	1.5

4.4.1 For the Sikasso region

The sample size for the Sikasso region calculated using the parameters in Table 1 was 2,154 individuals, i.e. 44 clusters of 50 people aged 50 and over (Table 2).

Table 2: Calculation of sample size for the Sikasso region.

Parameters		Simple random sampling		
Population size	3,947,305	Confidence interval	Sample size	Choice
Expected frequency	7.1%	80%	614	
Acceptable percentage	5.7%	90%	1011	
No answer	10%	95%	1,436	
Cluster sampling with a confidence interval of 95% and an acceptable percentage of 5.7% to 8.5%				
Bunch size	Cluster effect	Sample size	Number of clusters	
40	1.4	2,010	51	
50	1.5	2,154	44	
60	1.6	2,298	39	

4.4.2 For the Segou region

For the Segou region, using the parameters in Table 1, the sample size was 2,154 individuals, i.e. 44 clusters of 50 people aged 50 and over (Table 3).

Table 3: Calculation of sample size for the Segou region.

Parameters		Simple random sampling		
Population size	3,492,074	Confidence interval	Sample size	Choice
Expected frequency	7.1%	80%	614	
Acceptable percentage	5.7%	90%	1,011	
No answer	10%	95%	1,436	
Cluster sampling with a confidence interval of 95% and an acceptable percentage of 5.7% to 8.5%				
Bunch size	Cluster effect	Sample size	Number of clusters	
40	1.4	2,010	51	
50	1.5	2,154	44	
60	1.6	2,297	39	

4.5 Population studied

The study population consisted of people aged 50 and over living in the Sikasso and Segou regions. The RAAB only included people aged 50 and over, as the prevalence of blindness is highest in this age group.

Inclusion criteria

The inclusion criteria were:

- Be aged 50 or over.
- Have agreed to participate.
- Have lived in the household for at least 6 months prior to the survey in the study area.

Non-inclusion criterion

- People aged under 50.
- Visitors to the household who have lived there for less than 6 months.
- Refusal to participate (non-consenting).
- Any participant who is seriously ill and unable to answer the questions and take the test.

4.6 Sampling method

Two-stage sampling was used. Eighty-eight (88) primary sampling units (neighbourhoods/villages) were randomly selected from a complete list of neighbourhoods in each region using the probability proportionate to size method. All the neighbourhoods/villages in the regions of Sikasso and Segou were obtained from projections of population data from Mali's National Population Directorate.

The full list of neighbourhoods/villages was uploaded into the RAAB software, which has an in-built probability proportionate to size tool. In each region, 44 clusters/neighbourhoods/villages were randomly selected.

In each cluster/neighbourhood/village, 50 eligible participants were selected to take part in the study. A field guide worked with each team and the chief of the village to identify the village boundaries.

Once the boundaries of the cluster/neighbourhood/village were clear, the cluster/neighbourhood/village was divided into small segments and one segment was drawn randomly for data collection. A cluster informant also worked closely with each team to carry out the segmentation; they were responsible for informing the research team in good time and providing them with a copy of the cluster map.

On the day of the survey, the team met with the village chief, accompanied by the field guide. The research team started the data collection with the house in the segment closest to the main road and checked with the head of household the number of eligible respondents living there. All were counted, including those temporarily absent. All participants present received a visual acuity measurement during the research team's visit, and the team revisited the house at the end of the day to collect data from anyone absent at the time of the visit. Basic data for all participants not available for visual acuity measurement was collected from family members or neighbours, where possible.

4.7 Data collection

Each RAAB participant completed the following steps: demographic and eye health history data, visual examination, questions about disability and questions on economic status. The details of these three steps are described below. All data was collected using an application on a touch-screen smartphone. The precise location of neighbourhoods/villages (not households) was recorded using Global Positioning System (GPS) coordinates so that only cluster-level data (not individual-level data) could be mapped and geo-spatially analysed.

In this study, the cluster informant obtained permission and approval from the village chief before segmenting the village/cluster. Within each household, the interviewers first obtained individual consent of the head of the household before also obtaining individual consent of each participant aged 50 and over.

When the team arrived at a compound, they introduced themselves to the head of the household, facilitated by the village guide who had been chosen by the chief of the neighbourhood or village because of their knowledge of the community. Together, they determined how many people were eligible to take part in the study. As well as providing full information about the study and the purpose of the visit, the team informed eligible participants of their rights to refuse or withdraw their consent, and also on the potential benefits of their participation. A written consent was obtained from each participant, and in case a participant was unable to read or write, their thumbprint was obtained and witnessed by an independent person, not part of the study team.

4.7.1 Ophthalmological examination

The International Classification of Diseases 11th edition (2018) classifies distance vision disorders as follows (11):

- Leger, a term used at the beginning of the RAAB, now called (early visual impairment, EVI) – visual acuity worse than 6/12 to 6/18 in the better eye).
- Moderate (moderate visual impairment, MVI) – visual acuity of less than 6/18 to 6/60 in the better eye.
- Severe (severe visual impairment, SVI) – visual acuity of less than 6/60 to 3/60 in the better eye.
- Blindness – visual acuity of less than 3/60 in the better eye. Blindness can be presented in two ways: the presented vision, for example, that obtained with the correction normally available to individuals (where applicable), or the best corrected vision, that obtained with a pinhole shutter.

All participants underwent an ophthalmological examination carried out by ophthalmologists or senior ophthalmological technicians. They followed the standard RAAB protocol, which uses the Classification of Severity of Visual Impairment based on the visual acuity of the better eye (11). The following steps were carried out:

1. Measurement of visual acuity in each eye (all participants).
2. Assessment of visual acuity with the pinhole of each eye showing a VA < 6/12.
3. Examination of the lens of each eye with a torch in a dark room (all participants).

4. Examination of the posterior-segment of each eye presenting < 6/12 with a direct ophthalmoscope where the principal cause could not be attributed to refractive error, cataract-related cause, or corneal scarring.
5. Assessment of the main cause of visual impairment in each eye with a VA< 6/12 and in people where both eyes have a VA < 6/12 and the causes are not the same.
6. Asked questions regarding cataract surgery: age at operation, place of operation, fees payment, and type of operation.
7. Questions concerning the reasons why cataract surgery has not been performed and where it is indicated (see data collection tool in Appendix A).

Minor eye conditions (such as conjunctivitis) identified were treated by the team. Other conditions (such as cataracts and glaucoma) were referred to the nearest eye care centre. Sightsavers regularly makes kits available for the management of these conditions at eye care centres in these regions. It is therefore possible that these patients will benefit from this treatment.

4.7.2 Disability assessment tool

Disability is a complex concept and there are many ways to define and measure it. The United Nations Statistics Division has commissioned a group to develop a methodology that could easily and simply measure disability in traditional surveys in a way that conceptualises disability as a dynamic interaction between an individual's health conditions, environmental factors and personal factors (12). Thus, the Washington Group working on disability statistics has developed several sets of questions that can be used to measure disability in traditional surveys, such as RAAB (13). The tools have been tested and validated and have been used internationally, notably in censuses and surveys such as the Demographic and Health Surveys.

In this study of rapid assessment of avoidable blindness, we propose to use the disability assessment tool "The Washington Group Short Set - Enhanced Questionnaire" (Appendix B), which includes 12 questions related to an individual's self-perceived difficulties in performing in certain areas of functioning. The response categories were non-binary, allowing respondents to position themselves on a scale of functioning, thus enabling a nuanced analysis of the severity of the impairment as well as the type. Although several approaches to analysis are possible, a binary measure of disability will be determined if an individual reports difficulty in at least one functional area.

4.7.3 Mali's equity tool

The equity tool (Appendix C) is an internationally recognised tool designed to assess systemic differences between social groups: the socio-economic status of participants is determined by classifying them in one of five quintiles; those who are poorest and often most marginalised fall into the lowest quintile; those who are richest are in the highest quintile. The equity tool is a simple, easy-to-use tool for measuring relative wealth. Using a specific questionnaire, this tool can allow us to compare the wealth of our respondents to the national population or to a population in other countries.

4.8 Training of data collectors and inter-observer variation

A certified trainer in RAAB carried out four days of training and one day of practical work in the field. Days 1 and 2 focused on procedures for rapid assessment of avoidable blindness and the third day was devoted to disability and economic issues. The fourth day was devoted to the inter-observer variability test in the Kati health district. The fifth day was devoted to the first survey, which was carried out in the presence of all the teams.

All field staff were trained to follow a consistent procedure for identifying eligible participants, measuring visual acuity, and examining the lens. Standardised instructions on definitions, the method of selecting participants, the examination protocol, and methods for obtaining and recording data for reference were given to each team. During training, inter-observer variability (IOV) was assessed for vision, goal assessment, and causes of visual impairment to ensure that examiners had at least 60% agreement.

4.9 Study logistics

Five trained and standardised teams collected the data; each team comprised:

- An ophthalmologist, team leader
- An ophthalmology medical assistant
- A cluster informant (health information system officer)
- A driver
- A field guide

The selection of data collectors was gender sensitive. A proportional number of women and men were recruited for the survey.

4.10 Data management and analysis

The study tools were designed in a single application using CommCare (14). Data was downloaded in Comma-separated values (.CSV) format and uploaded into Stata v15 software for analysis (15).

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

After in-depth statistical analysis, the key indicators were exported to ArcGIS (16) software for mapping and spatial analysis to understand the geographical patterns around the prevalence of visual impairment and care-seeking behaviour.

4.11 Ethical considerations

The protocol was submitted to the National Ethics Committee for Health and Life Science (NECHS) of the Ministry of Health and Social Development (MHSD) of Mali. Ethical

clearance N 2022 135/MHSD-NECHS/PS was issued for the study. A report summarising all the key results and a detailed report will be written and shared with the NECHS.

5 Results: Segou region

Characteristics of the sample

1,972 participants aged 50 and over were examined, representing a response rate of 89.6% (Table 4).

Table 4: Distribution of participants by gender according to examination status in the Segou region.

	Examined	Not available	Refused	Unable to communicate	Total
Men	876	60	13	9	958
	91.4%	8.9%	1.4%	0.9%	43.6%
Women	1,096	72	11	63	1,242
	88.2%	5.8%	0.9%	5.1%	5%
Total	1,972	132	24	72	2,200
	89.6%	6.0%	1.1%	3.6%	100%

1,096 (55.6%) of the respondents were women. The female/male sex ratio was 1.25 (Table 5).

Table 5: Distribution of participants by gender in the Segou region.

Sex	Frequency	Percentage
Men	876	44.4
Women	1,096	55.6
Total	1,972	100

The predominant age range was 60-69 for men (38.2%) and 50-59 for women (43.5%). Compared with the projected population for the region, young people (aged 50-59) were under-represented in our sample (39.7% compared with 50.9% in the projected population for the region). (See Table 6).

Table 6: Breakdown of participants by sex and age group and comparison with the projected population of Segou.

	Survey sample			Projected regional population (2022 projection of 2018 data)		
	Men	Women	Total	Men	Women	Total
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
50-59	306 (34.9%)	477 (43.5%)	783 (39.7%)	66,730 (52.1%)	75,184 (49.9%)	141,914 (50.9%)
60-69	335 (38.2%)	355 (32.4%)	690 (35.0%)	39,189 (30.6%)	47,702 (31.6%)	86,891 (31.2%)
70-79	167 (19.1%)	188 (17.2%)	355 (18.0%)	17,832 (13.9%)	22,756 (15.1%)	40,588 (14.6%)
80+	68 (7.8%)	76 (6.9%)	144 (7.3%)	4,244 (3.3%)	5,118 (3.4%)	9,362 (3.4%)
Total	876 (100,0%)	1,096 (100.0%)	1,972 (100.0%)	127,995 (100.0%)	150,760 (100.0%)	278,755 (100.0%)

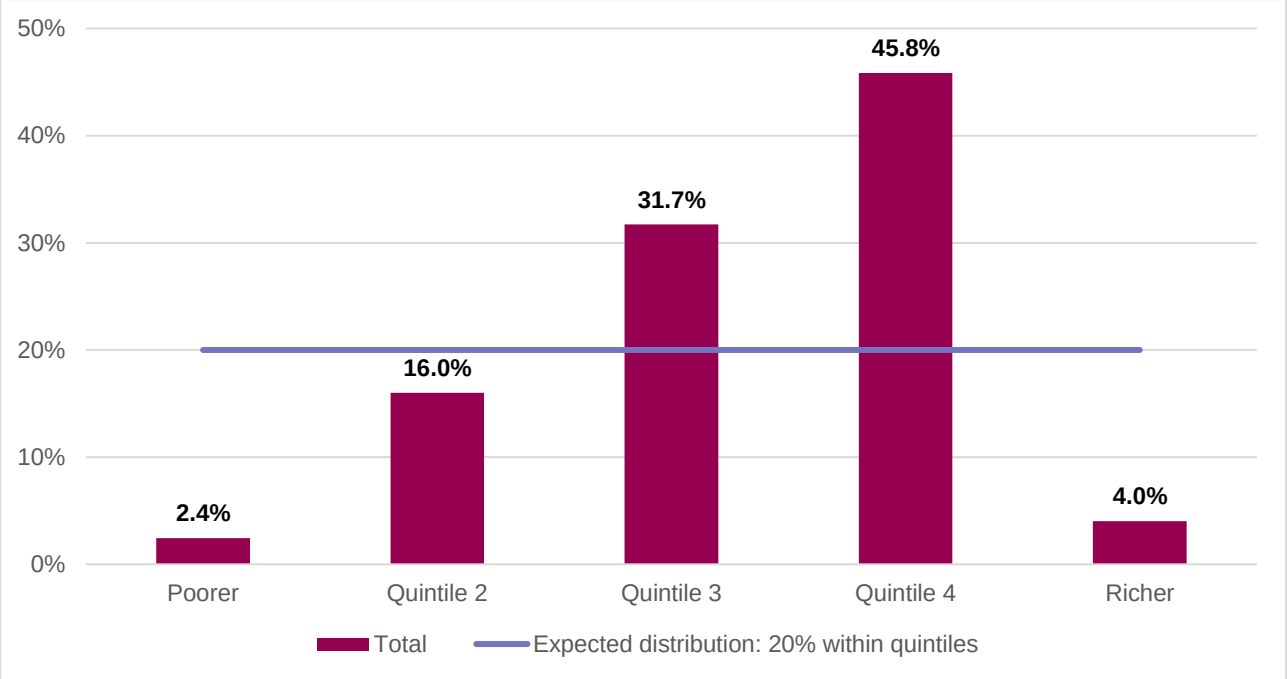
The prevalence of disability in the sample was 12.6%. Women had more disabilities than men (see Table 7).

Table 7: Prevalence of disability among male and female participants in the Segou region.

Types of disability	Men		Women		Total	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Disability: all domains	102	11.6	147	13.4	249	12.6
Disability: excluding seeing difficulties	70	8.0	106	9.7	176	8.9

Compared to the national population, the study population appears to be relatively wealthier, with 49.8% of participants belonging to the two richest quintiles and 18.4% belonging to the two poorest quintiles (see Figure 4). (If the study population were similar to the national population, the expected share would be 40%).

Figure 4: Distribution of participants in the Segou region according to national wealth quintiles.



Prevalence of visual impairment

Of the 1,972 participants examined, 85 (4.3%) CIs [3.5-5.3%] had had presenting visual acuity (PVA) <3/60, meaning they were blind in both eyes. Using the pinhole to obtain the best-corrected VA (BCVA), this reduced to 76 participants (3.9%) blind in both eyes. SVI was observed in 77 participants (3.9%), MVI in 197 participants (10.0%) and EVI in 159 participants (8.1%) (Table 8).

Table 8: Prevalence of visual impairment in men and women examined in the Segou region.

	Men	Women	Total
Blind: best corrected VA < 3/60 in the better eye			
Bilateral cases	33	43	76
	3.8 % [2.7-5.3%]	3.9% [2.9-5.3%]	3.9% [3.1-4.8%]
All eyes	157	185	342
	9.0% [7.7-10.4%]	8.4% [7.3-9.7%]	8.7% [7.8-9.6%]
Blind: presenting VA less than VA<3/60 in the better eye			
Bilateral cases	41	44	85
	4.7% [3.5-6.3%]	4.0% [3.0-5.4%]	4.3% [3.5-5.3%]

All eyes	184	208	392
	10.5% [9.1-12.0%]	9.5 % [8.3-10.8%]	9.9% [9.0-10.9%]
Severe visual impairment: the better eye can see 3/60 but not at 6/60			
Bilateral cases	29	48	77
	3.3% [2.3-4.7%]	4.4 % [3.3-5.8%]	3.9% [3.1-4.9%]
All eyes	78	99	177
	4.5% [3.6-5.5%]	4.5% [3.7-5.5%]	4.5% [3.9-5.2%]
Moderate visual impairment: the better eye can see at 6/60 but not at 6/18			
Bilateral cases	80	117	197
	9.1% [7.4-11.2%]	10.7% [9.0-12.6%]	10.0% [8.7-11.4%]
All eyes	172	249	421
	9.8% [8.5-11.3%]	11.4 % [10.1-12.8%]	10.7% [9.7-11.7%]
Early visual impairment: the better eye can see at 6/18 but not at 6/12			
Bilateral cases	65	94	159
	7.4% [5.9-9.4%]	8.6% [7.1-10.4%]	8.1% [6.9-9.4%]
All eyes	144	208	352
	8.2% [7.0-96%]	9.5% [8.3-10.8%]	8.9% [8.1-9.9%]

Taking into account age and sex structure of the population in 2018, the prevalence of blindness in the Segou region among people aged 50 and above is estimated at 3.1% (CI 95=% 2.4%-4.0%) (see Table 9). In this study, we found no statistically significant differences in the prevalence of blindness and SVI between men and women (Table 9). However, sex-specific estimates for MVI and EVI indicate that women may carry a higher burden of MVI and EVI than men in Segou.

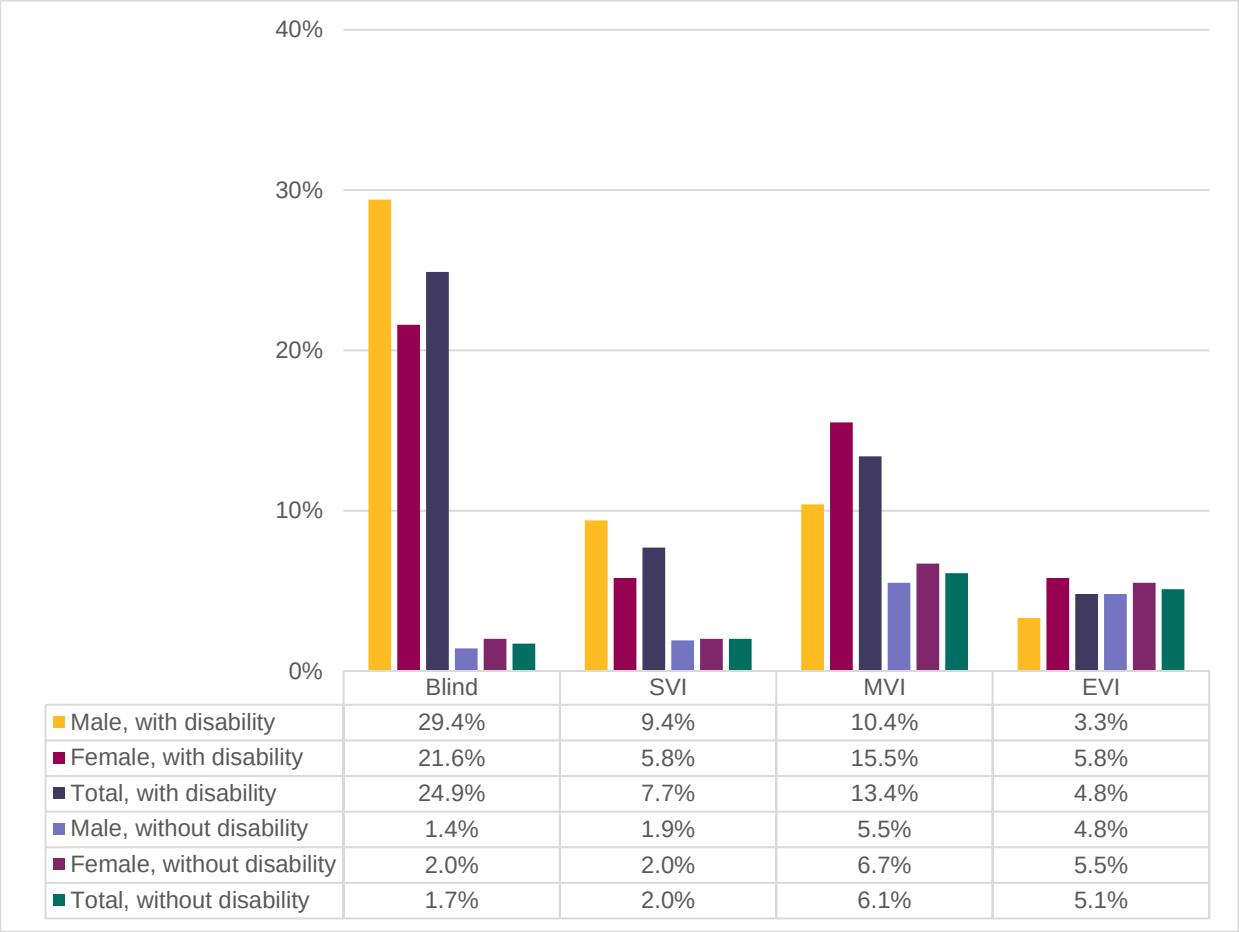
Table 9: Age-sex adjusted distribution of visual impairment in the Segou region.

	Men	Women	Total
Blind: best corrected VA < 3/60 in the better eye			
Bilateral cases	3,343	4,415	7,758
	2.6% [1.8-3.8%]	2.9% [2.1-4.1%]	2.8% [2.1-3.7%]
All eyes	17,570	21,042	38,613
	6.9% [5.7-8.2%]	7.0% [5.9-8.2%]	6.9% [6.1-7.9%]
Blind: presenting VA less than 3/60 in the better eye			
Bilateral cases	4,085	4,549	8,634
	3.2% [2.3-4.4%]	3.0 % [2.2-4.1%]	3.1% [2.4-4.0%]
All eyes	20,577	24,118	44,695
	8.0% [6.8-9.5%]	8.0% [6.8-9.4%]	8.0% [7.1-9.1%]

Severe visual impairment: the better eye can see 3/60 but not at 6/60			
Bilateral cases	3,402	5,840	9,242
	2.7% [1.9-3.8%]	3.9% [2.7-5.5%]	3.3% [2.5-4.4%]
All eyes	8,990	12,173	21,164
	3.5% [2.7-4.5%]	4.0% [3.1-5.2%]	3.8% [3.1-4.6%]
Moderate visual impairment: the better eye can see at 6/60 but not at 6/18			
Bilateral cases	8,420	14,360	22,780
	6.6% [5.3-8.2%]	9.5% [8.1-11.2%]	8.2 [7.2-9.2%]
All eyes	19,548	31,246	50,794
	7.6% [6.5-9.0%]	10.4% [8.9-12.0%]	9.1% [8.0-10.4%]
Early visual impairment: the better eye can see at 6/18 but not at 6/12			
Bilateral cases	7,607	11,749	19,356
	5.9% [4.7-7.5%]	7.8% [6.1-9.9%]	6.9% [5.7-8.4%]
All eyes	17,506	26,808	(44,314)
	6.8% [5.6-8.3%]	8.9% [7.3-10.8%]	7.9% [6.7-9.3%]

Figure 5 shows how the age- and sex-adjusted prevalence of VI differs by disability and gender. Men and women who reported a disability were more likely to have a visual impairment than non-disabled people. These differences were most striking for the more severe forms of visual impairment, particularly blindness. For example, 29.4% of men and 21.6% of women who reported a disability were blind, compared with 1.4% of men and 2.0% of women who reported no disability.

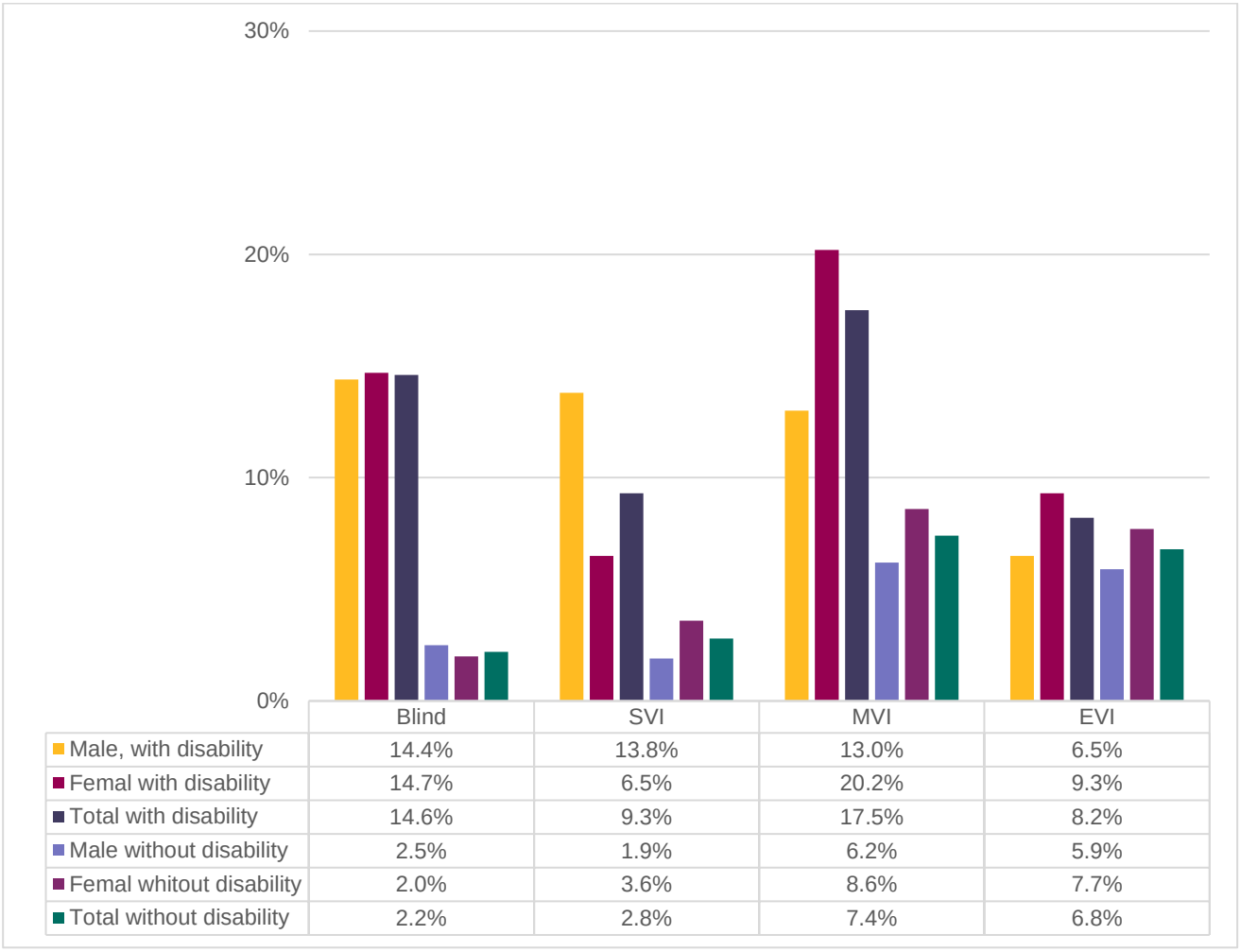
Figure 5: Age- and sex-adjusted prevalence of visual impairment, by disability, all domains in the Segou region.



	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%

Figure 6 shows how the prevalence of VI by disability and adjusted for age and sex differs when the "difficulty in seeing" domain is excluded. We observe that the relationship between disability and visual impairment remains very high: respectively, 14.4% and 14.7% of men and women with a disability (excluding “difficulty in seeing”) were blind, as opposed to 2.5% and 2.0% of men and women without disabilities.

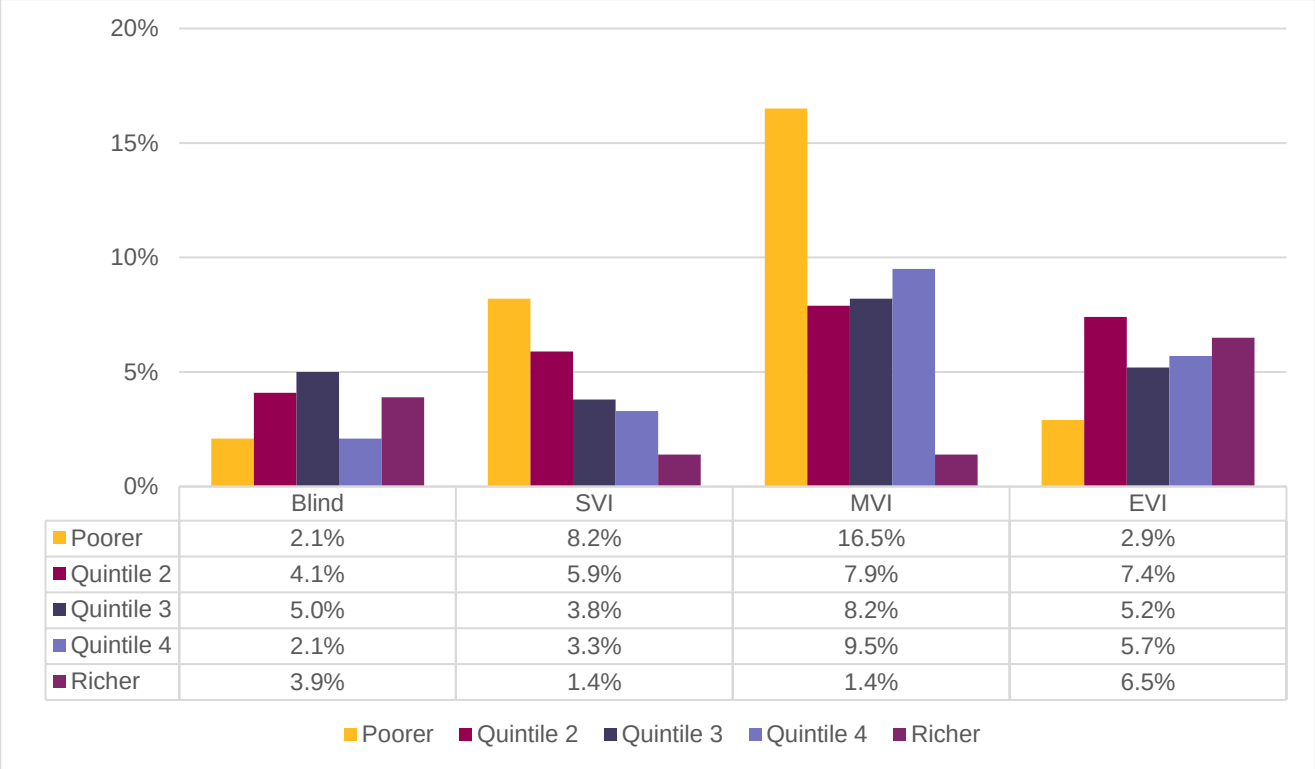
Figure 6: Age- and sex-adjusted prevalence of visual impairment by disability (excluding vision) in the Segou region.



	Blind	SVI	MVI	EVI
Male, with disability	14.4%	13.8%	13.0%	6.5%
Femal with disability	14.7%	6.5%	20.2%	9.3%
Total with disability	14.6%	9.3%	17.5%	8.2%
Male without disability	2.5%	1.9%	6.2%	5.9%
Femal whitout disability	2.0%	3.6%	8.6%	7.7%
Total without disability	2.2%	2.8%	7.4%	6.8%

Figure 7 shows the relationship between VI and relative wealth. The results show that the distribution of blindness varies across the five wealth quintiles, although with no clear pattern, although the prevalence of SVI and MVI appears to be higher among individuals from the two poorer quintiles.

Figure 7: Age- and sex-adjusted prevalence of visual impairment by wealth quintile in the Segou region.

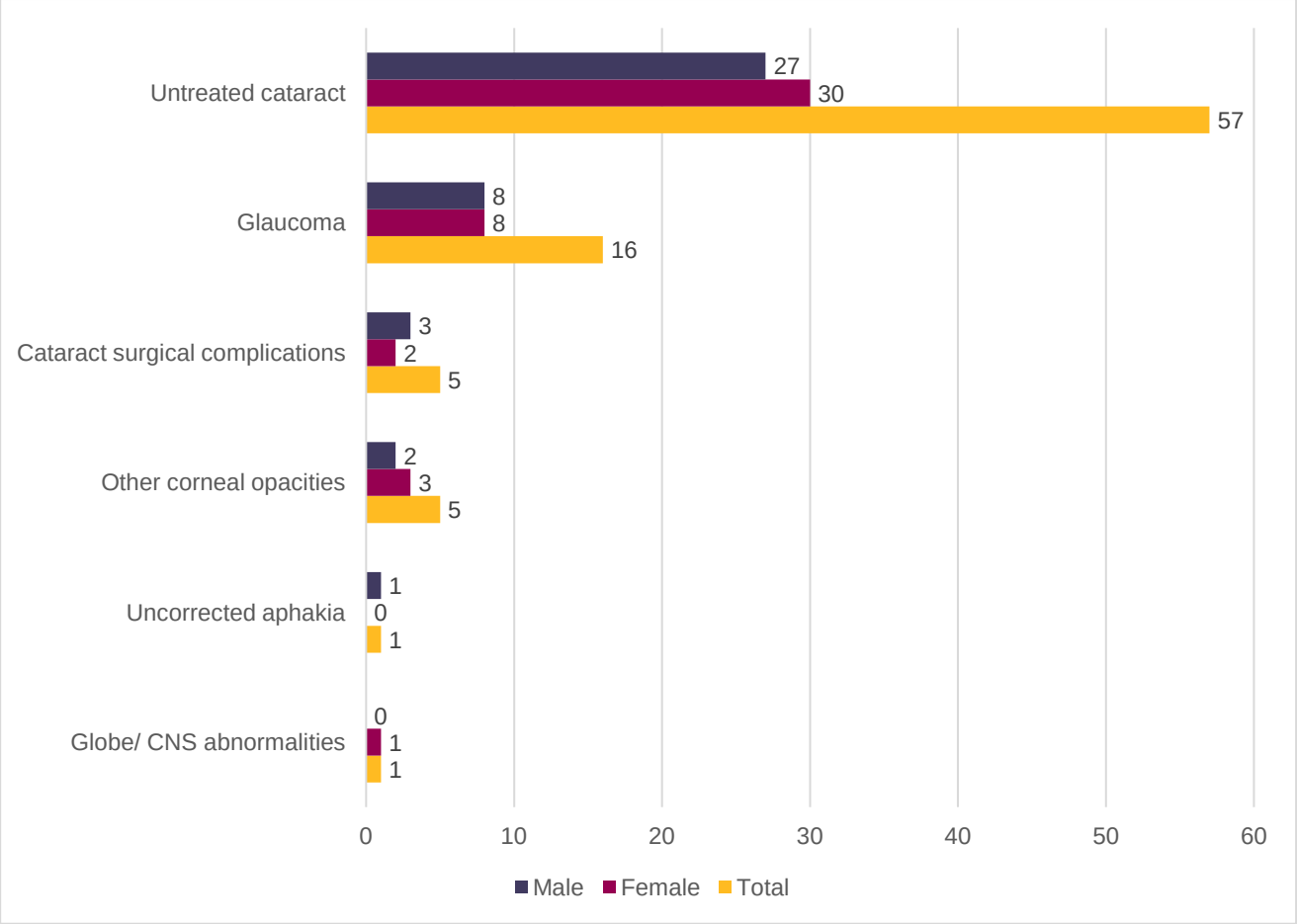


	Blind	SVI	MVI	EVI
Poorer	2.1%	8.2%	16.5%	2.9%
Quintile 2	4.1%	5.9%	7.9%	7.4%
Quintile 3	5.0%	3.8%	8.2%	5.2%
Quintile 4	2.1%	3.3%	9.5%	5.7%
Richer	3.9%	1.4%	1.4%	6.5%

Causes of visual impairment

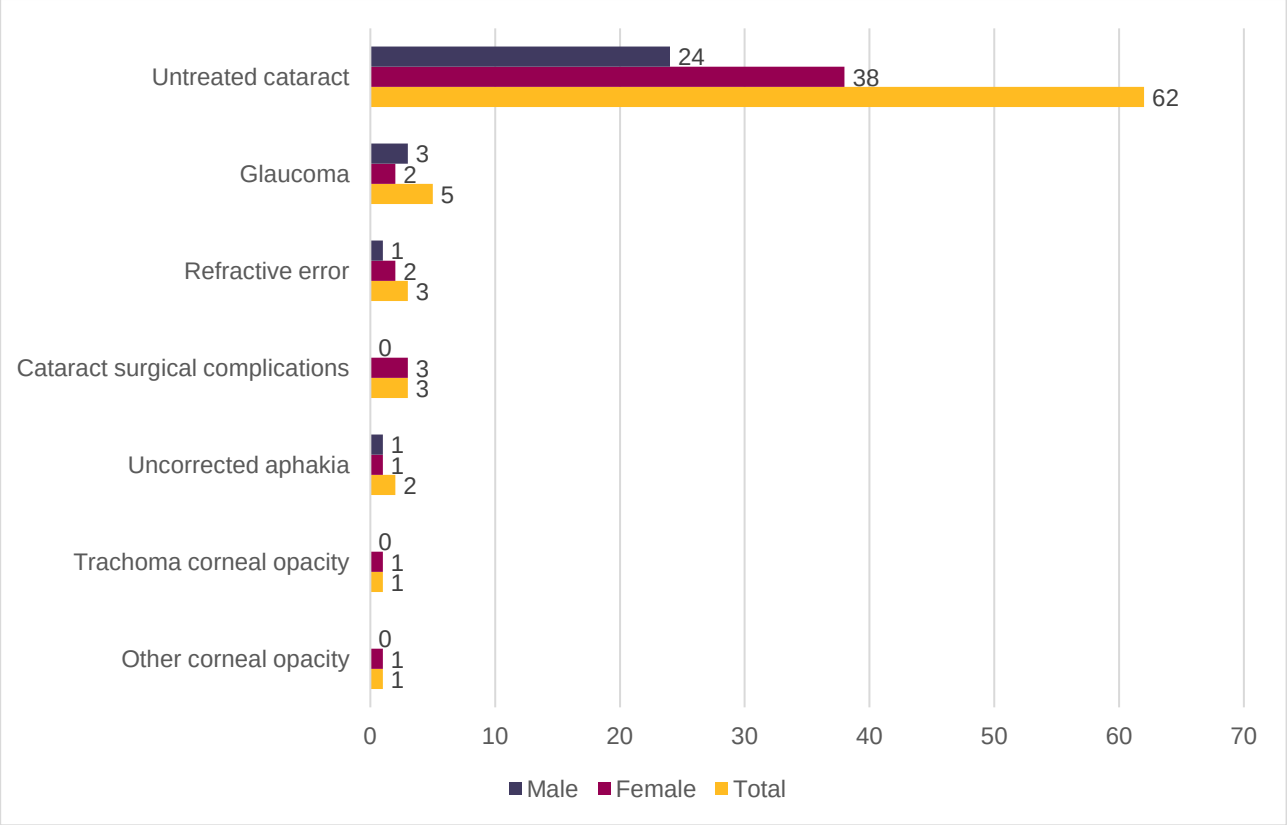
The main cause of blindness was unoperated cataract (57 cases; 67.1%), followed by glaucoma (16 cases; 18.8%), cataract surgical complications (5 cases, 5.9%), and other corneal opacity (5 cases; 5.9%) (Figure 8).

Figure 8: Principal causes of bilateral blindness by sex in the Segou region.



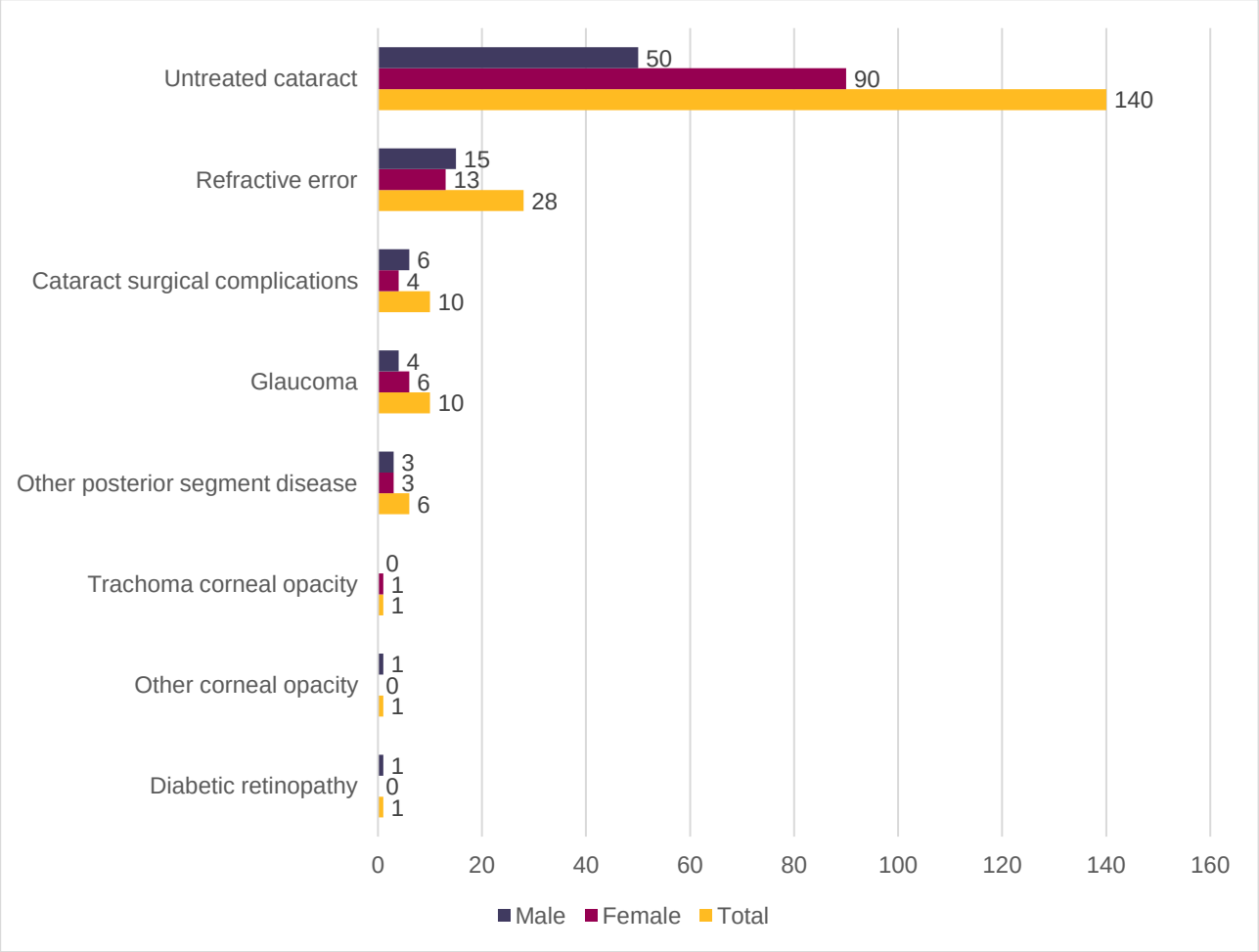
Unoperated cataract was also the main cause of severe VI (62 cases; 80.5%), followed by glaucoma (5 cases; 6.5%), refractive error, and cataract surgical complication with (three cases, 3.9%) each (Figure 9).

Figure 9: Principal causes of severe visual impairment by sex in the Segou region.



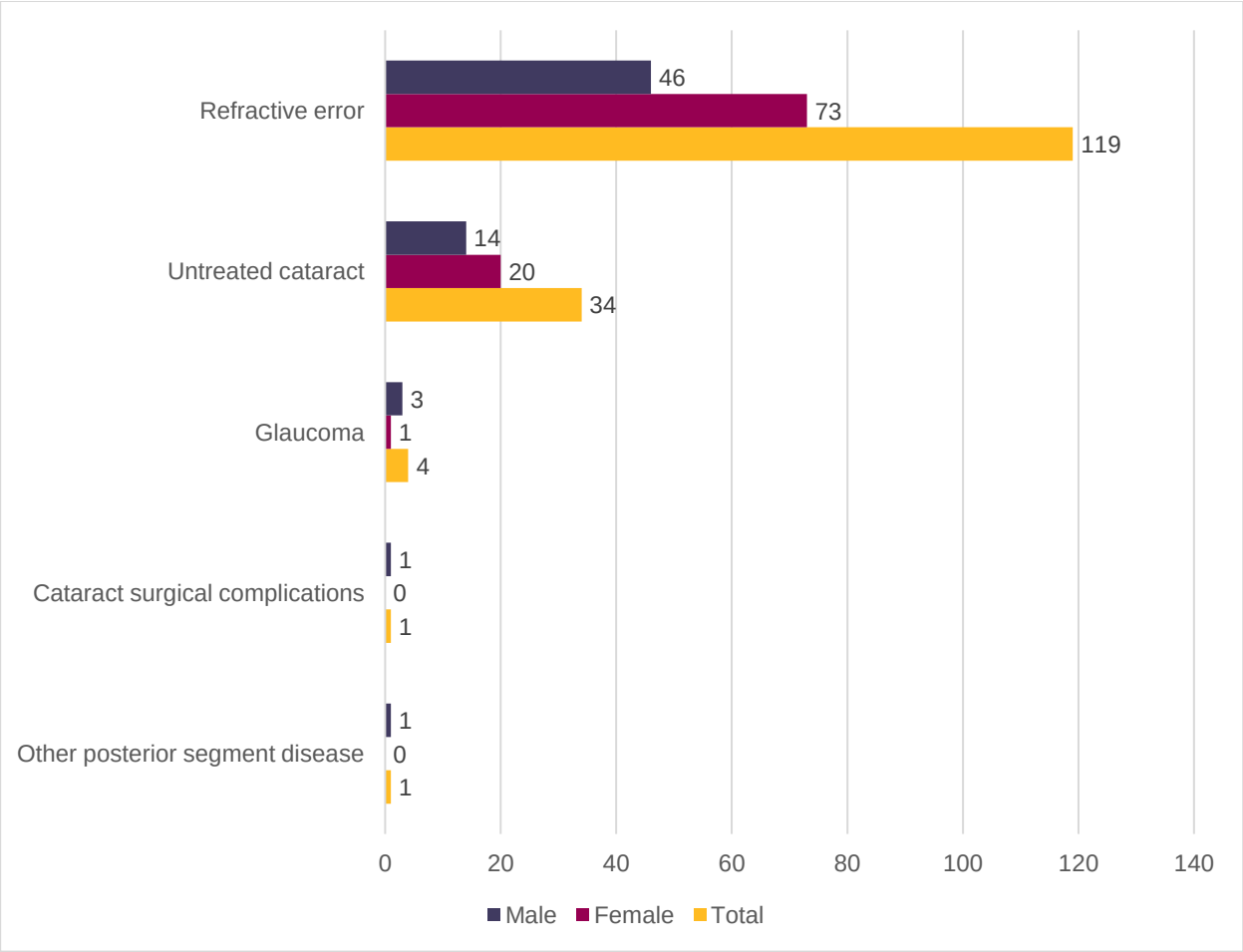
Unoperated cataract was the leading cause of MVI (140 cases; 71.1%), followed by refractive error (28 cases; 14.2%) (see Figure 12). Other causes responsible for MVI were cataract surgical complications and glaucoma (10 cases; 5.1%) each and other corneal opacities (six cases; 3%) (see Figure 10).

Figure 10: Principal causes of moderate visual impairment by sex in the Segou region.



Cataract surgical complications and glaucoma (10 cases; 5.1%) each and other corneal opacities (six cases; 3%) (see Figure 11).

Figure 11: Principal causes of early visual impairment by sex in the Segou region.



Cataract: prevalence, service coverage and visual outcomes

Table 10 shows that 1.4% (95% CI [1.0-1.9%]) of people aged 50 years and over in the Segou region are bilaterally blind with cataracts, and 1.0% (95% CI [0.6-1.5%]) have severe visual impairment due to cataracts. This translates to approximately 3,886 blind people, and 21,761 blind eyes and 2,702 people with SVI, and 7,305 SVI eyes due to cataract across Segou. We did not find statistically significant gender differences in cataract related blindness, SVI, and EVI, but cataract related MVI may be higher among women (5.6%; 95%CI 4.4-7.1%) than men (2.7%, 95%CI 1.9-3.7%) (confidence intervals are distinct and do not overlap).

Table 10: Age- and sex-adjusted prevalence of cataract-related visual impairment in the Segou region.

	Men	Women	Total
Blind: best corrected vision VA < 3/60 in the better eye			
Bilateral cataract	1,894	1,992	3,886
	1.5% [0.9-2.3%]	1.3% [0.8-2.1%]	1.4% [1.0-1.9%]
Unilateral cataract	<5 (2)	8,587	13,986

	4,2 % [2,9-5,6 %]	5,7 % [4,6-6,8 %]	5,0 % [4,1-5,9 %]
Eyes affected by cataracts	9/33	12,572	21,761
	3.6% [2.4-4.8%]	4.0% [3.0-5.4%]	3.9% [3.0-4.8%]
Severe visual impairment: the better eye can see 3/60 but not at 6/60			
Bilateral cataract	967	1,735	2,702
	0.8% [0.4-1.5%]	1.2% [0.7-1.8%]	1.0 (0.6-1.5%)
Unilateral cataract	559	1,342	1,901
	0.4% [0.1-0.8%]	0.9% [0.5-1.3%]	0.7% [0.4-0.9%]
Eyes affected by cataracts	2,493	4,812	7,305
	1.0% [0.2-1.8%]	1.6% [1.0-2.2%]	1.3% [0.8-1.8%]
Moderate visual impairment: the better eye can see at 6/60 but not at 6/18			
Bilateral cataract	(3) (394)	8,381	11,775
	2.7% [1.9-3.7%]	5.6% [4.4-7.1%]	4.2% [3.5-5.1%]
Unilateral cataract	3,257	1,331	4,588
	2.5% [1.4-3.7%]	0.9% [0.2-1.6%]	1.6% [1.1-2.2%]
Eyes affected by cataracts	10,046	18,095	28,141
	3.9% [2.5-5.3%]	6.0% [4.7-7.3%]	5.0% [4.2-5.9%]
Early visual impairment: the better eye can see at 6/18 but not at 6/12			
Bilateral cataract	3,717	6,695	10,412
	2.9% [2.0-4.2%]	4.4% [3.4-5.7%]	3.7% [3.0-4.7%]
Unilateral cataract	1,960	3,057	5,017
	0.8% [0.0-2.1%]	1.0% [0.0-2.3%]	0.9% [0.0-1.9%]
Eyes affected by cataracts	9,394	16,446	25,840
	3.7% [2.2-5.2%]	5.5% [4.2-6.8%]	4.6% [3.4-5.8%]

Cataract surgical coverage (CSC) was estimated at 27.2% for persons at VA < 6/12, the WHO recommended reporting level. CSC was higher among males than females, 34.4% versus 22.6% at VA < 6/12 (see Table 11).

Table 11: Sex-adjusted cataract surgical coverage in the Segou region.

	Men	Women	Total
VA < 3/60	69.4	67.2	68.2
VA < 6/60	59.4	53.7	56.2
VA < 6/18	42.7	29.3	34.6
VA < 6/12	34.4	22.6	27.2

Among 218 operated eyes, 99 (45.4%) had good post-operative vision (6/12), 53 (24.3%) had borderline vision (6/60 to 6/12), and 66 (30.3%) had poor vision (worse than 6/60). One hundred and eighty-four (84.8%) of operated eyes had an intraocular lens (IOL) implanted, of which 98 (53.3%) had good vision, 52 (28.3%) had borderline vision, and 34 (18.5%) had poor vision.

Twenty-eight (12.9%) eyes had been couched, of which 92.9% had poor vision. Among the 100 eyes operated on in the past three years (46.1% of the total), 47% had good vision, and 26% poor vision. The majority of surgeries (144; 66.4%) took place in a government hospital, of which 50.7% had good vision. The major cause of borderline or poor post-operative vision was surgical complications (44.1%), followed by unaddressed refractive error (22.0%), co-morbidities (18.6%), and long-term complications (15.3%) (see Table 12).

Table 12: Presenting visual acuity in operated eyes: characteristics of surgeries in the Segou region.

	Good: 6/12	Limited: < 6/12 to 6/60	Poor: <6/60	Total
Total eyes operated	99 (45.4%)	53 (24.3%)	66 (30.3%)	218
By gender				
Men	42 (39.6%)	28 (26.4%)	36 (34.0%)	106 (48.6%)
Women	57 (50.9%)	25 (22.3%)	30 (26.85%)	112 (51.4%)
By type of surgery				
With implant	98 (53.3%)	52 (28.3%)	34 (18.5%)	184 (84.8%)
Without implant	-	-	(5) 100.0%	5 (2.3%)
Cataract reduction	1 (3.6%)	1 (3.6%)	26 (92.9%)	28 (12.9%)
By years after surgery				
0 to 3 years	47 (47.0%)	27 (27.0%)	26 (26.0%)	100 (46.1%)
4 to 7 years	25 (59.5%)	16 (27.1%)	18 (30.5%)	59 (26.3%)
Ages 8 and over	27 (41.5%)	10 (15.4%)	21 (32.3%)	65 (29.0%)
By location of surgery				
Government hospital	73 (50.7%)	40 (27.8%)	31 (21.55%)	144 (66.4%)
Charity hospital	3 (100.0%)	-	-	3 (1.4%)
Private hospital	13 (46.4%)	8 (28.6%)	7 (25.0%)	28 (12.9%)
Awareness camp	9 (69.2%)	4 (30.8%)	-	13 (6.0 %)
Traditional frame	(1) 3.4%	(1) 3.4%	27 (93.2%)	29 (13.4%)
Cause of vision < 6/12 after cataract surgery				
Co-morbidity	-	9 (40.9%)	13 (59.1%)	22 (18.6%)
Surgical complications	-	16 (30.8%)	36 (69.2%)	52 (44.1%)

Refractive errors	-	20 (76.9%)	6 (23.1%)	26 (22.0%)
Long-term complications	-	8 (44.4%)	10 (56.6%)	18 (15.3%)

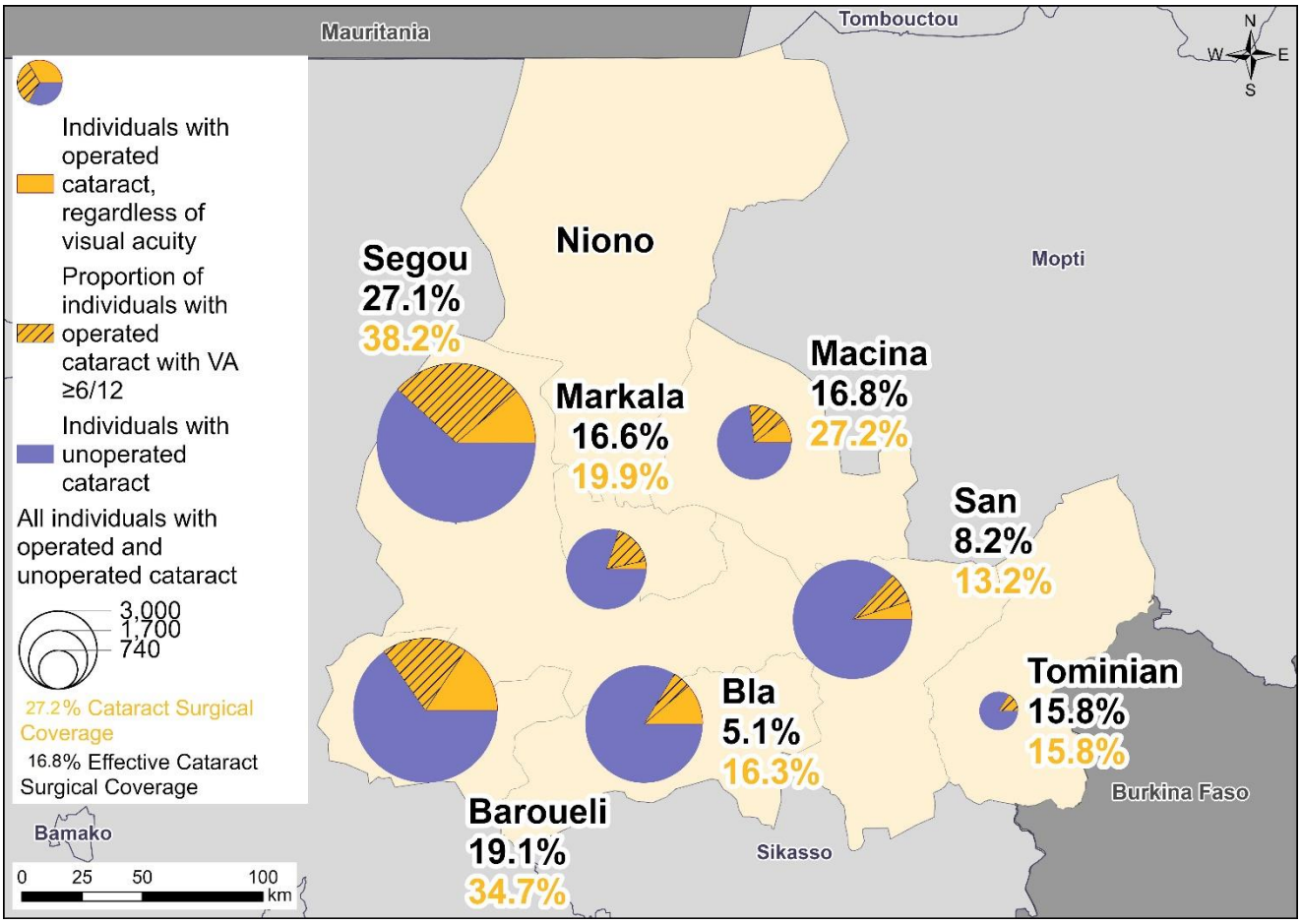
When looking at eCSC, we found that the proportion of people who had surgery – and a good visual outcome from surgery – was low at 16.8% at the 6/12 level, the WHO recommended reporting level. It was slightly higher among males (18.8%) than females (15.5%) (see Table 13).

Table 13: Effective coverage of cataract surgery (percentage), adjusted for sex and age in the Segou region.

	Men	Women	Total
AV < 3/60	40.3	48.8	44.8
AV < 6/60	34.5	38.1	36.5
AV < 6/18	23.6	20.8	21.9
AV < 6/12	18.8	15.5	16.8

Figure 12 shows the distribution of operated and unoperated cataracts by health district in Segou. The orange section shows the estimated number of individuals with operated cataracts in the district. The hatched section overlying the orange shows the proportion of those individuals with operated cataracts which have good visual outcomes, as in, they could see 6/12 or better. The purple section shows the number of individuals with unoperated cataracts. The size of the circle shows the relative total number of operated and unoperated cataracts in that district.

Figure 12: Distribution of operated and unoperated cataracts by health district in the Segou region.



The main reason given by people with bilateral unoperated cataracts for not having cataract surgery was being unable to afford the operation (42.7%), followed by the need not felt (30.8%) and fear of surgery or poor results (15.4%) (see Table 14).

Table 14: Barriers to cataract surgery in people with bilateral cataracts and BCVA <6/60 in the Segou region (some participants gave more than one reason).

	Men	Women	Total
Cannot afford operation	20 (42.6%)	30 (42.9%)	50 (42.7%)
Need not felt	13 (27.7%)	23 (32.9%)	36 (30.8%)
Fear of surgery or poor result	7 (14.9%)	11 (15.7%)	18 (15.4%)
No access to treatment	5 (10.6%)	1 (1.4%)	6 (5.1%)
Unaware that treatment is possible	2 (4.3%)	1 (1.4%)	3 (2.6%)
Treatment denied by provider	0 (0.0%)	4 (5.7%)	4 (3.4%)
Total	47	70	117

6 Results: Sikasso region

Characteristics of the sample

1,955 participants aged 50 and over were examined, representing a response rate of 88.9% (see Table 15).

Table 15: Distribution of participants by sex according to examination status in the Sikasso region.

	Examined	Not available	Refused	Unable to communicate	Total
Men	842	85	14	18	959
	87.8%	8.9%	1.5%	1.9%	43.6%
Women	1,113	74	11	43	1,241
	89.7%	6.0%	0.9%	3.5%	56.4%
Total	1,955	159	25	61	2,200
	88.9%	7.2%	1.1%	2.8%	100%

A total of 1,113 (56.9%) of the respondents were women. The female/male sex ratio was 1.32 (see Table 16).

Table 16: Distribution of participants by gender in the Sikasso region.

Sex	Frequency	Percentage
Men	842	43,1
Women	1,113	56,9
Total	1,955	100

The predominant age range for men and women examined was 50 to 59 years (see Table 17). Compared with the forecast population for the region, young people (aged 50 to 59) were under-represented in our sample: 41.4% compared with 50.9% in the 2022 projected population for the region).

Table 17: Breakdown of participants by sex and age group and comparison with the projected population of Sikasso.

	Survey participants			Projected regional population (2022 projection of 2018 data)		
	Men	Women	Total	Men	Women	Total
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
50-59	308 (36.6)	501 (45.0)	809 (41.4)	75,429 (52.1)	84,985 (52.9)	160,414 (50.9)

60-69	296 (35.2)	354 (31.8)	650 (33.3)	44,298 (30.6)	53,920 (31.6)	98,218 (31.2)
70-79	168 (20.0)	173 (15.6)	341 (17.4)	20,156 (13.9)	25,723 (15.1)	45,879 (14.6)
80+	70 (8.3)	85 (7.6)	155 (7.9)	4,797 (3.3)	5,785 (3.4)	10,582 (3.4)
Total	842 (100.0)	1,113 (100.0)	1,955 (100.0)	144,680 (100.0)	170,414 (100.0)	315,094 (100.0)

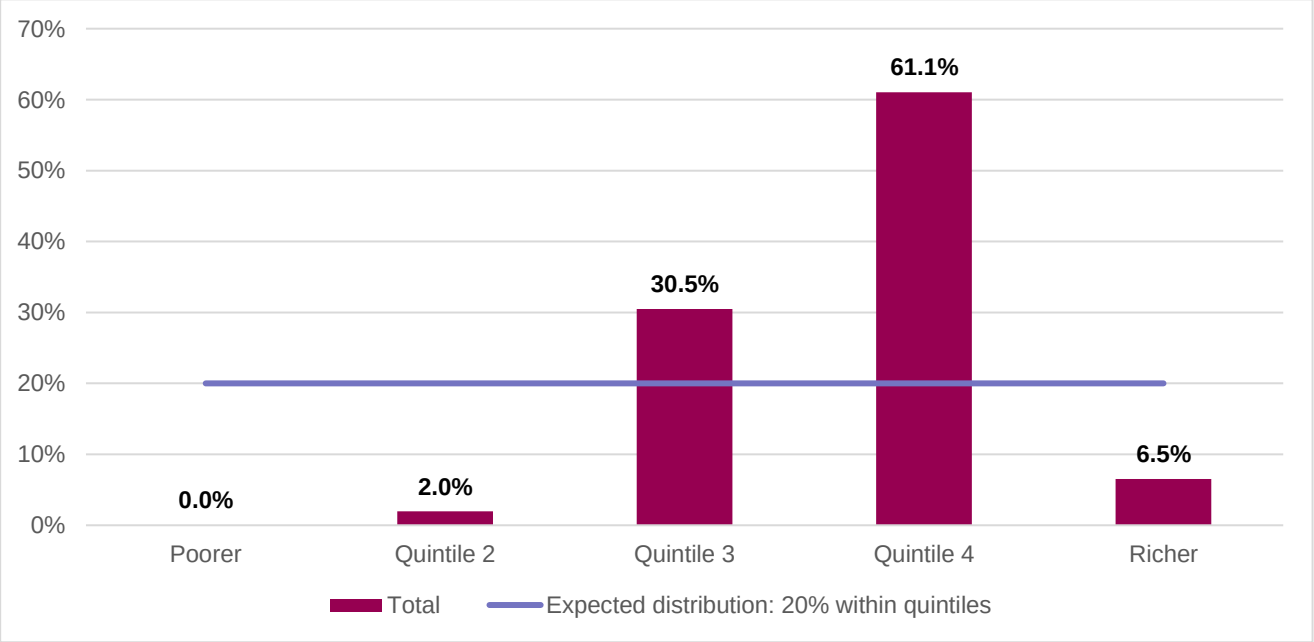
The prevalence of disability in Sikasso was 11.9%. Women had more disabilities than men (see Table 18).

Table 18: Breakdown of disability by sex.

Types of disability	Men		Women		Total	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Disability: all domains	100	11.9	132	11.9	232	11.9
Disability: excluding seeing difficulties	55	6.5	91	8.2	146	7.5

Compared with the national population, the study population appears to be relatively much wealthier, with 67.6% of participants belonging to the two wealthiest quintiles compared with 2% belonging to the two poorest quintiles (see Figure 13).

Figure 13: Distribution of participants by national wealth quintile in the Sikasso region.



Prevalence of visual impairment

Of the 1,955 participants examined, 83 (4.3%) were bilaterally blind. Using the pinhole occluder to obtain the best corrected VA, 75 participants (3.8%) were blind. Severe VI was observed in 66 participants (3.4%), moderate VI in 213 participants (10.9%) and early VI in 178 participants (9.1%) (see Table 19).

Table 19: Prevalence of visual impairment in men and women examined in the Sikasso region.

	Men	Women	Total
Blind: best corrected vision VA < 3/60 in the better eye			
Bilateral cases	37	38	75
	4.4% [3.2-6.0%]	3.4% [2.5-4.7%]	3.8% [3.1-4.8%]
All eyes	170	155	325
	10.1% [8,7-11.6%]	7.0% [6.0-8.1%]	8.3% [7.5-9.2%]
Blind: presenting vision VA less than 3/60 in the better eye			
Bilateral cases	43	40	83
	5.1% [3.8-6.8%]	3.6% [2.6-4.9%]	4.3% [3.4-5.2%]
All eyes	202	177	379
	12.0% [10.5-13.6%]	8.0% [6.9-9.2%]	9.7% [8.8-10.7%]
Severe visual impairment: the better eye can see at 3/60 but not at 6/60			
Bilateral cases	26	40	66
	3.1% [2.1-4.5%]	3.6% [2.6-4.9%]	3.4% [2.7-4.3%]
All eyes	69	114	183
	4.1% [3.2-5.2%]	5.1% [4.3-6.1%]	4.7% [4.1-5.4%]
Moderate visual impairment: the better eye can see at 6/60 but not at 6/18			
Bilateral cases	81	132	213
	9.6% [7.8-11.8%]	11.9% [10.1-13.9%]	10.9% [9.6-12.4%]
All eyes	166	265	431
	9.9% [8.5-11.4%]	11.9% [10.6-13.3%]	11.0% [10.1-12.0%]
Early visual impairment: the better eye can see at 6/18 but not at 6/12			
Bilateral cases	71	107	178
	8.4% [6.7-10.5%]	9.6% [8.0-11.5%]	9.1% [7.9-10.5%]
All eyes	143	225	368
	8.5% [7.3-9.9%]	10.1% [8.9-11.4%]	9.4% [8.5-10.4%]

Adjusting for age and sex, the prevalence of blindness among people aged 50 years and over is estimated to be 3.1% (95%CI 2.4%-3.9%). Extrapolating this to the general

population, it is estimated that there are 9,750 blind people aged 50 and above, and 48,481 blind eyes in Sikasso (see Table 20).

Severe visual impairment adjusted for age and sex affects about 7,847 people (2.5%) and 23,315 (3.7%) SVI eyes in total. Moderate visual impairment adjusted for age and sex affects 27,943 people (8.9%) and 58,833 (9.3%) eyes. Age- and sex-adjusted early visual impairment affects 25,033 people (7.9%) and 53,265 (8.5%) eyes (see Table 20).

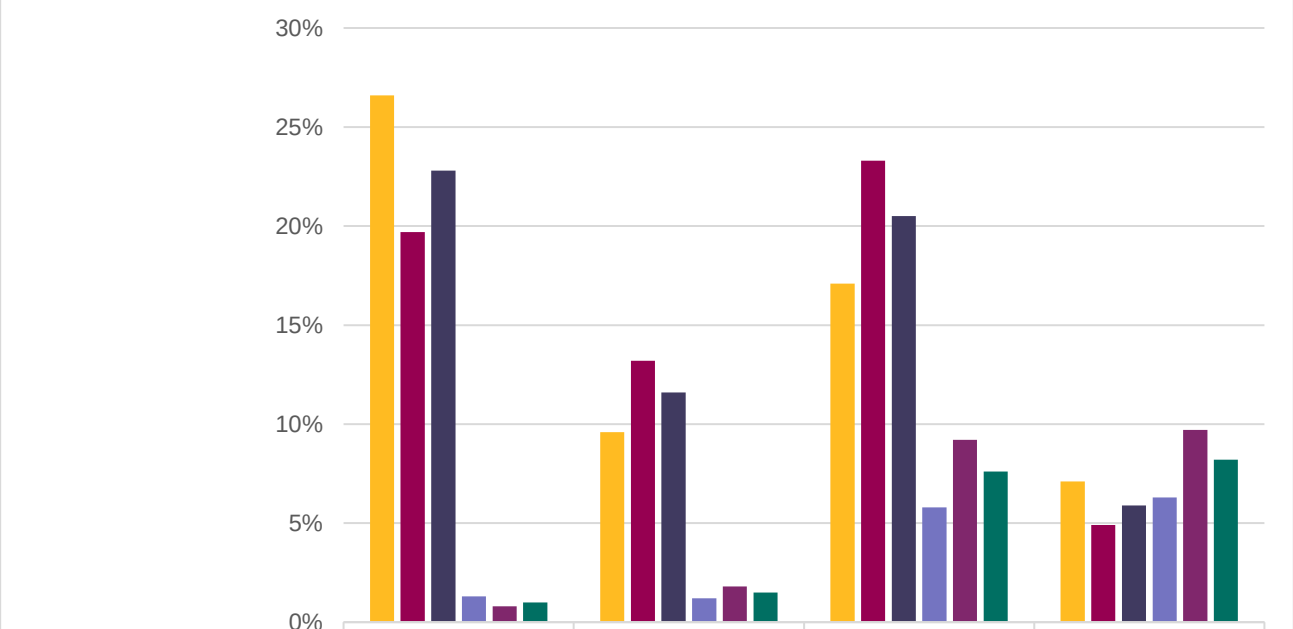
Table 20: Age-adjusted sex distribution of visual impairment in the Sikasso region.

	Men	Women	Total
Blind: best corrected vision VA <3/60 in the better eye			
Bilateral cases	4,574	4,125	8,700
	3.2% [2.3-4.4%]	2.4% [1,7-3.4%]	2.8% [2.2-3.5%]
All eyes	22,800	18,639	41,439
	7.9% [6.6-9.3%]	5.5% [4.4-6.8%]	6.6% [5.7-7.5%]
Blind: presenting vision AV less than 3/60 in the better eye			
Bilateral cases	5,302	4,447	9,750
	3.7% [2.7-5.0%]	2.6% [1.8-3.7%]	3.1% [2.4-3.9%]
All eyes	26,738	21,743	48,481
	9.2% [7.9-10.8%]	6.4% [5.2-7.8%]	7.7% [6.7-8.8%]
Severe visual impairment: the better eye can see 3/60 but not at 6/60			
Bilateral cases	2,849	4,998	7,847
	2.0% [1.3-3.1%]	2.9% [2.1-4.1%]	2.5% [1.9-3.2%]
All eyes	8,114	15,201	23,315
	2.8% [2.1-3.7%]	4.5% [3.6-5.5%]	3.7% [3.1-4.5%]
Moderate visual impairment: the better eye can see at 6/60 but not 6/18			
Bilateral cases	9,946	17,997	27,943
	6.9% [5.5-8.6%]	10.6 % [8.8-12.7%]	8.9% [7.6-10.3%]
All eyes	21,285	37,548	58,833
	7.4% [6.0-8.9%]	11.0% [9.3-13.0%]	9.3% [8.1-10.7%]
Early visual impairment: the better eye can see at 6/18 but not at 6/12			
Bilateral cases	9,246	15,787	25,033
	6.4% [5.1-8.0%]	9.3% [7.4-11.6%]	7.9% [6.6-9.6%]
All eyes	19,701	33,563	53,265
	6.8% [5.4-8.5%]	9.8% [8.3-11.6%]	8.5% [7.3-9.8%]

Figure 14 shows the age- and sex-adjusted prevalence of visual impairment by disability and sex. Men and women who reported a disability were more likely to be visually impaired than those who reported no disability. These differences were more striking for more severe forms

of visual impairment, particularly blindness. For example, 26.6% of men and 19.7% of women who reported a disability were blind, compared to 1.3% of men and 0.8% of women who reported no disability.

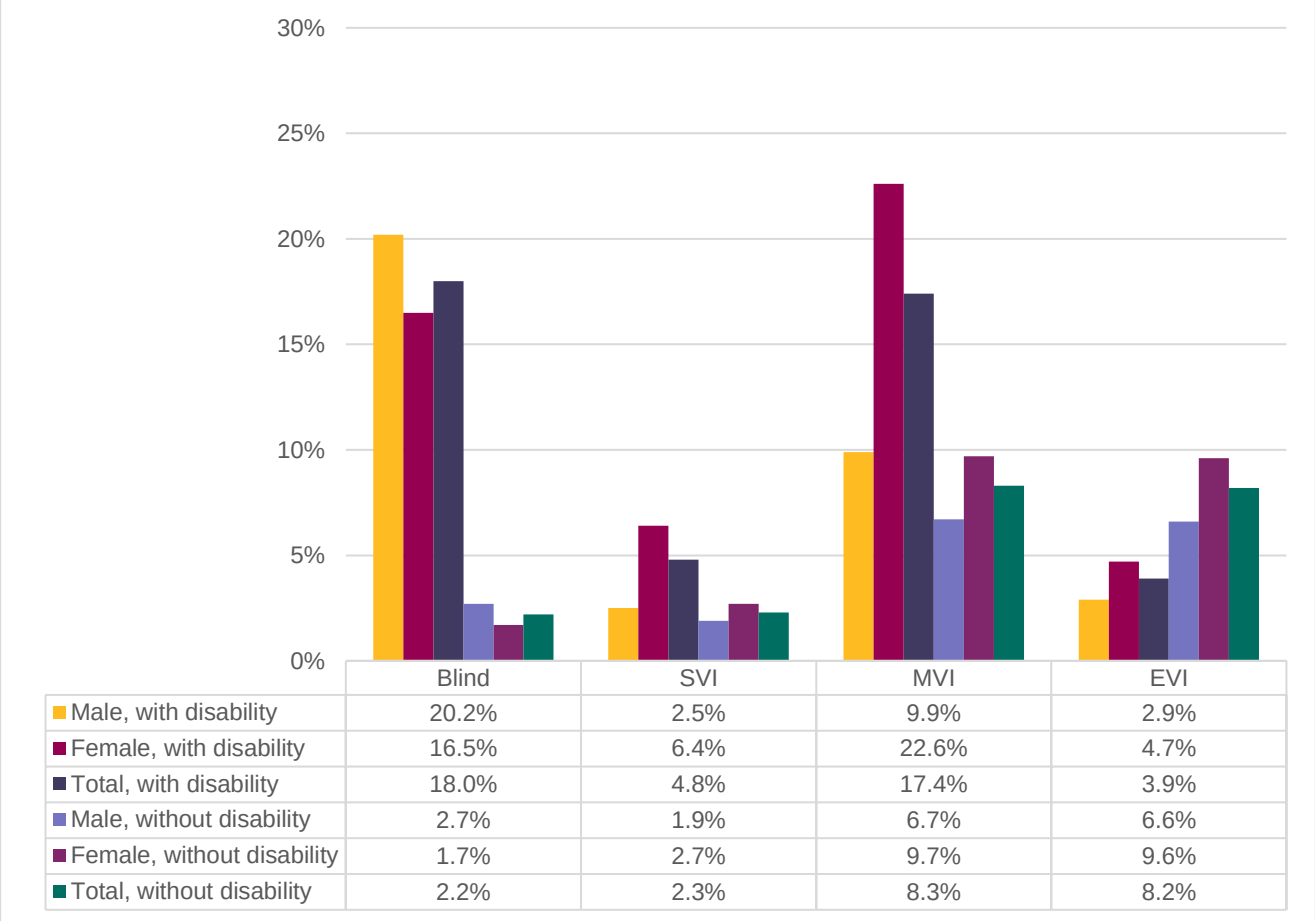
Figure 14: Age- and sex-adjusted prevalence of visual impairment, by disability, all domains combined, in the Sikasso region.



	Blind	SVI	MVI	EVI
Male, with disability	26.6%	9.6%	17.1%	7.1%
Female, with disability	19.7%	13.2%	23.3%	4.9%
Total, with disability	22.8%	11.6%	20.5%	5.9%
Male, without disability	1.3%	1.2%	5.8%	6.3%
Female, without disability	0.8%	1.8%	9.2%	9.7%
Total, without disability	1.0%	1.5%	7.6%	8.2%

Since visual impairment is likely to be strongly correlated with "difficulty in seeing", it is important to explore how VI is related to the other domains of disability measured. Figure 15 shows how the prevalence of VI adjusted for age and sex varies by disability when the "difficulty in seeing" domain is excluded. We observe that the relationship between disability and visual impairment remains very strong: 20.2% of men who reported a disability (excluding "difficulty in seeing") were blind, as opposed to 2.7% of men who reported no non-visual disabilities.

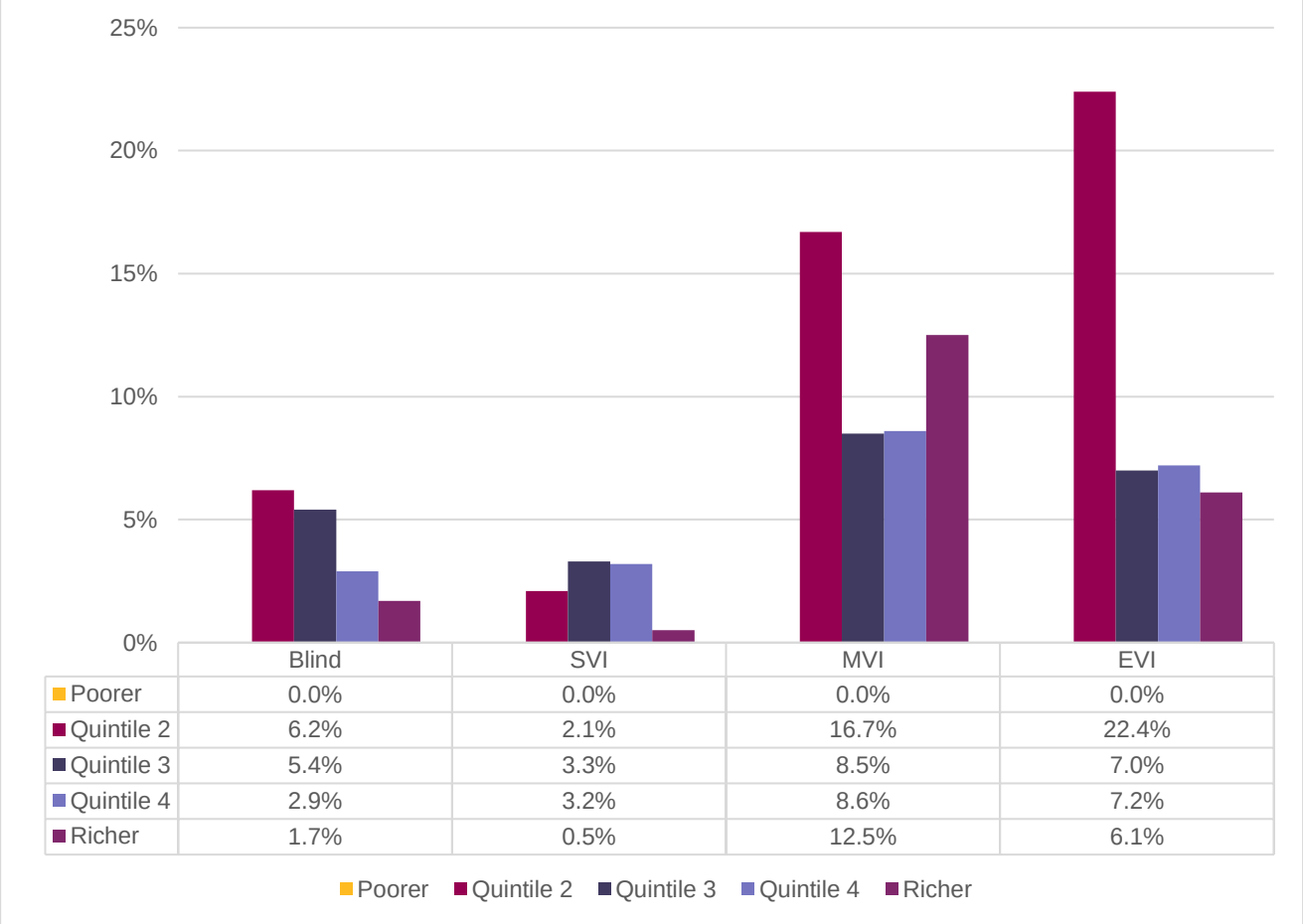
Figure 15: Age- and sex-adjusted prevalence of visual impairment by type of disability (excluding vision) in the Sikasso region.



	Blind	SVI	MVI	EVI
Male, with disability	20.2%	2.5%	9.9%	2.9%
Female, with disability	16.5%	6.4%	22.6%	4.7%
Total, with disability	18.0%	4.8%	17.4%	3.9%
Male, without disability	2.7%	1.9%	6.7%	6.6%
Female, without disability	1.7%	2.7%	9.7%	9.6%
Total, without disability	2.2%	2.3%	8.3%	8.2%

No participants in Sikasso were identified as living in households belonging to the poorest 20% quintile nationally. Figure 16 shows that blind participants appeared more likely to belong to the less wealthy quintiles. However, there was no clear pattern in the distribution of other levels of VI by wealth.

Figure 16: Age- and sex-adjusted prevalence of visual impairment by wealth quintile in the Sikasso region.

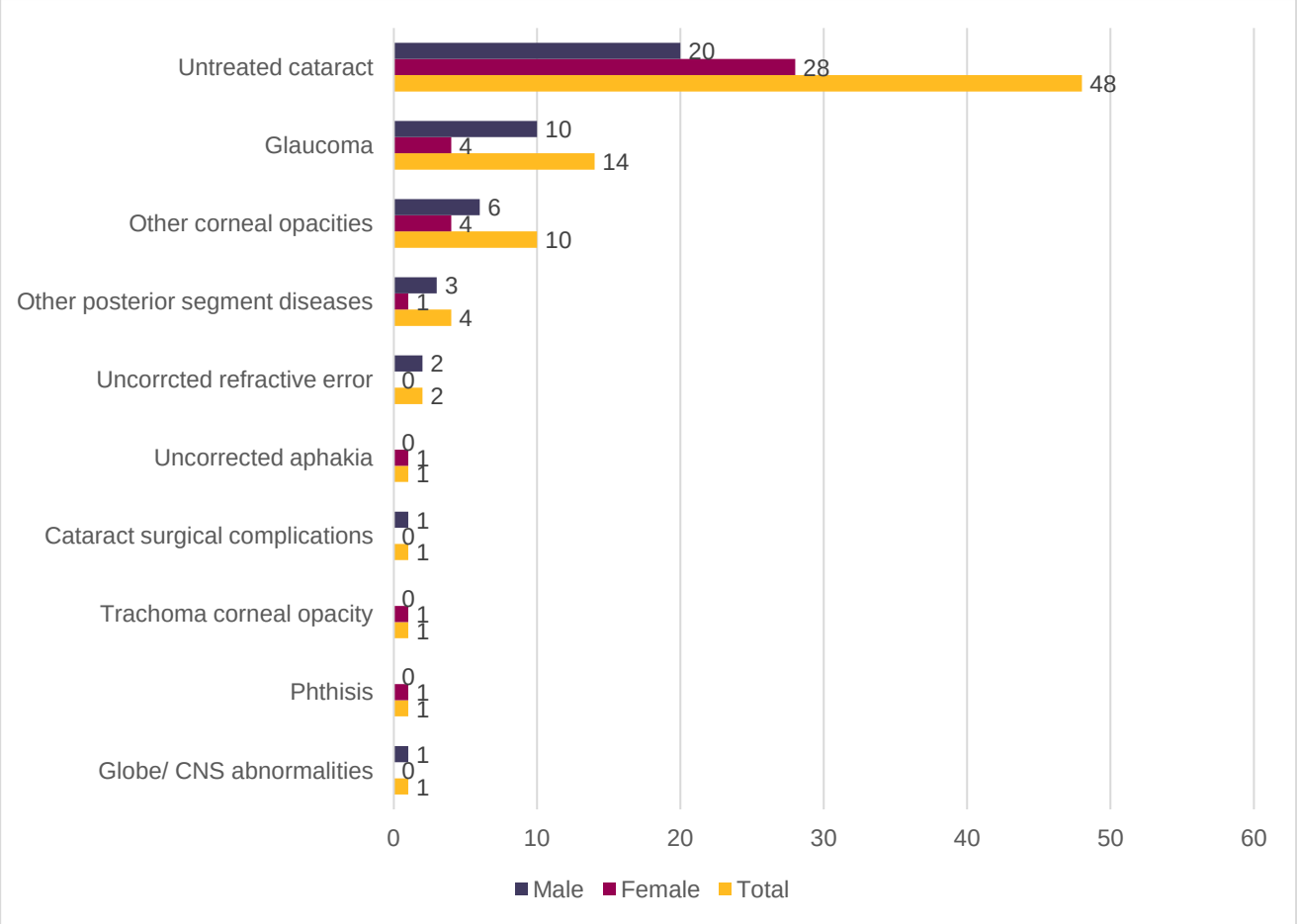


	Blind	SVI	MVI	EVI
Poorer	0.0%	0.0%	0.0%	0.0%
Quintile 2	6.2%	2.1%	16.7%	22.4%
Quintile 3	5.4%	3.3%	8.5%	7.0%
Quintile 4	2.9%	3.2%	8.6%	7.2%
Richer	1.7%	0.5%	12.5%	6.1%

Causes of visual impairment

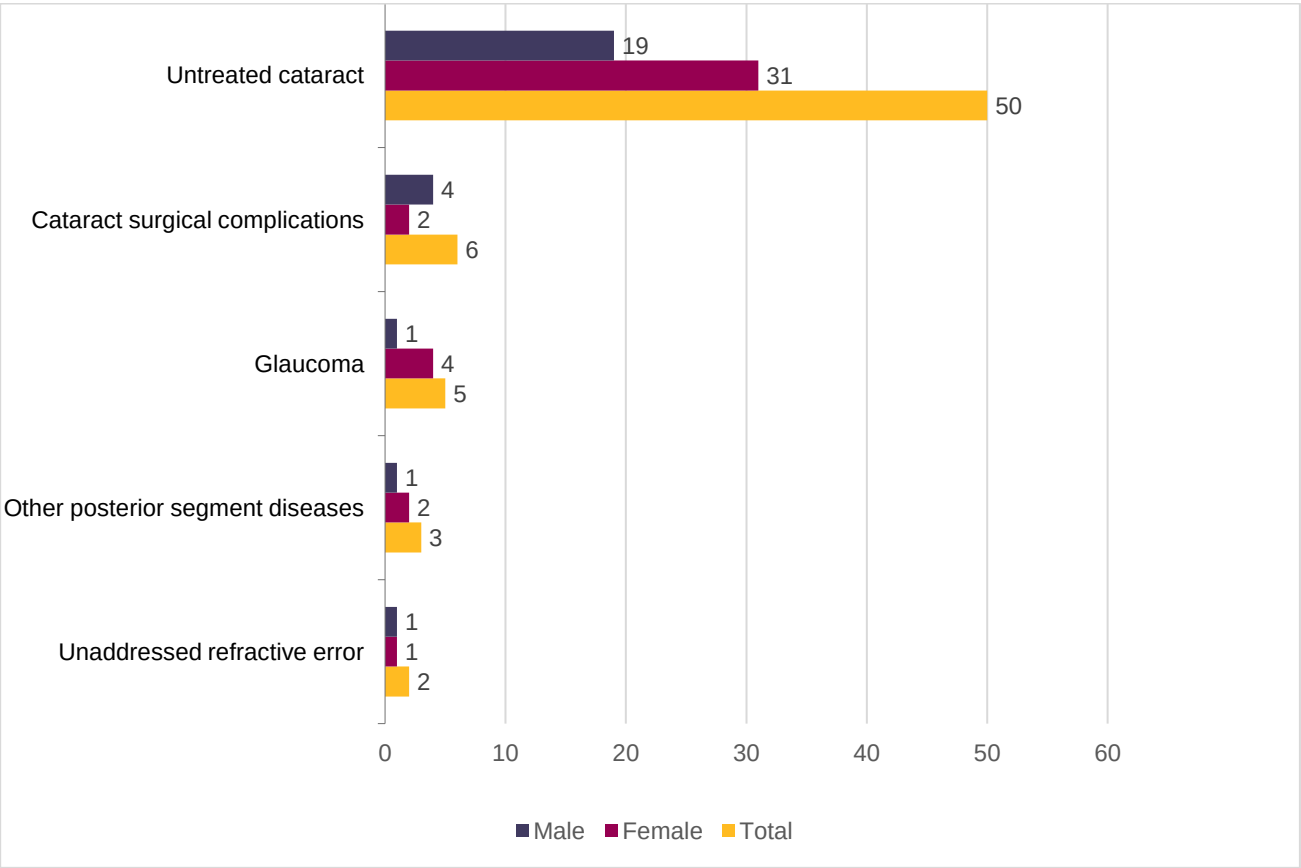
The main cause of blindness was unoperated cataract (48 cases; 57.8%), followed by glaucoma (14 cases;16.9 %), and other corneal opacity (10 cases; 12.0%) (see Figure 17).

Figure 17: Principal causes of bilateral blindness by sex in the Sikasso region.



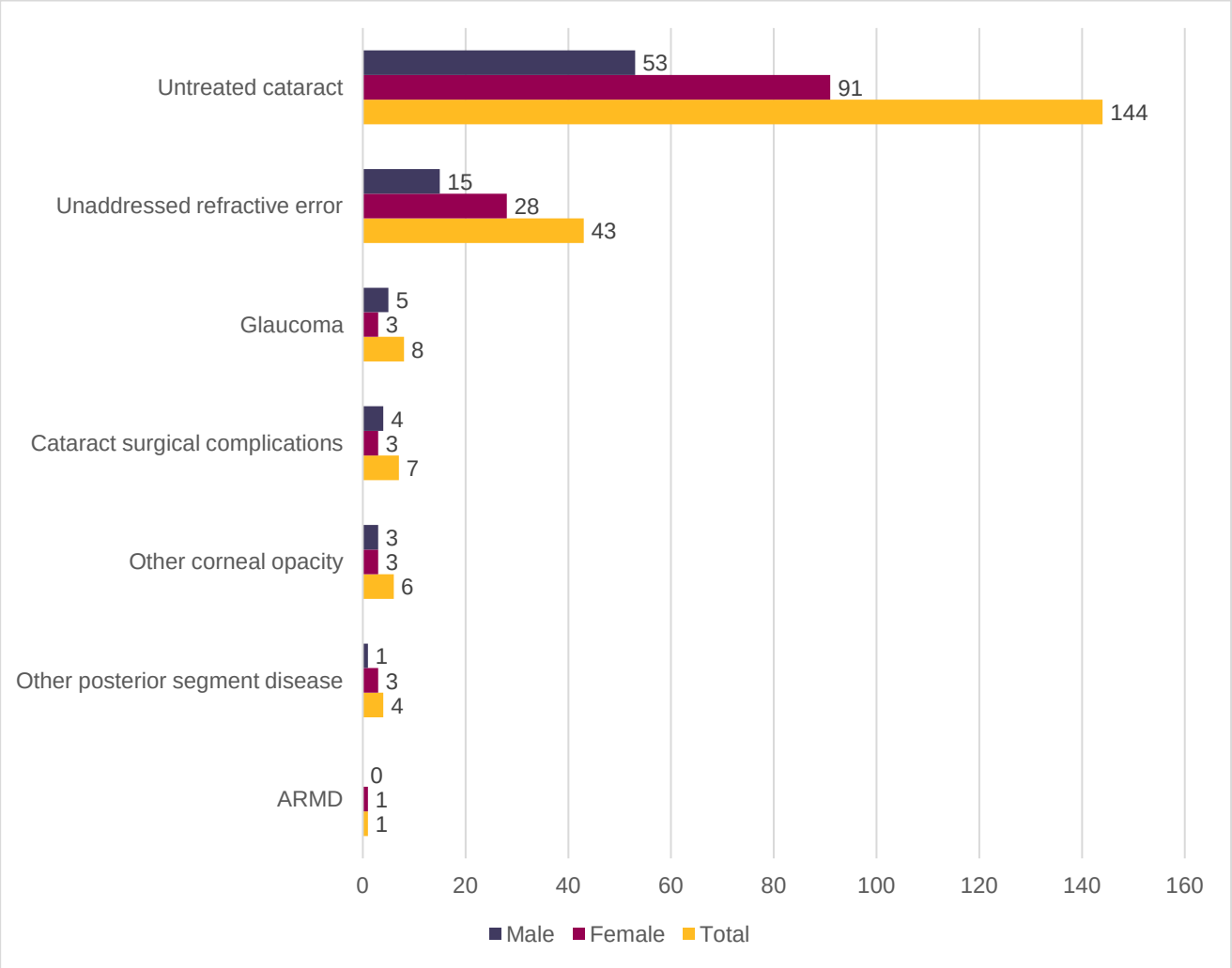
Unoperated cataract was also the main cause of severe VI (50 cases; 75.8%), followed by cataract surgical complication (6 cases; 9.1%) (see Figure 18).

Figure 18: Principal causes of bilateral severe visual impairment by sex in the Sikasso region.



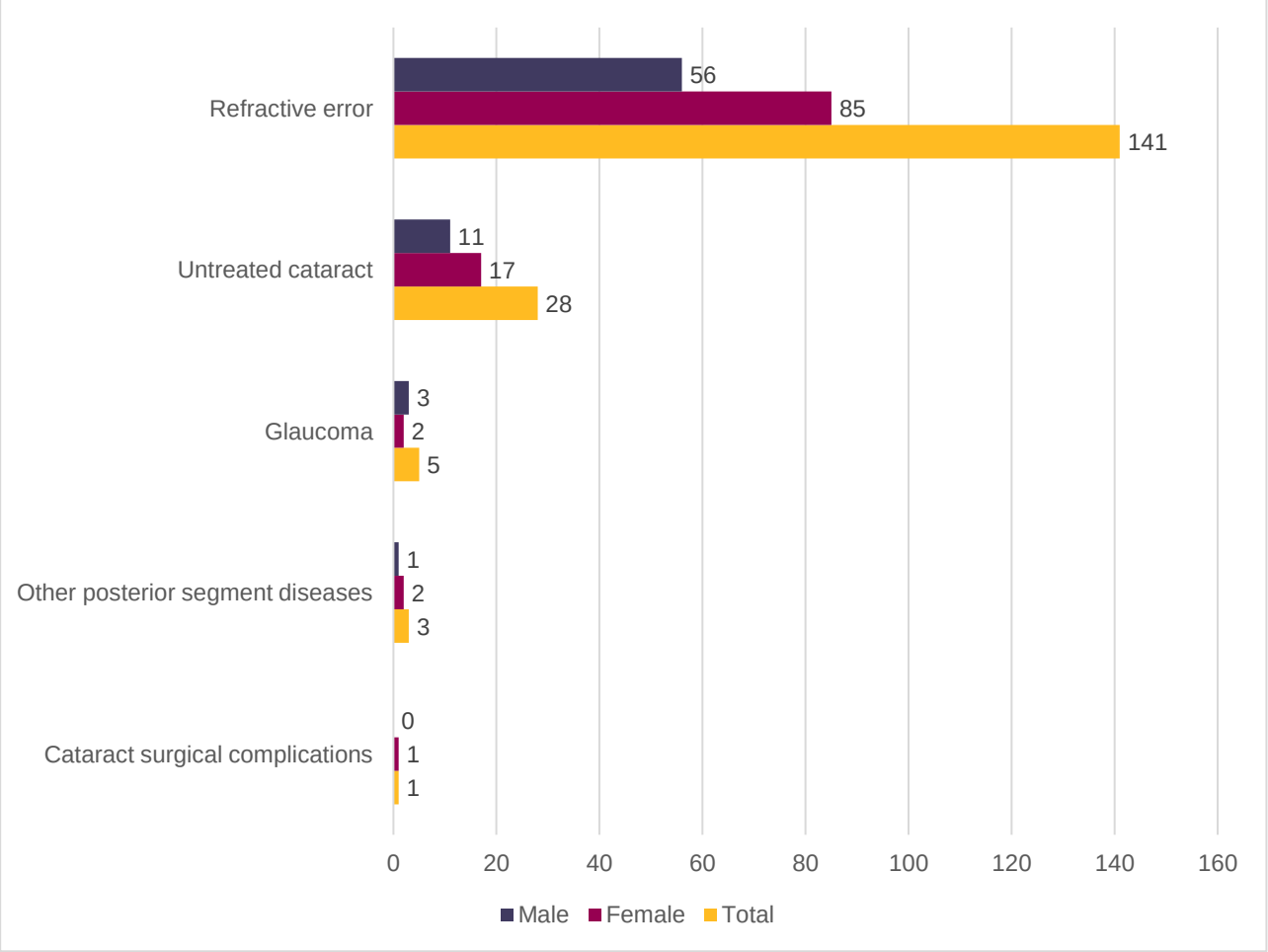
Unoperated cataract was the main cause of moderate VI (144 cases; 67.6%), followed by unaddressed refractive error (43 cases; 20.2%) and glaucoma (8 cases; 3.8%) (see Figure 19).

Figure 19: Principal causes of bilateral moderate visual impairment by sex in the Sikasso region.



Refractive error was the main cause of EVI (141 cases; 79.2%), followed by untreated cataract (28 cases; 15.7%) (see Figure 20).

Figure 20: Principal causes of bilateral early visual impairment by sex in the Sikasso region.



Cataract: prevalence, coverage of service, and visual outcomes

Table 21 shows that 1.2% (95% CI [0.5-1.8]) of people aged 50 years and over in the Sikasso region are bilaterally blind with cataracts and 0.8% (95% CI [0.4-1.3]) have severe visual impairment due to cataract. This translates to approximately 3,628 blind people and 2,671 people with SVI due to cataract across Sikasso. Including people with unilateral cataracts, there are estimated to be 20,872 blind eyes in the Sikasso region and a further 9,538 SVI eyes.

Table 21: Age- sex-adjusted prevalence of cataract-related visual impairment in the Sikasso region.

	Men	Women	Total
Blind: best corrected vision VA <3/60 in the better eye			
Bilateral cataract	1,460	2,168	3,628
	1.0% [0.2-1.8%]	1.3% (0.3–2.2%)	1.2% (0.5–1.8%)
Unilateral cataract	6,332	(7) (284)	13,616
	4.4% (2.9-5.95%)	4.3% (3.1–5.5%)	4.3% (3.3–5.3%)
Eyes affected by cataracts	9,253	11,619	20,872
	3.2% (1.9–4.5%)	3.4% (2.3–4.6%)	3.3% (2.4–4.35%)
Severe visual impairment: the better eye can see 3/60 but not at 6/60			
Bilateral cataract	745	1,926	2,671
	0.5% (0.0–1.1%)	1.1% (0.4–1.9%)	0.8% (0.4–1.3%)
Unilateral cataract	1,896	2,300	4,196
	1.3% (0.5-2.1%)	1.4% (1.0–1.7%)	1.3% (0.9–1.8%)
Eyes affected by cataracts	3,386	6,152	9,538
	1.2% (0.4-2%)	1.8% (1.1–2.5%)	1.5% (1.0–2.1%)
Moderate visual impairment: the better eye can see at 6/60 but not at 6/18			
Bilateral cataract	4,022	7,669	11,691
	2.8% (1.3–4.2%)	4.5% (3.1–5.9%)	3.7% (2.5–4.9%)
Unilateral cataract	2,900	4,256	7,156
	2.0% (0.9–3.1%)	2.5% (1.6–3.4%)	2.3% (1.5–3.0%)
Eyes affected by cataracts	10,944	19,593	30,537
	3.8% (2.4–5.2%)	5.7% (4.4–7.1%)	4.8% (3.9–5.8%)
Early visual impairment: the better eye can see at 6/18 but not at 6/12			
Bilateral cataract	3,560	(6) (549)	10,109
	1.2% (0.1–2.4%)	1.9% (0.6–3.2%)	1.6% (0.7–2.5%)
Unilateral cataract	638	929	1,567
	0.2% (0.0–1.3%)	0.3% (0.0–1.5%)	0.2% (0.0–1.2%)
Cataract eyes	7,756	14,024	21,780
	2.7% (1.6–3.8%)	4.1% (2.9–5.3%)	3.5% (2.6–4.3%)

Cataract surgical coverage (CSC) was estimated at 32.5% for people with a VA <6/12. CSC was higher among men than women, 38.0% versus 29.2% for VA <6/12 (see Table 22).

Table 22: Cataract surgical coverage (persons, percentage), adjusted for sex and age.

	Men	Women	Total
AV <3/60	76.1	73.9	74.7
A V<6/60	66.8	61.5	63.5
AV <6/18	47.2	36.8	40.8
AV <6/12	38.0	29.2	32.5

Table 23 shows 211 eyes were identified as having been operated for cataract (Table 19). The majority (87.6%) had an intraocular lens (IOL), 12 (5.7%) did not have an IOL, and 14 (6.7%) had been couched. Of those with an IOL, 41.5% had good vision, and 21.9% were considered to have poor vision. The majority of those with no IOL (91.77%) and those that had been couched (85.7%) had poor vision, and none had good vision. Among the eyes operated on in the past three years, 42.3% had good visual outcomes. However, 22.7% of eyes operated in this period had poor visual outcomes. The majority of surgeries (78.0%) took place in a government hospital. The major cause of poor or borderline vision after surgery was unaddressed refractive error (32.3%), followed by surgical complications (27.1%), co-morbidities (24.1%), and long-term complications (16.5%).

Table 23: Presenting visual acuity in operated eyes: characteristics of surgeries in the Sikasso region.

	Good: 6/12	Limited: <6/12 to 6/60	Poor: <6/60	Total
Total eyes operated	76 (36.0%)	70 (33.2%)	65 (30.8%)	211
By gender				
Men	30 (30.9%)	29 (29.9%)	38 (39.2%)	97 (46.0%)
Women	46 (40.4%)	41 (36.0%)	27 (23.7%)	114 (54.0%)
By type of surgery				
With implant	76 (41.5%)	67 (36.6%)	40 (21.9%)	183 (87.6%)
Without implant	-	1 (12.5%)	11 (91.7%)	12 (5.7%)
Cataract reduction	-	2 (14.3%)	12 (85.7%)	14 (6.7%)
Number of years after surgery				
0 to 3 years	41 (42.3%)	34 (38.1%)	22 (22.7%)	97 (46.4%)
4 to 7 years	21 (38.2%)	17 (30.9%)	17 (30.9%)	55 (26.3%)
Ages 8 and over	14 (24.6%)	19 (33.3%)	24 (42.1%)	57 (28.2%)
Place of surgery				
Government hospital	61 (37.4%)	63 (38.7%)	39 (23.9%)	163 (78.0%)
Charity hospital	2 (40.0%)	2 (40.0%)	1 (20.0%)	5 (2.4%)
Private hospital	12 (85.7%)	1 (7.1%)	1 (7.1%)	14 (6.7%)
Cataract awareness camp	1 (9.1%)	1 (9.1%)	9 (81.8%)	11 (5.3%)
Traditional frame	-	3 (18.8%)	13 (81.2%)	16 (7.7%)
Cause of vision <5/10 after cataract surgery				
Co-morbidity	-	10 (31.3%)	22 (68.7%)	32 (24.1%)
Surgical complications	-	13 (36.1%)	23 (63.9%)	36 (27.1%)
Refractive errors	-	37 (86.0%)	6 (14.0%)	43 (32.3%)
Long-term complications	-	10 (45.5%)	12 (54.5%)	22 (16.5%)

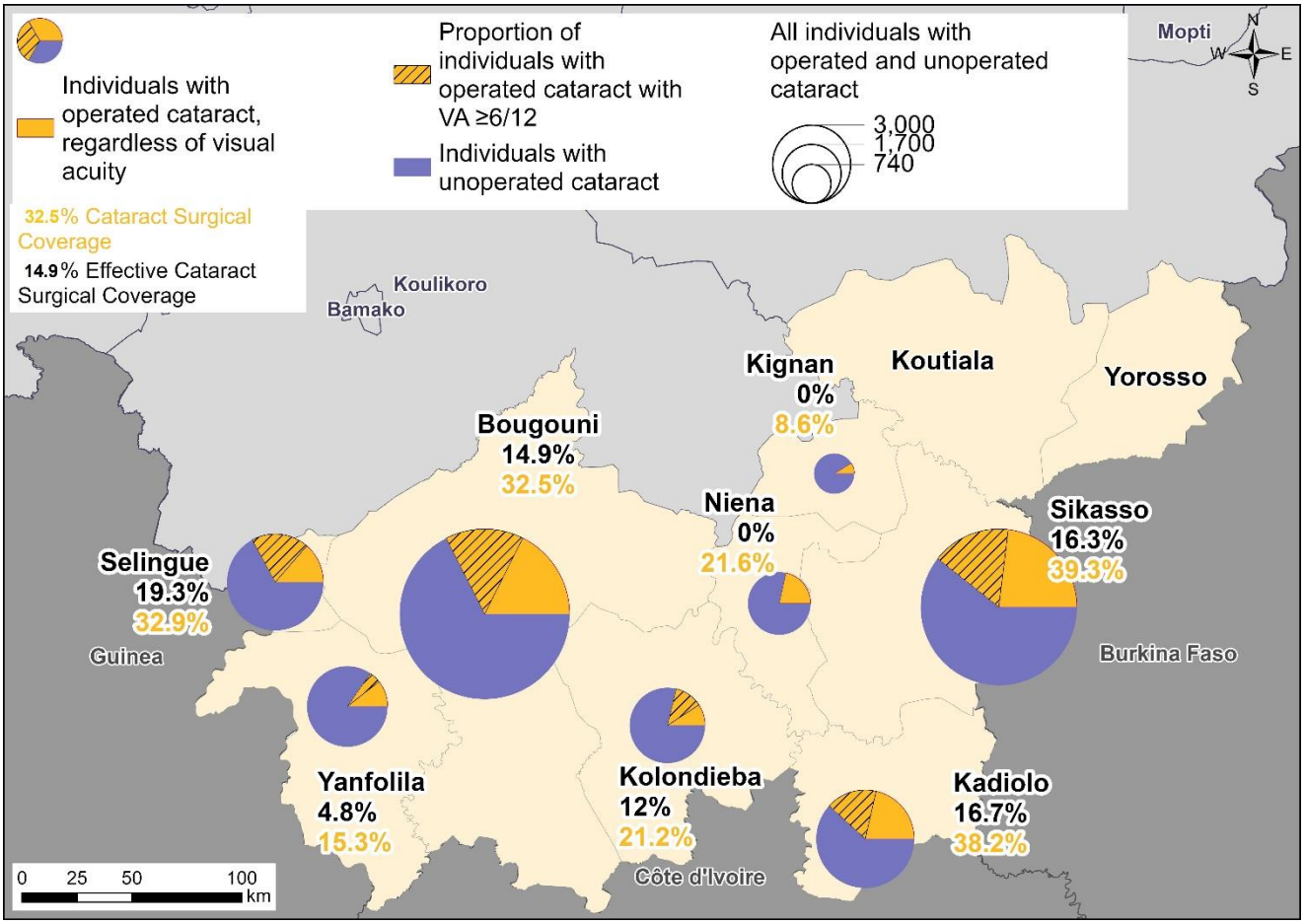
When looking at eCSC, we found that the proportion of people who had surgery – and a good visual outcome from surgery – was low at 14.9% overall. It was slightly higher among males (16.4%) than females (14.1%) (see Table 24).

Table 24: Effective coverage of cataract surgery (persons, percentage) adjusted for age and sex, in the Sikasso region.

	Men	Women	Total
AV < 3/60	35.5	38.0	37.0
AV < 6/60	29.8	37.5	31.1
AV < 6/18	21.4	18.5	19.6
AV < 6/12	16.4	14.1	14.9

Figure 21 shows the distribution of operated and unoperated cataracts by health district in Segou. The orange section shows the estimated number of individuals with operated cataracts in the district. The hatched section overlying the orange shows the proportion of those individuals with operated cataracts which have good visual outcomes, as in, they could see 6/12 or better. The purple section shows the number of individuals with unoperated cataracts. The size of the circle shows the relative total number of operated and unoperated cataracts in that district in the Sikasso region.

Figure 21: Distribution of operated and unoperated cataracts by health district in the Sikasso region.



The main reason given by people with bilateral unoperated cataracts for not having cataract surgery was being unable to afford the operation (43.5%), followed by fear of surgery or poor result (26.9%), and not feeling a need for surgery (13.0%) (see Table 25).

Table 25: Barriers to cataract surgery in people with bilateral cataracts and an BCVA <6/60 in the Sikasso region (some participants gave more than one reason).

	Male	Female	Total
Inability to pay for the operation	23 (57.5%)	24 (35.3%)	47 (43.5%)
Fear of surgery	6 (15%)	23 (33.8 %)	29 (26.9%)
Need not felt	2 (5.0%)	12 (17.6%)	14 (13.0%)
Does not know that treatment is possible	5 (12.5%)	4 (5.9%)	9 (8.3%)
Problems with access to treatment	3 (7.5%)	4 (5.9%)	7 (6.5%)
Other	1 (2.5%)	1 (1.5%)	2 (1.9%)
Total	**40**	**68**	**108**

7 Discussion

The aim of this study was to estimate the prevalence and causes of visual impairment, and also to understand the associations between eye health outcomes, relative wealth and disability in people aged 50 and over in the Segou and Sikasso regions of Mali.

The age- and sex-adjusted prevalence of blindness in people aged 50 and over was 3.1% [2.4-4.0%] in Segou and 3.1% [2.4-3.9%] in Sikasso. The age- and sex-adjusted prevalence of severe visual impairment (SVI) was 3.3% [2.5-4.4%] in Segou and 2.5% [1.9-3.2%] in Sikasso. Moderate visual impairment (MVI) adjusted for age and sex was 8.2 [7.2-9.2%] in Segou and 8.9% [7.6-10.3%] in Sikasso, and early visual impairment (EVI) was 6.9% [5.7-8.4%] in Segou and 7.9% [6.6-9.6%] in Sikasso.

Although there has been no previous survey in these two regions, the results indicate a lower prevalence of visual impairment than that observed in the neighbouring region of Koulikoro in 2011 (7.1%; 95%CI 5.1-9.2%) (18). There was little difference between men and women in the overall prevalence of visual impairment in the two regions.

Cataracts were the main cause of blindness in both regions: 67.1% in Segou and 57.8% in Sikasso. Cataract was also the main cause of SVI and MVI in both regions. Glaucoma was the second leading cause of blindness in Segou (18.8%) and Sikasso (16.9%). Data on other causes of VI should be treated with caution as the RAAB assigns only one cause per eye or per visually impaired person, and this must be the one that is easiest to treat.

Using recently updated definitions of cataract surgical coverage (19), less than a third of cataract patients with an AV of 5/10 (6/12) had undergone surgery in the two regions (19). In Segou, the CSC was 27.2% overall, 34.4% in men and 22.6% in women. In Sikasso, the CSC was 32.5% overall, 38.0% in men and 29.2% in women.

The WHO has recently updated the definition of what constitutes a "good" visual result after cataract surgery from 3/10 (6/18) or better to 5/10 (6/12) or better (19). The definition of a "bad" result remains unchanged, namely, vision of less than 1/10 (6/60), and these figures were relatively high in both regions. Overall, in Segou, of the 218 eyes operated on, 66 (30.3%) had a poor result, compared with 99 (45.4%) with a good result.

In Sikasso, of the 211 eyes operated on, 65 (30.8%) had poor results, but a smaller proportion, 76 (36.0%) had good results. Cataract removal remains widespread in both regions, with 28 (12.9%) eyes in Segou and 14 (6.7%) eyes in Sikasso having undergone the procedure. Unsurprisingly, most of the eyes that had undergone cataract reduction had had poor visual results.

Overall, the reasons for poor and limited results were slightly different in the two regions: in Segou, the most important cause was cataract surgical complications (including cataract lowering) (44.1%), followed by untreated refractive error (22.0%), co-morbidities (18.6%) and long-term complications (15.3%). In Sikasso, the main cause was untreated refractive error (32.3%), followed by surgical complications (27.1%), co-morbidities (24.1%) and long-term complications (16.5%). This indicates that there is a need to improve the cataract surgery skills of ophthalmologists, including the ability to perform better biometry and the management of intra-operative complications. In addition, it is important to acquire and establish a pool of different implants to avoid the use of standard ones.

The provision of spectacles and the management of uncorrected aphakia, as well as a better-quality control system, need to be considered. The introduction of surgical follow-up and outcome assessment to identify and address the causes of poor outcomes is necessary to improve the quality of services. Access to post-operative refractive services could improve a significant number of poor or borderline post-operative outcomes.

Working with communities to raise awareness, reducing harmful practices, such as cataract removal, and providing access to quality, affordable eye care services closer to people will also lead to better outcomes. The creation of local centres with the necessary quality control systems can help to improve access to care and reduce the number of cataract operations. The development of standard operating procedures for the various health facilities offering ophthalmic care at different levels of the health pyramid will ensure compliance with quality control systems.

The effective cataract surgery coverage indicator (eCSC) recently defined by the WHO and approved as an indicator of universal coverage at the 2021 World Health Assembly (WHA) is low in both regions (19) 16.8% in Segou (18.8% among men and 15.5% among women), and 14.9% in Sikasso (16.4% among men and 14.1% among women). In order to achieve the WHO objective of a 30% increase by 2030, the Segou and Sikasso services must strive to identify strategies to improve access to eye health services and the quality of cataract surgery results as a priority.

The CSC and eCSC were both higher for men than for women. Although the gender differences were not as pronounced as in other sub-Saharan African countries, this result is consistent with the findings of other RAABs (20, 21). More gender-sensitive strategies and activities are needed to ensure that men and women have equal access to services. The prevalence of disability among people aged 50 and over was 12.6% in Segou and 11.9% in Sikasso, which is consistent with other studies. It would appear that people living in Segou and Sikasso who have difficulties in areas other than vision are more likely to be blind or suffer from SVI than people with no functional difficulties, which is also consistent with the results of other studies (20-22). No clear relationship was found between wealth and visual impairment. However, it is important to note that a large proportion of the population refused to answer questions about relative wealth; if these people were economically similar, there may be a relationship that we were unable to determine.

Finally, it is important to stress the general limitation of all RAABs: it is difficult to diagnose posterior segment disease under the field conditions of RAABs with a simple direct ophthalmoscope. Furthermore, only a single cause (the easiest to treat) can be attributed to each eye or person, which underestimates the prevalence of posterior segment disease and other eye diseases.

Limits of the study

We have identified a number of limitations that need to be considered when interpreting the results. The survey response rate was good in both regions: 89.6% in Segou and 88.9% in Sikasso. However, when comparing the populations of Segou and Sikasso (distribution by 10-year age group) with the study samples, younger people (aged 50-59) were under-represented, so statistical adjustments were made to weight the results against the "real" population. As the most recent estimates (2022) of the distribution by 10-year age group and gender in the two regions were not available, we applied the 2018 national distribution to the estimated regional population totals in 2022.

The sampling frame did not include all villages in both regions due to security issues, which limits the generalisability of the results. It is possible that people living in less secure areas who were not included have more difficult access to eye health services than those living in relatively secure areas, and therefore the results obtained here underestimate the true burden of visual impairment in the regions.

In both Segou and Sikasso, the equity tool indicates that the population studied is relatively wealthier than the national population. However, it is important to note that the national wealth threshold used by the equity tool is relatively old (data collected in 2015) (17). Therefore, the relative wealth observed may be due to the overall increase in asset ownership, and not the substantial wealth of the study population; as in 2015, neither region appeared to be particularly wealthy compared to the national average.

It is important to remember that the RAAB methodology allows only one cause (the most easily treatable) to be attributed to each eye or person. Comparisons between groups should be made with caution, as the results do not show the full distribution of causes of DV in the population studied. When a significant proportion of the population has an untreated cataract or refractive error, these causes are more likely to be listed as the main causes of DV independently of other co-morbidities.

Recommended actions

- Train community and primary health care workers in primary eye care (PEC) to improve access to patient-centred eye care services at the community level as a pathway to attaining universal health coverage.
- Organise refresher training for ophthalmologists and ophthalmic surgeons to improve the quality of cataract surgeries.
- Establish a system for monitoring cataract surgical outcomes at facility level with a plan to improve the quality of surgeries by providing the required training, equipment and consumables necessary for good outcomes.
- An integrated approach to eye health delivery is required in districts in the two regions to strengthen static eye care facilities at regional and district level.

- Develop a standardised glaucoma screening and management strategy. The recently developed glaucoma toolkit for the Africa region by the IAPB should provide guidance on the national glaucoma strategy focusing on a community-oriented approach to glaucoma management.
- Strengthen the monitoring and supervision mechanisms by the National Eye Health Programme to ensure the delivery of quality and inclusive eye health services.
- Implement the recommendations of the Quality System Assessment (QSAT) and the accessibility audits carried out in 2023 to improve the quality standards and accessibility of the infrastructure and services.
- Identify and engage with organisations of people with disabilities (OPDs) and other civil society organisations in planning, implementation and monitoring of eye health activities to improve access for women and people with disabilities.

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9 Appendices

Appendix A: Rapid assessment tool for avoidable blindness

RAPID ASSESSMENT FOR AVOIDABLE BLINDNESS

A. GENERAL INFORMATION — **Year - month:** 2 0 1 4 - ☐☐

Survey area: NORTHERN — **Cluster:** — **Individual no.:** ☐☐

Name: — **Sex:** Male: O (1) Female: O (2) — **Age (years):** ☐☐

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)
Cataract surg. complications:	O (4)	O (4)	O (4)
Pterygium:	O (5)	O (5)	O (5)
Corneal opacity:	O (6)	O (6)	O (6)
Phthisis:	O (7)	O (7)	O (7)
Myopic Degeneration:	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) All	O (12)
globe/CNS abnormalities:	O (13)	O (13) Not	O (13)
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 questionnaire

Preamble to the enhanced WGSS

The interviewer reads*:* **"**The following questions ask about any difficulties you might have doing certain activities because of a health problem."

VISION		
VIS_1	[Do you find it difficult to see, even when wearing [your] glasses?	1. No difficulty 2. Some difficulties 3. Many difficulties 4. Can't do it at all
AUDIENCE		
HEAR_1	Do you have difficulty hearing, [even when using one or more hearing aids]?	1. No difficulty 2. Some difficulties 3. Many difficulties 4. Can't do it at all
MOBILITY		
MOB_1	Do you have difficulty walking or climbing stairs?	1. No difficulty 2. Some difficulties 3. Many difficulties 4. Can't do it at all
COMMUNICATION		
COM_1	Using your usual language, are you having difficulty communicating, for example, understanding or being understood?	1. No difficulty 2. Some difficulties 3. Many difficulties 4. Can't do it at all
COGNITION		
COG_1	Do you have trouble remembering or concentrating?	1. No difficulty 2. Some difficulties 3. Many difficulties 4. Can't do it at all
TAKING CARE OF YOURSELF		
SC_SS	Do you find it difficult to take care of yourself, such as washing yourself or getting dressed?	1. No difficulty 2. Some difficulties 3. Many difficulties 4. Can't do it at all
UPPER BODY		
UB_1	Do you have difficulty lifting a 2-litre bottle of water or soft drink from eye level?	1. No difficulty 2. Some difficulties 3. Many difficulties 4. Can't do it at all
UB_2	Do you have difficulty using your hands and fingers, such as picking up small objects like a button or pencil, or opening or closing containers or bottles?	1. No difficulty 2. Some difficulties 3. Many difficulties 4. Can't do it at all
ILLNESS (ANXIETY AND DEPRESSION)	*Interviewer: If the respondent asks if he/she should answer about his/her emotional states after taking mood-regulating medication, say:* "Please answer according to the medication [you were taking/he/she was taking]".	

ANX_1	How often do you 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 felt worried, nervous or anxious, how would you describe the level of these feelings?	1. A little bit 2. Many 3. Moderately
DEP_1	How often do you feel depressed?	1. Daily 2. Weekly 3. Monthly 4. A few times a year 5. Never
DEP_2	Thinking about the last time you felt depressed, how depressed did you feel?	1. A little bit 2. Many 3. Moderately

Appendix C: Mali equity tool

	Question	Option 1	Option 2	Option 3
	Has your household...			
Q1	... electricity?	Yes	No	
Q2	...a television?	Yes	No	
Q3	...a bed	Yes	No	
Q4	...a fan	Yes	No	
Q5	...a cupboard	Yes	No	
Q6	... a CD/DVD player/VCR?	Yes	No	
Q7	... a fridge?	Yes	No	
Q8	...a chair	Yes	No	
Q9	... a motorbike or scooter?	Yes	No	
Q10	... In your home, do you have soap, washing powder or ash/sand/earth to wash your hands?	Yes	No	
Q11	... Does any member of this household have a bank account?	Yes	No	
Q12	... Where is your main source of drinking water?	Outside the plot, but less than 30 minutes round trip	Within the plot, OR more than 30 minutes round trip	
Q13	What is the main material used to build the exterior walls of your home?	Brick	Other	
Q14	What is the main material used for the roof of your home?	Cement	Banco plus wood	Other
Q15	What is the main flooring material in your home?	Earth/sand soil	Tiling	Other
Q16	In your household, what is the main fuel used for cooking?	Coal	Wood	Other
Q17	Does your household own.... Any pigs?	Yes	No	
Q18	Does your household own camels?	Yes	No	
Q19	Does your household own any guinea fowl/ducks/turkeys/geese?	Yes	No	

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