Rapid Assessment of Avoidable Blindness in Fatick and Kaolack Regions, Senegal

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Authors and contributors

Emma Jolley - Head of Portfolio, Health, and Disability Research, Sightsavers, UK

Dr Mouctar Dieng Badiane - Programme Manager, National Eye Health Programme, Ministry of Health and Social Action, Senegal

Dr Ibrahima AW - Programme Manager, Eye Health and NTDs, Sightsavers, Senegal

Salimata Bocoum - Country Director, Sightsavers, Senegal

Vladimir Pente - Research Advisor, Sightsavers, Cameroon

Dr Joseph Oye - Global Technical Advisor, Sightsavers, Cameroon

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

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

Other contributions

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Abbreviations

BCVA	Best Corrected Visual Acuity
CSC	Cataract Surgical Coverage
ECSC	Effective Cataract Surgical Coverage
eREC	Effective Refractive Error Coverage
IOL	Intraocular lens
IOV	Interobserver Variability
GPS	Global Positioning System
LMICs	Low Middle-Income Countries
MHSA	Ministry of Health and Social Action
EVI	Mild (Early) visual impairment
MVI	Moderate visual impairment
SVI	Severe visual impairment
NECHR	National Ethics Committee for Health Research
NSDA	National Statistics and Demography Agency
PVA	Presenting visual acuity
VA	Visual acuity
VI	Visual impairment
RAAB	Rapid Assessment of Avoidable Blindness
PS	Permanent Secretary
SET	Senegal Equity Tool
UNCRPD	United Nations Convention on the Rights of Persons with Disabilities
WHO	World Health Organisation
WGSS-ED	Washington Group Short Set – Enhanced Disability

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Executive 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 Organisation (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). Two RAABs conducted in Senegal in 2010 (in the regions of Fatick and Kaolack) found the prevalence of blindness among people in this age group to be 7.5% and 7.6% respectively. Since 2010, no new data has been produced to guide Senegalese decision-makers in developing a new eye-care action plan. Therefore, for this study, we estimated the prevalence and causes of blindness and VI among people aged 50 years and older in the same regions of Fatick and Kaolack.

RAAB is a descriptive, cross-sectional, population-based study. In this instance, the sample size for each region was 2,000 participants, and two-stage sampling was used. For the first stage, 40 primary sampling units (villages) were selected from a complete list using probability proportionate to size methodology. At the second stage, within each primary units, households were selected based on the random walking method. In each village, 50 eligible participants were selected to participate in the study. The data was collected using a questionnaire made up of three tools: the RAAB tool for visual examination, the disability assessment tool, and the equity tool to assess economic status. An ethical clearance N 00000044 MHSA/NECHR/PS was issued prior to the study.

Key findings

Prevalence of blindness

The prevalence of blindness among people aged 50 years and over was 5.2% [3.9-6.4] in Fatick and 3.6% [2.8-5.0] in Kaolack. The prevalence of severe visual impairment (SVI) was 3.4% in Fatick and 3% in Kaolack. Moderate visual impairment (MVI) was 13.5% in Fatick and 10.9% in Kaolack, and mild (early) visual impairment (EVI) was 9.5% in Fatick and 7.9% in Kaolack. We observed no difference between men and women in the overall prevalence of visual impairment.

The prevalence of visual impairments in general has remained stable among people aged 50 years and over, and equally between men and women in the Fatick region, while in Kaolack we observed a significant drop in the prevalence of blindness and SVI among people aged 50 and over. However, the absolute number of people living with a VI has not changed significantly in the past ten years, due to the increasing number of older people in the population.

Prevalence of disability

Overall, the prevalence of disability was 12.1% in Fatick and 9% in Kaolack. The results indicate that people with disabilities, including people with non-visual disabilities, were more likely to have

visual impairment, particularly severe forms such as blindness. The distribution of VI among the five socio-economic quintiles within the population was similar.

Cataract surgical rate

Overall, the cataract surgical coverage was high in both regions: 64.8% in Fatick and 74.1% in Kaolack.

Principal cause of visual impairment

Across both regions, cataract is the most frequent cause of VI among blind people and is also the main cause in people with SVI and MVI. The most common reasons for not having undergone surgery in both Fatick and Kaolack were not knowing that treatment was possible (29.3% and 35.1% respectively), followed by the inability to afford the operation (25.9% and 25.7%).

Introduction

In 2020, over 1.1 billion people globally were estimated to be visually impaired. Among them, 43 million people aged 50 years and over were blind, and 295 million were moderately to severely visually impaired (1). Globally, the prevalence of age-standardised blindness decreased from 0.85% in 1990 to 0.60% in 2019; however, the total number of blind people increased by 42.8% from 34.4 million in 1990 to 43 million in 2020. This will increase further over the next thirty years by 55% to 61 million people, largely due to population growth and ageing (1, 2). About 90% of visual impairment (VI) is found in low- and middle-income countries (LMICs) and about 90% of it is preventable or treatable (2). The leading cause of blindness is cataract with about 15.2 million cases, followed by glaucoma (3.6 million), uncorrected refractive defects (2.3 million), age-related macular degeneration (1.8 million), and diabetic retinopathy (0.9 million) (1).

In terms of regional differences, it is estimated that the prevalence of distance VI in LMICs is four times greater than in high-income countries (3). The prevalence of unaddressed near-VI is estimated to be above 80% in western, eastern, and central Africa, while the comparable prevalence in high-income countries is less than 10% (3).

Population growth and ageing are expected to increase the absolute numbers of people living with visual impairment. To reduce the burden of VI, the World Health Organisation (WHO) advocates an approach centred on strengthening quality, comprehensive eye-care services, including at community level through integrated patient-centred eye care embedded in the general health system (4). This approach is based on the principles of the Vision 2020 initiative, the Right to Sight, which was superseded by the World Report on Vision, and the commitment of member states to reduce the burden of avoidable VI and achieve a better quality of life for all citizens (4, 5).

In 2021, the 74th World Health Assembly agreed ambitious new targets for eye health, and countries must now seek to establish baseline figures for the two indicators, and revise or develop national eye-health plans in order to achieve them by 2030 (6). The two indicators - effective cataract surgical coverage (eCSC) and effective refractive error coverage (eREC) - are designed to act as proxy indicators that would contribute to universal health coverage, and to encourage countries to improve coverage of services while maintaining quality levels. Countries are expected to achieve a 30% increase in eCSC by 2030 and a 40% increase in eREC, although many do not currently have established baseline figures against which to measure progress.

The lack of country-specific epidemiological data is a major constraint on the development of these national health plans and policies in LMICs. To address this issue, the WHO recommends the scale-up of Rapid Assessment of Avoidable Blindness (RAAB) studies to provide data for planning blindness and VI prevention programmes. RAAB is a standard methodology for obtaining reliable data on the prevalence of VI in people at highest risk (aged 50 years and over) (5) and more than 300 RAABs have been conducted worldwide, including over 50 in sub-Saharan Africa (7).

Visual impairment and access to eye-health services in Senegal

Two RAABs conducted in Senegal in 2010 in the Fatick and Kaolack regions found the prevalence of blindness among people aged 50 years and older to be 7.5% and 7.6% respectively (7). Women were more likely to be bilaterally blind than men in both regions (see Table 1).

Table 1: Prevalence of visual impairment in Fatick and Kaolack regions (RAAB, 2010) (6)

	Fatick*	Kaolack*
	Sample size = 2,600	Sample size = 2,900
Adjusted prevalence of bilateral blindness (in the 50+) VA<1/20	7.6%	7.5%
Adjusted prevalence of low vision in the 50+ VA<6/60-3/60	3.1%	3.9%
Prevalence of blindness for all ages	0.9%	0.9%

RAAB data also showed that unoperated cataract was the leading cause of blindness in both regions. In Fatick, unoperated cataract was responsible for 54.7% of blindness, followed by trachoma (9.4%) and glaucoma (7.3%) (7). In Kaolack, cataract (56.8%) and glaucoma (11.3%) were the main causes of blindness (see Table 2).

Table 2: Major causes of blindness in Fatick and Kaolack regions (RAAB, 2010) (6)

Causes (%)	Fatick Sample size = 2,600	Kaolack Sample size = 2,900
Refractive error	1.0	4.7
Unoperated cataract	54.7	56.8
Uncorrected aphakia	3.6	2.8
Total treatable	**59.4**	**64.3**
Surgical complications	4.2	3.8
Trachoma	9.4	2.8
Phthisis	5.7	7.5
Other corneal scars	6.8	3.8
Onchocerciasis	0.0	0.0
Total treatable or avoidable	**85.4**	**82.2**
Glaucoma	7.3	11.3
Diabetic retinopathy	0.0	0.0
Potentially avoidable*	**7.3**	**11.3**
Global anomaly	0.0	0.0
DMLA	0.0	0.9
Other post. segment / central nervous system	7.3	5.6

Access to eye-care services is not always equitable and certain groups of people have been identified as vulnerable to exclusion; for example, women, people living in poverty and people with disabilities (8). In order to effectively plan services including human and financial resources, infrastructure, and equipment, it is important to understand how VI and access to services differs

between groups. In Kaolack, the cataract surgical coverage in 2010 was lower in women (56.6%) than in men (72%) at visual acuity (VA)<3/60 (7).

In addition to visual impairment, people aged 50 and over are more likely to also experience other types of disability (9). Although the 2010 RAAB did not measure disability, the general population census carried out in Senegal in 2013 reported a prevalence of disability of 5.9% (7). A recent study using the Washington Group Short Set of questions to assess disability reported a prevalence of 11.7% (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” (10). It is widely acknowledged that those with disabilities are also further marginalised due to low socio-economic status. Evidence suggests that people with disabilities are often less likely to access the health services they need (11-13) and 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 everyone benefits.

Objective of the study

The last RAAB in Senegal was conducted in 2010 (7) followed by an Eye Health Systems Assessment (EHSA) in 2018 (14). A need was identified for up-to-date, accurate population-based prevalence data for planning and monitoring purposes, including a specific focus on marginalised groups. This study sought to estimate the prevalence and causes of blindness and visual impairment among people aged 50 years and over in the regions of Fatick and Kaolack in Senegal in 2022.

The goal of this study was to provide the up-to-date data needed for the planning of an eye-health programme to the Ministry of Health and its partners in order to improve the eye health of populations in Senegal.

Specific objectives

1. To determine the prevalence and distribution of blindness and VI in the study population.
2. To determine the primary causes of blindness and VI.
3. To assess the access to quality cataract surgical services by determining cataract surgical coverage and visual outcomes from cataract surgery.
4. To identify the barriers to uptake of cataract services.
5. To identify the prevalence of disability among the study population.
6. To explore the relationship between disability and socio-economic status and eye health.

Methods

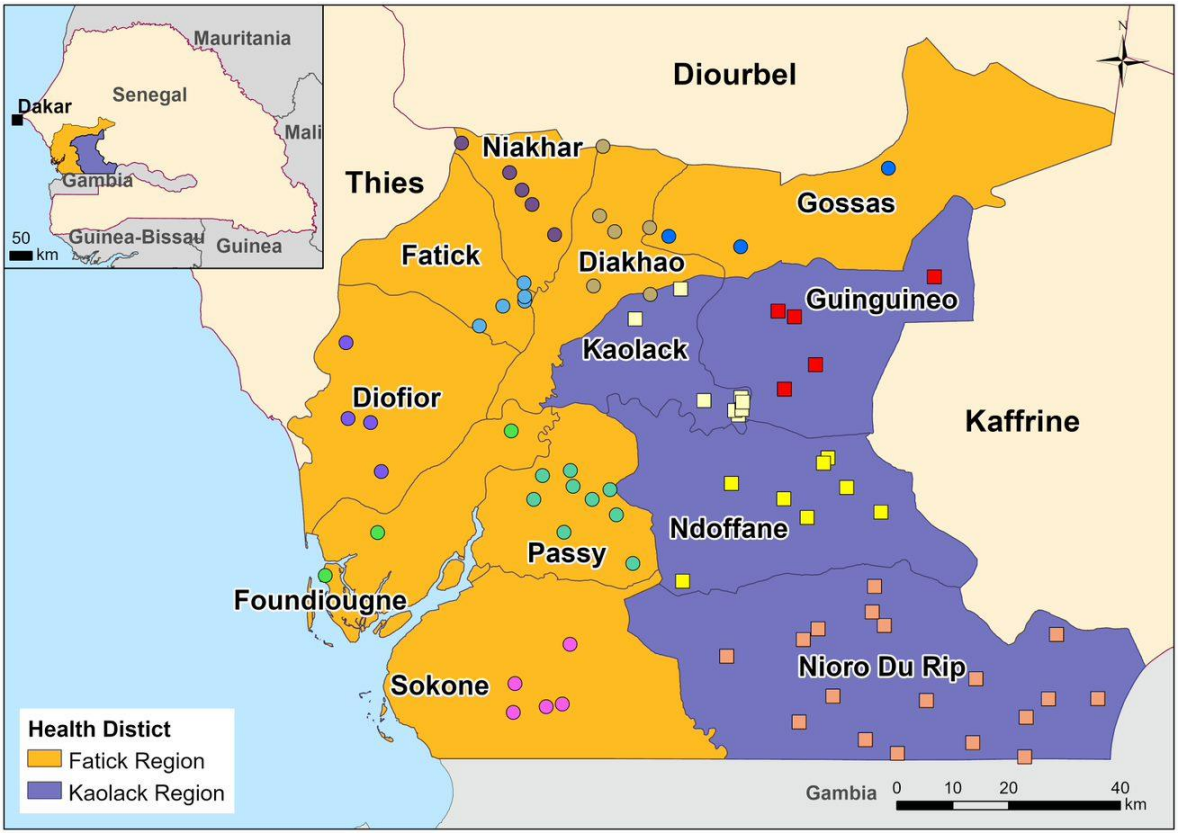
Study design and location

A RAAB is a descriptive, cross-sectional population-based study. Effectively, we conducted two RAABs in two regions of Senegal: Fatick and Kaolack.

Fatick covers an area of 7,935 km^2, which comprises 4.4% of Senegal's national land mass. It is bordered by the regions of Diourbel and Louga to the north and north-east, the region of Thiès to the north-west, the region of Kaolack to the east, the Gambia to the south and the Atlantic Ocean to the west. The population was estimated in 2022 at 1,000,675 inhabitants (15).

Kaolack covers an area of 5,127km^2, which comprises 2.84% of the national land mass. It is bordered by the region of Fatick to the north (department of Gossas) and west (departments of Foundiougne and Fatick), the new region of Kaffrine to the east, and the Gambia to the south. The estimated population in 2022 was 1,306,304 inhabitants. (15).

Figure 1: Map showing data collection locations in the Fatick and Kaolack regions



Study population

The study population was people aged 50 years and over who live in the Fatick and Kaolack regions of Senegal. RAAB includes only this age group, as it is where the prevalence of blindness is highest.

Inclusion criteria

- Each participant must be aged 50 or over.
- Each participant must have consented to participate.
- Each participant must be ordinarily resident in their stated household for at least six months prior to the survey.

Exclusion criteria

- People aged under 50 years.
- Visitors to the household who have resided there less than six months.
- Those who don't consent to participate.
- Anyone who is acutely ill or unable to answer the questions.

Sample size and sampling strategy

The sample size was calculated using the RAAB (version 6) software package, using the information in Table 3 to calculate the sample size.

Table 3: Parameters used to calculate the sample size

Items	Kaolack	Fatick
Total population in 2021 (NSDA projection)	1,306,304	1,000,675
Prevalence of blindness (Senegal RAAB, 2010)	7.5%	7.6%
Expected prevalence of blindness (+/- 20%)	6%	6.1%
Confidence intervals	95%	95%
Non-response rate	10%	10%
Design effect	1.5%	1.5%

Based on the above parameters, the sample size for the Kaolack region was 1,972 individuals or 40 clusters of 50 people aged 50 and above with a total of 2,000 participants. For the Fatick region, the sample size was 1,996 individuals with 40 clusters of 50 people aged 50 and above and a total sample of 2,000 participants.

Two-stage sampling was used. For the first stage, 40 primary sampling units (villages) were selected from a complete list using probability proportionate to size methodology. A list of all villages in Fatick and Kaolack and their populations was obtained and verified from the National Statistics and Demography Agency (NSDA). The complete list of all villages was uploaded to the RAAB software, which has an inbuilt probability proportionate to size selection tool. At the second stage, within each primary units, households were selected based on the random walking method.

In each village, 50 eligible participants were selected to participate in the study. A field guide was identified in each village, who worked closely with the chiefs of each village to identify its different boundaries. In each team, a cluster informant was responsible for developing a map based on the

information provided by the field guide and the chief. If the village population was large (i.e., exceeding 500 inhabitants) a map was developed with the village leader to divide it into smaller segments. In this case, a segment was chosen through first numbering segments, then choosing a number at random.

Once the village/segment boundaries were clear, the cluster informer relayed this information to 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 chief, accompanied by the field guide. The study team started at the house in the segment, which was closest to the main road, and confirmed with the head of each household the number of eligible respondents living there. In addition to providing comprehensive information about the study and the purpose of the visit, the research team informed eligible participants of their rights to refuse or withdraw from the study, as well as the potential benefits of participation. Written consent was obtained from each participant. In the event that a participant was unable to sign, their thumbprint was obtained and attested by an independent person who was not part of the research team.

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

Data collection

Each RAAB participant completed the following steps: visual examination (Appendix A), questions about disability (Appendix B) and questions on economic status (Appendix C). All data was collected using an app on a touchscreen smartphone. The precise location of each village (not individual households) was recorded using Global Positioning System (GPS) coordinates so that only cluster-level data (not individual level) could be mapped visually and analysed geo-spatially.

Visual examination

All participants underwent an ophthalmic examination by an ophthalmologist (see list in Appendix A). Following the standard RAAB protocol, the following steps were implemented:

1. Presenting visual acuity measurement of each eye (all participants) was measured.
2. Pinhole visual acuity assessment of each eye presenting <5/10 was measured.
3. The lens of each eye was examined with a torch in a darkened room (all participants).
4. Examined the posterior-segment of each eye presenting <5/10 with a direct ophthalmoscope where the principal cause could not be attributed to refractive error, cataract, or corneal scarring.
5. Assessed the major cause of VI of each eye presenting <5/10 and in persons where both eyes presented <5/10 and the causes were not the same.
6. Asked questions regarding cataract surgery and where it has taken place.
7. Asked questions regarding why cataract surgery has not taken place, where it is indicated. (See the data collection tool in Appendix A).

Minor eye conditions identified by the team (such as conjunctivitis) were treated, and other conditions (active trachoma, trachomatous trichiasis, trauma) were treated and referred. Conditions such as a painful red eye with decreased vision, vasculopathies, cataracts and retinal detachment were immediately referred to the health centre or hospital in the area.

Presenting vision was tested first, with the participant wearing their usual correction (if they had any) to measure presenting visual acuity (PVA). Eyes with presenting vision worse than 5/10 (6/12) were tested again using a pinhole occluder to measure best corrected visual acuity (BCVA).

Table 4: The International Classification of Diseases 11 edition (2018) classifying distance vision impairment

Visual acuity measurement	WHO classification
Can see 5/10 (6/12)	Normal vision
Cannot see 5/10 (6/12) but can see 3/10 (6/18)	Mild (early) visual impairment (EVI)
Cannot see 3/10 (6/18) but can see 1/10 (6/60)	Moderate visual impairment (MVI)
Cannot see 1/10 (6/60) but can see 1/20 (3/60)	Severe visual impairment (SVI)
Cannot see 1/20 (3/60) but can see 1 metre	Blind
Light perception (LP+)	Blind
No light perception (LP-)	Blind

Disability survey 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 (WGSS-ED) tool which comprises 12 questions related to an individual's self-perceived difficulties in functioning in certain areas of 'domains', and which has been used successfully in other RAABs (16). Response options include four categories, allowing respondents to position themselves along a scale of functioning, and thus allowing for nuanced analysis of severity of impairment as well as type. Although several approaches to analysis are possible, in this report a binary measure of disability was determined if an individual reported at least a lot of difficulty in at least one functional domain.

The study tool is included in Appendix B.

Senegal Equity Tool

The Senegal Equity Tool (SET) is an internationally recognised, easy-to-use tool designed to measure relative wealth by evaluating 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), while those who are the wealthiest are in the top quintile (quintile 5). In a short survey, this tool can allow us to

compare the wealth of respondents to the national population or populations in other countries. The current SET was released in December 2015 and is based on DHS 2013 data (17).

The study tool is included in Appendix C.

Data collection and management

The data was stored in smartphones and synchronised at the end of each day with the Cloud server, which was accessible only to members of the research team responsible for data management and analysis. The application itself has built-in controls to minimise errors and ensure data quality. In addition, the quality of the submitted data was checked regularly by the data manager, and errors or inconsistencies were reported to the field teams in order to ensure and guarantee the quality of the data.

Training of data collectors and interobserver variation measurement

The training of the field team, which took place over five days, was carried out by a RAAB-certified trainer, and comprised four days of theoretical training and one day of practice in the field. The fourth day of training was reserved for the interobserver variability (IOV) test in order to obtain a uniform measurement of IOV within the different teams. IOV was assessed for vision, lens assessment and causes of visual impairment to ensure that examiners had at least 60% agreement.

Study teams

Five teams were formed to collect the data, with each including an ophthalmologist to act as team leader, an ophthalmic nurse, a cluster informant, a driver, and a guide (one for each village).

Data management and analysis

Study tools were programmed into CommCare software and deployed as an app on Android-based smartphones (18). Data was downloaded in .csv format and uploaded in Stata v15 software for analysis (19).

Results were tabulated, calculating sample prevalence estimates for each outcome 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 (20) for mapping and spatial analyses to understand geographic patterns around the prevalence of visual impairment.

This version of the report has been updated to use the definitions of cataract surgical coverage and effective cataract surgical coverage published in late 2022 (21).

Ethical considerations

The protocol was submitted to the National Ethics Committee for Health Research (NECHR) of the Ministry of Health and Social Action (MHSA) of Senegal. An ethical clearance N 00000044 MHSA/NECHR/PS was issued prior to the study.

COVID-19 prevention and protection measures

During this study, we carried out a COVID-19 awareness campaign which started during the training of data collectors. The following WHO standard COVID-19 prevention measures for community-based interventions (22) were adapted to the study.

- **Distancing and ventilation:** Data collection took place outdoors in well-ventilated spaces, while respecting a safe distance of at least one metre if possible. Each participant was seated in their own chair, and no materials were shared or exchanged between members of the research team and participants.
- **Hand hygiene:** Hands were cleaned before touching a participant, before aseptic procedures, after exposure/contact with bodily fluids and after touching a participant.
- **Use of gloves:** Gloves were made available to each team and were used in case of direct contact with blood or other bodily fluids, including secretions or excretions, mucous membranes, or broken skin. One pair of gloves was used for each respondent.
- **Equipment and surfaces:** These were cleaned with soap and water or detergent, followed by disinfectant.
- **Medical masks:** Wearing a mask was mandatory throughout data collection. A mask was also offered to each participant by the research team.

Results: Fatick

Demographic characteristics of participants

1,784 participants aged 50 years and over were examined, representing a response rate of 89.2%. 1,102 or 61.8% of the respondents were female (see Table 5).

Table 5: Examination status of participants by sex in Fatick region

	Examined	Not available	Refused	Unable to communicate	Total
Male	682	42	46	9	779
	87.5%	5.4%	5.9%	1.2%	100%
Female	1,102	51	32	36	1,221
	90.3%	4.2%	2.6%	2.9%	100%
Total	1,784	93	78	45	2,000
	89.2%	4.7%	3.9%	2.3%	100

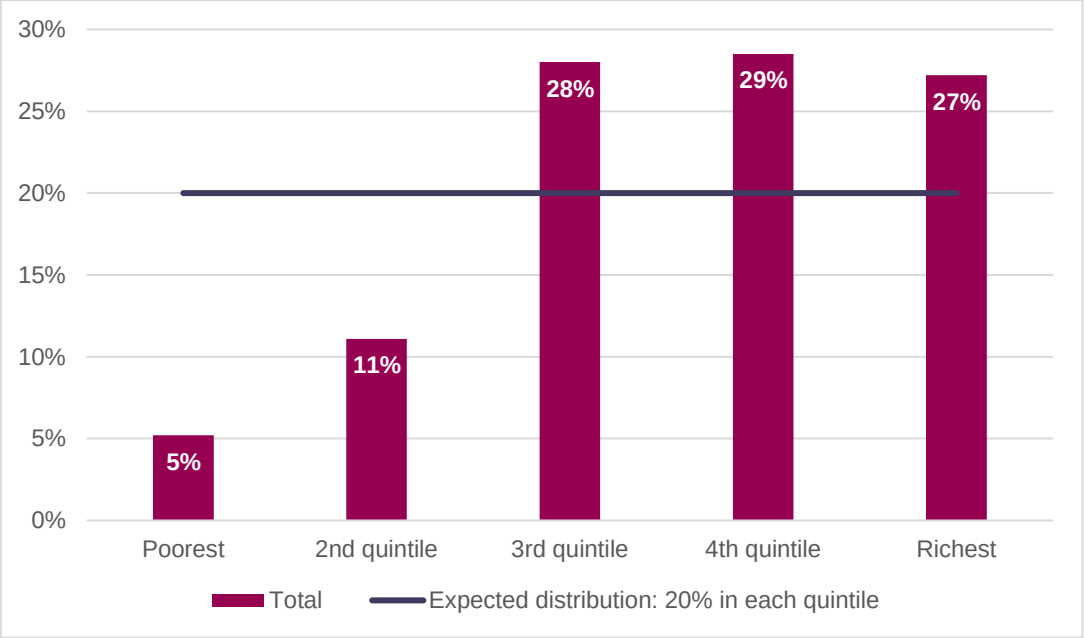
Table 6 presents the sex and age distribution of the participants examined. The majority of those examined (n=708; 39.7%) were aged between 50 and 59 years. Compared to data from the National Statistics and Demography Agency, older people and females were over-represented among the sampled population. This means the sample results may overestimate 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 6: Participants examined by sex and age group in Fatick region, compared to the total population of the region (2022 projection)

	Survey participants			Region population (2022 projection)		
	Male	Female	Total	Male	Female	Total
50-59	227	481	708	20,454	25,024	45,478
	33.3%	43.7%	39.7%	46.0%	46.5%	46.3%
60-69	223	287	510	14,139	16,197	30,337
	32.7%	26.0%	28.6%	31.8%	30.1%	30.9%
70-79	148	233	381	6,674	8,256	14,930
	21.7%	21.1%	21.4%	15.0%	15.3%	15.2%
80+	84	101	185	3,226	4,327	7,553
	12.3%	9.2%	10.4%	7.3%	8.0%	7.7%
Total	**682**	**1,102**	**1,784**	**44,493**	**53,805**	**98,298**

Compared to the national population, the study population appears to be relatively wealthier, with 56% of participants belonging to the two richest quintiles and 16% belonging to the two poorest quintiles (see Figure 2).

Figure 2: Household wealth of participants examined in Fatick region



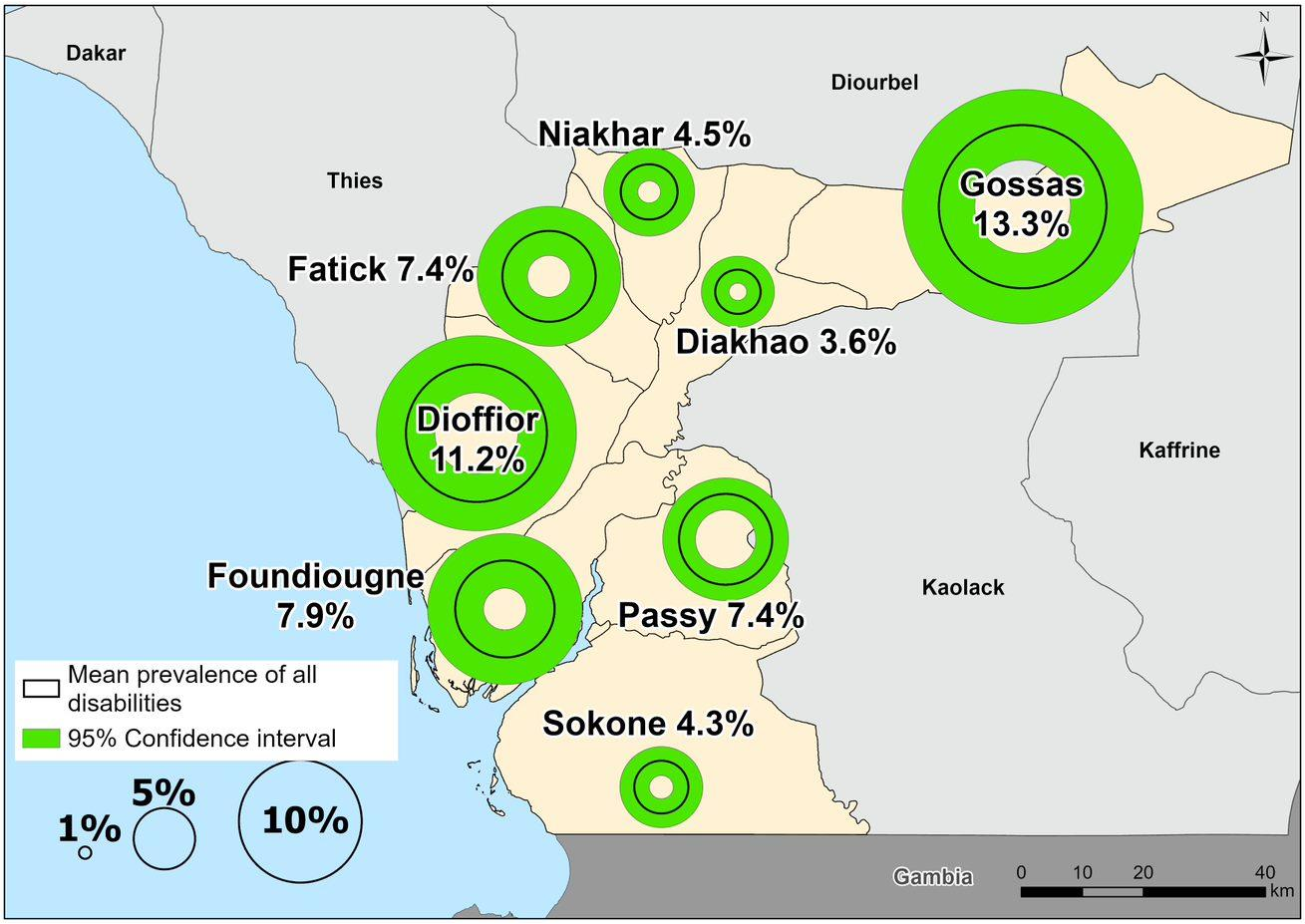
The prevalence of disability in Fatick was 12.1% and was slightly higher among males (12.6%) than females (11.7%). The prevalence of disability excluding visual difficulties was 6.8% (see Table 7).

Table 7: Prevalence of disability: all domains and disabilities excluding visual difficulties by sex in Fatick region

	Male	Female	Total
Disability: all domains	86	129	215
	12.6% [10.3-15.3]	11.7% [9,9-13,7]	12.1% [10.6-13.6]
Disability: excluding vision domain	51	71	122
	7.5% [5.7-9.7]	6.4% [5.1-8.1]	6.8% [5.8-8.1]

Figure 3 presents the distribution of the average prevalence of disability by district in the Fatick region. The prevalence of disability ranged from 4.3% in Sokone district to 13.3% in Gossas district.

Figure 3: Average prevalence of disability (all domains) by district in Fatick region



Prevalence of blindness and visual impairment

Of the 1,784 participants examined, 92 (5.2%) had presenting vision meaning they were bilaterally blind. Using the pinhole device to obtain best-corrected VA, this improved to 76 participants (4.3%). SVI was observed in 61 participants (3.4%), MVI in 240 participants (13.5%) and EVI in 170 participants (9.5%) (see Table 8).

Table 8: Prevalence of presenting visual impairment (unless otherwise stated) among the sample in Fatick region, by sex

	Male	Female	Total
Blindness: best corrected vision			
	32	44	76
	4.7% [3.3-6.6]	4.0% [3.0-5.3]	4.3% [3.4-5.3]
Blindness: presenting vision			
	39	53	92
	5.7% [3.6-7.8]	4.8% [3.5-6.1]	5.2% [3.9-6.4]
SVI			
	25	36	61
	3.7% [2.4-5.0]	3.3% [2.3-4.2]	3.4% [2.7-4.1]
MVI			
	91	149	240

	13.3% [10.2-16.5]	13.5% [11.0-16.0]	13.5% [11.1-15.8]
EVI			
	59	111	170
	8.7% [6.2-11.1]	10.1% [8.6-11.6]	9.5% [8.2-10.9]

Adjusting for the 2022 age and sex structure of the population, the prevalence of blindness in this region is estimated to be 4.4% (95%CI 3.1%-5.6%) (see Table 9). Extrapolating this to the 2022 population, it is estimated that there are 4,277 blind people aged 50 and above in Fatick. In total, it is estimated that 10% of the eyes of those aged 50 and above are blind, which in 2022 suggests a total of 19,682 eyes.

Adjusting for the 2022 age and sex structure of the population, we estimate that SVI affects around 2,694 people (2.7%) and 7,384 eyes. Adjusting for age and sex, we estimate that MVI affects 11,381 people (1.6%) and 22,580 eyes. Age- and sex-adjusted EVI affects 8,428 people (8.6%) and 16,927 eyes.

Table 9: Estimated magnitude of presenting VI in people aged 50 years and above in Fatick region, adjusted for age and sex

	Male	Female	Total
Blindness			
Bilateral cases	1,973	2,304	4,277
	4.4% [2.4-6.5]	4.3% [3.0-5.6]	4.4% [3.1-5.6]
All eyes	9,638	10,044	19,682
	10.8% [8.5-13.2]	9.3% [7.6-11.0]	10.0% [8.5-11.5]
SVI			
Bilateral cases	1,157	1,537	2,694
	2.6% [1.3-3.9]	2.9% [1.9-3.8]	2.7% [2.0-3.5]
All eyes	3,369	4,015	7,384
	3.8% [2.3-5.3]	3.7% [2.8-4.6]	3.8% [2.9-4.6]
MVI			
Bilateral cases	4,618	6,763	11,381
	10.4% [7.2-13.5]	12.6% [10.0-15.1]	11.6% [9.2-13.9]
All eyes	9,124	13,456	22,580
	10.3% [7.7-12.8]	12.5% [10.3-14.7]	11.5% [9.5-13.4]
EVI			
Bilateral cases	3,337	5,091	8,428
	7.5% [5.0-10.0]	9.5% [8.0-11.0]	8.6% [7.2-9.9]
All eyes	6,823	10,104	16,927
	7.7% [5.8-9.6]	9.4% [7.8-10.9]	8.6% [7.4-9.8]

Figure 4 shows the average prevalence of bilateral blindness from all causes by district in Fatick region. The average prevalence of bilateral blindness from all causes ranged from 1.1% in Diofior district to 7.1% in Sokone district.

Figure 4: Average prevalence in the sample of all-cause blindness in the Fatick region by health district

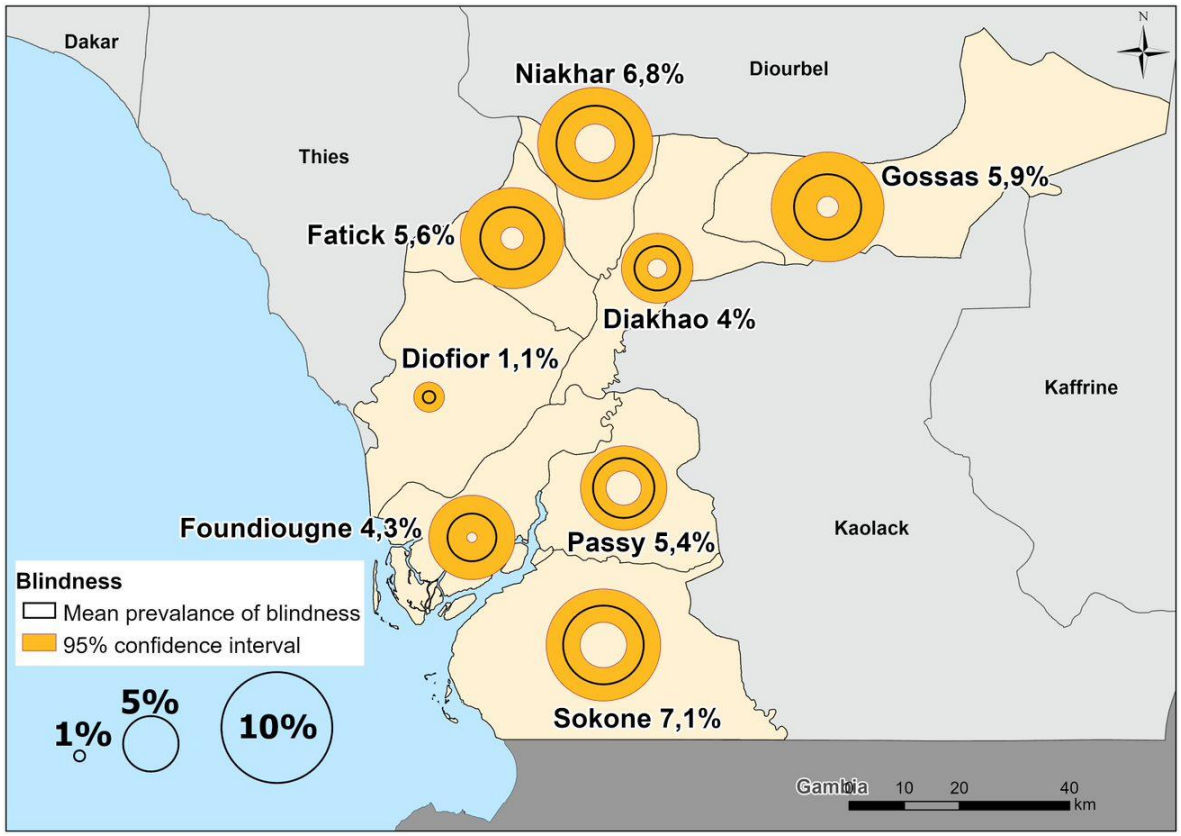
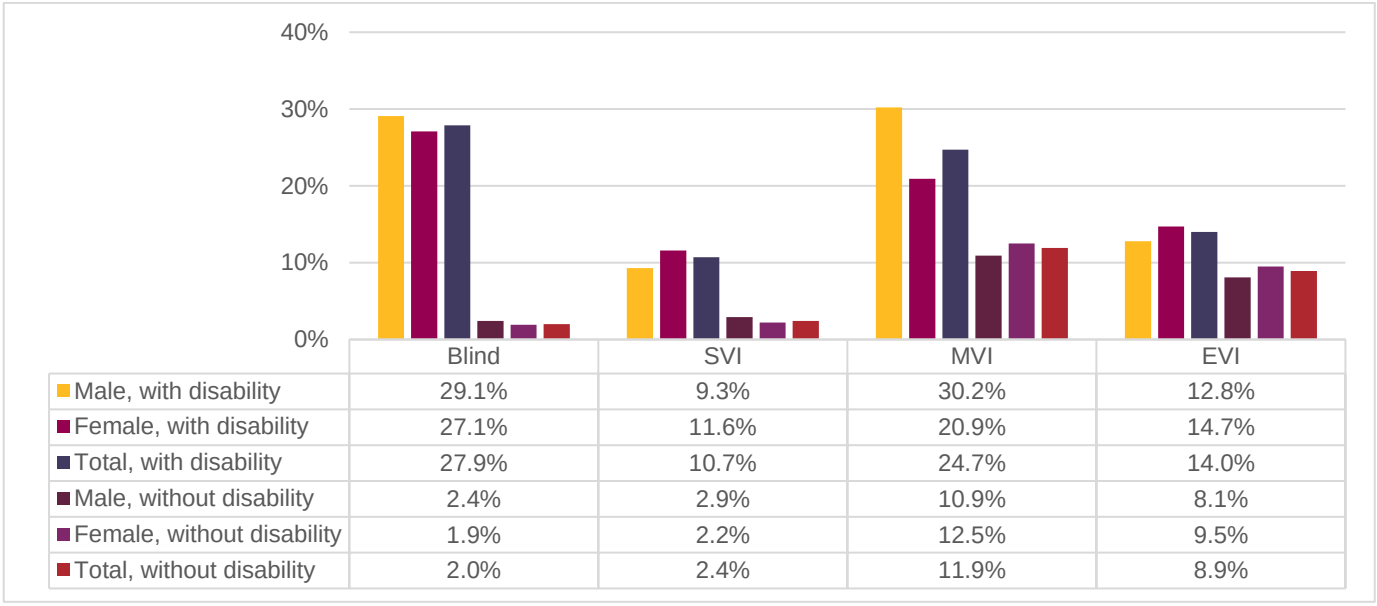


Figure 5 shows how the age- and sex-adjusted prevalence of VI differs by disability and sex. Men and women with disabilities were more likely to be visually impaired than individuals without disabilities. These differences were more striking for more severe levels of visual impairment, particularly blindness. For example, 29.1% of men with disabilities were blind compared to 2.4% of men without disabilities.

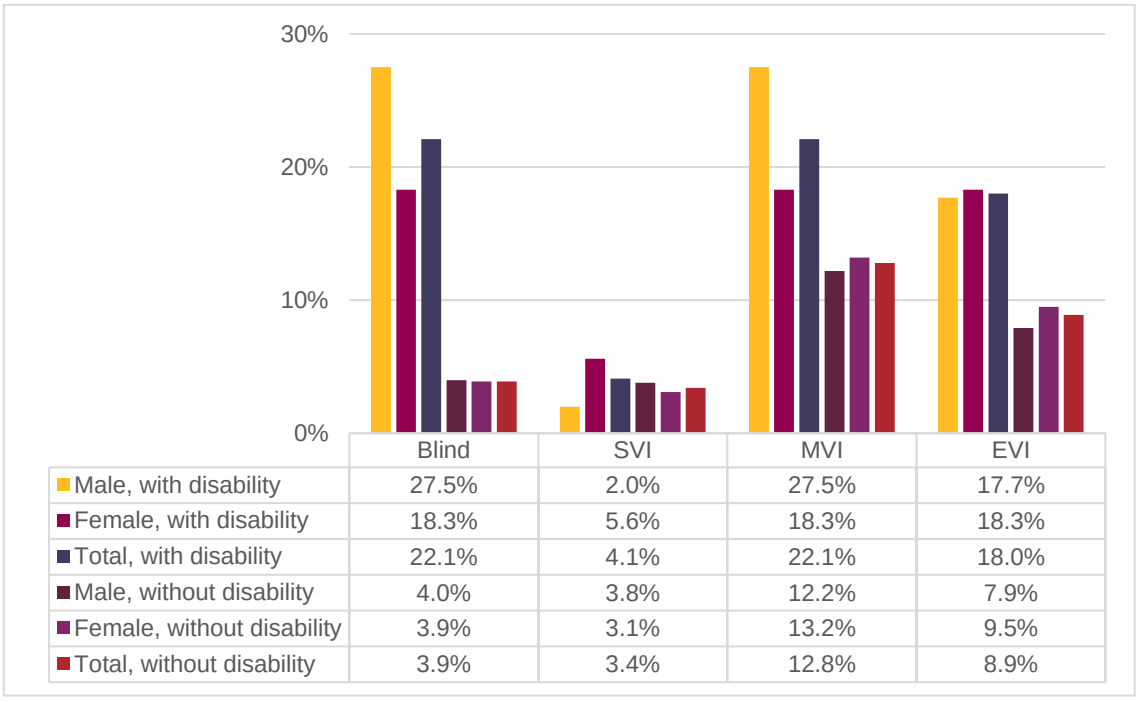
Figure 5: Prevalence of visual impairment, by disability, in all domains in Fatick region adjusted for age and sex



	Blind	SVI	MVI	EVI
Male, with disability	29.1%	9.3%	30.2%	12.8%
Female, with disability	27.1%	11.6%	20.9%	14.7%
Total, with disability	27.9%	10.7%	24.7%	14.0%
Male, without disability	2.4%	2.9%	10.9%	8.1%
Female, without disability	1.9%	2.2%	12.5%	9.5%
Total, without disability	2.0%	2.4%	11.9%	8.9%

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 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: 27.5% of men with a disability (excluding “difficulty in seeing”) were blind, as opposed to 4% of men without disabilities.

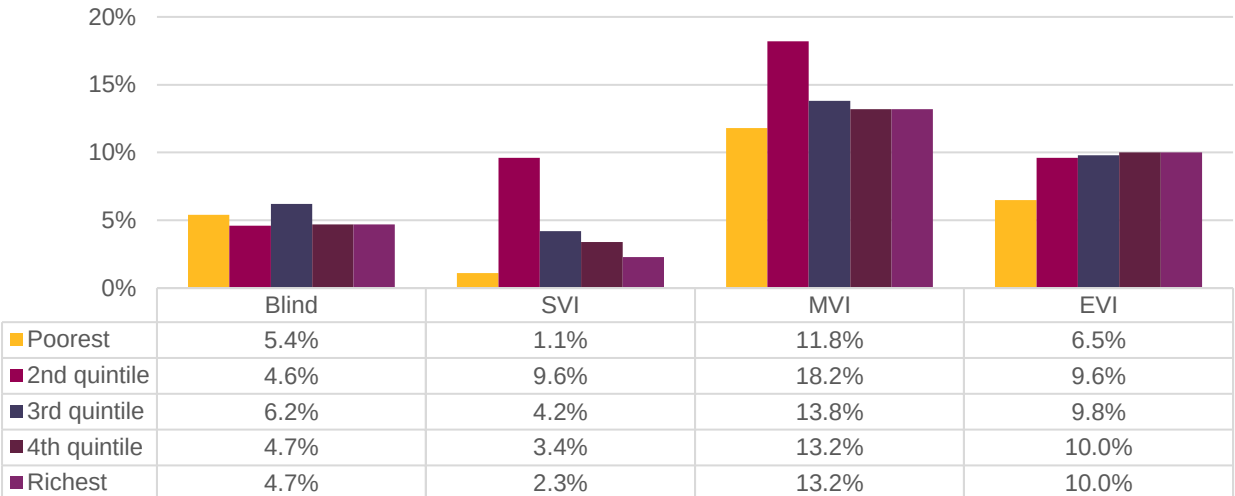
Figure 6: Prevalence of visual impairment by disability (excluding vision domain) in Fatick region, adjusted by age and sex



	Blind	SVI	MVI	EVI
Male, with disability	27.5%	2.0%	27.5%	17.7%
Female, with disability	18.3%	5.6%	18.3%	18.3%
Total, with disability	22.1%	4.1%	22.1%	18.0%
Male, without disability	4.0%	3.8%	12.2%	7.9%
Female, without disability	3.9%	3.1%	13.2%	9.5%
Total, without disability	3.9%	3.4%	12.8%	8.9%

Figure 7 shows the relationship between VI and relative wealth. The results show that the distribution of blindness was very similar across the five wealth quintiles, at around 5%. Prevalence of SVI and MVI was slightly higher among individuals in the second poorest quintile, while prevalence of EVI was slightly lower among individuals in the poorest quintile.

Figure 7: Prevalence of visual impairment by wealth quintile in Fatick region adjusted for age and sex



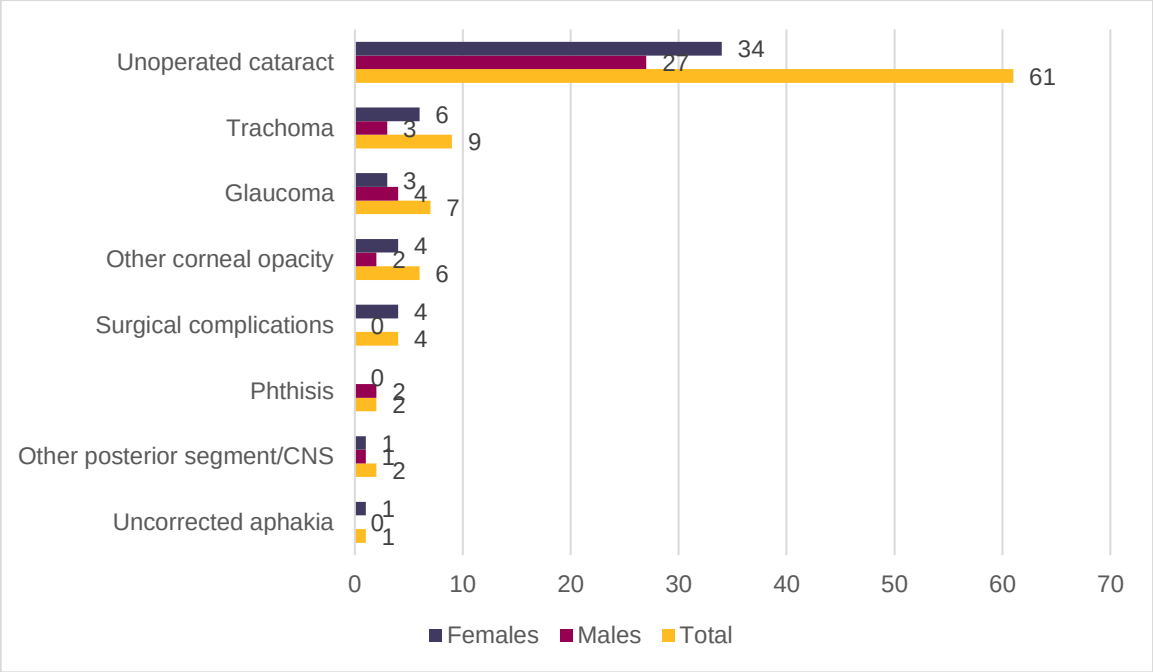
	Blind	SVI	MVI	EVI
Poorest	5.4%	1.1%	11.8%	6.5%
2nd quintile	4.6%	9.6%	18.2%	9.6%
3rd quintile	6.2%	4.2%	13.8%	9.8%
4th quintile	4.7%	3.4%	13.2%	10.0%
Richest	4.7%	2.3%	13.2%	10.0%

Causes of visual impairment

The main cause of blindness was unoperated cataract (N=61 cases; 66.3%), followed by trachoma (N=9 cases; 9.8%) and glaucoma (N=7 cases; 7.6%) (see Figure 8).

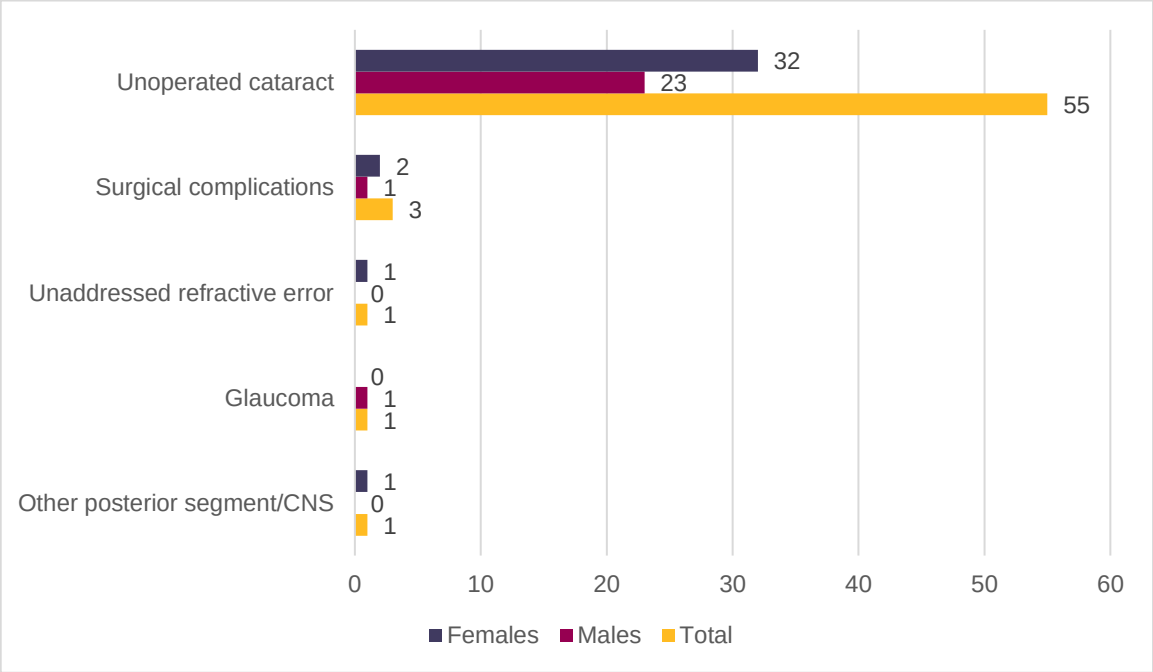
It is important to remember that RAAB methodology only allows a single cause (the most easily treatable) to be assigned to each eye or person. Comparisons between groups should be made with caution, as the results do not show the full distribution of causes of VI in the study population. When a significant proportion of the population has unoperated cataract or unaddressed refractive error, these causes are most likely to be listed as leading causes of VI independent of other comorbidities.

Figure 8: Main causes of blindness among males and females examined in Fatick region



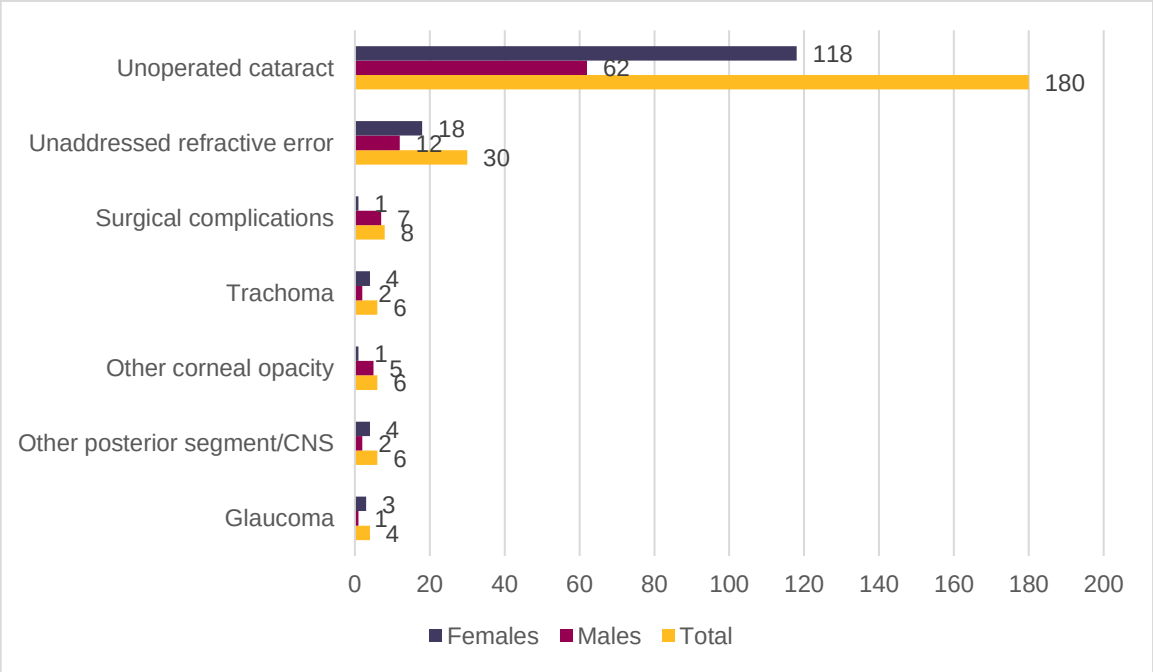
Unoperated cataract was also the main cause of severe VI (55 cases; 90.2%), followed by complications from surgery (three cases; 4.9%) (see Figure 9).

Figure 9: Main causes of severe visual impairment among males and females examined in Fatick region



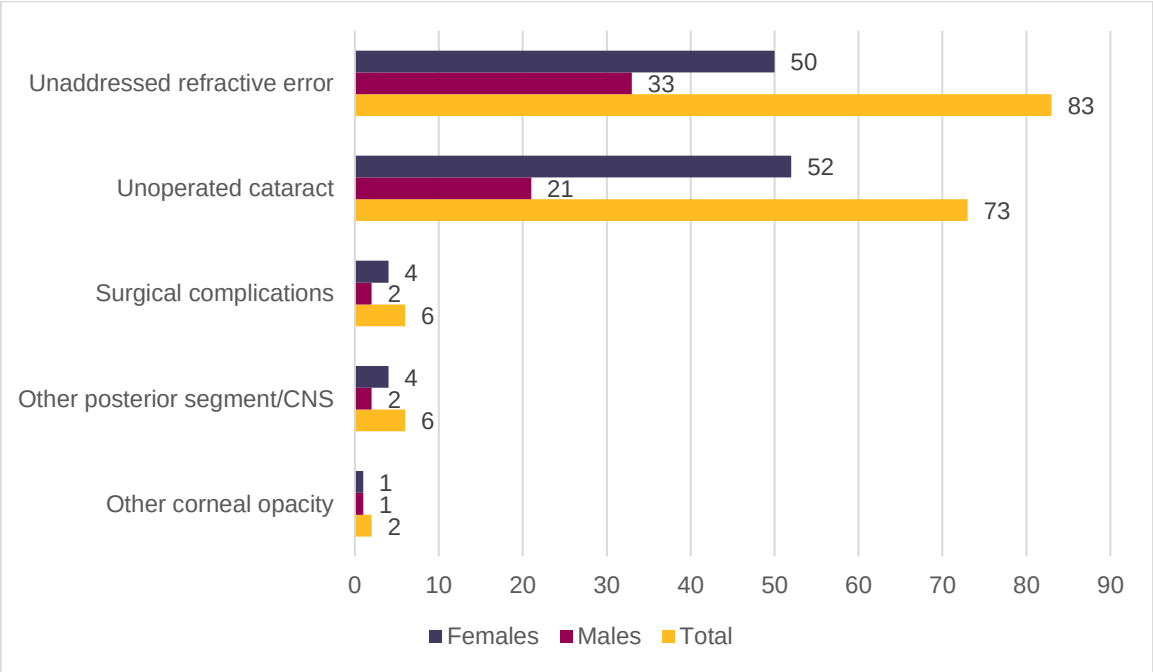
Unoperated cataract was the leading cause of moderate VI (180 cases; 75.0%), followed by unaddressed refractive error (30 cases; 12.5%) and complications of surgery (eight cases; 3.3%) (see Figure 10). The other minor causes responsible for moderate VI were trachoma (six cases; 2.5%) and other corneal opacities (six cases; 2.5%).

Figure 10: Main causes of moderate visual impairment among males and females examined in Fatick region



Unaddressed refractive error was the leading cause of early VI (83 cases; 48.8%) (see Figure 11), followed by unoperated cataracts (73 cases; 42.9%).

Figure 11: Main causes of early visual impairment among males and females examined in Fatick region



Cataract: prevalence, service coverage and visual outcomes

Cataract surgical coverage (CSC) was estimated at 64.8% for persons at VA <1/20 (see Table 10). At VA<1/10, the respective estimates were 53.3% for persons. CSC was higher among males than females, 71.7% versus 57.8% at VA<1/20 and 61.3% versus 46.0% at VA<1/10. This means that 61.3% of men who are blind or severely visually impaired due to cataract have had surgery, compared to fewer than one in two women (46.0%).

Table 10: Cataract surgical coverage (persons, percentage) in Fatick region adjusted by sex and age

	Male	Female	Total
VA < 1/20	71.7	57.8	64.8
VA < 1/10	61.3	46.0	53.3
VA < 3/10	39.4	29.2	33.9
VA < 5/10	31.9	19.8	24.1

Figure 12 shows the distribution of operated and unoperated cataracts by health district in Fatick region. The number of operated cataract cases varied from five in the district of Gossas to 21 in the district of Passy. On the other hand, the number of cases of unoperated cataracts varied from two cases in Diofor district to 17 in Sokone district.

Figure 12: Operated and unoperated cataracts by health district in Fatick region.

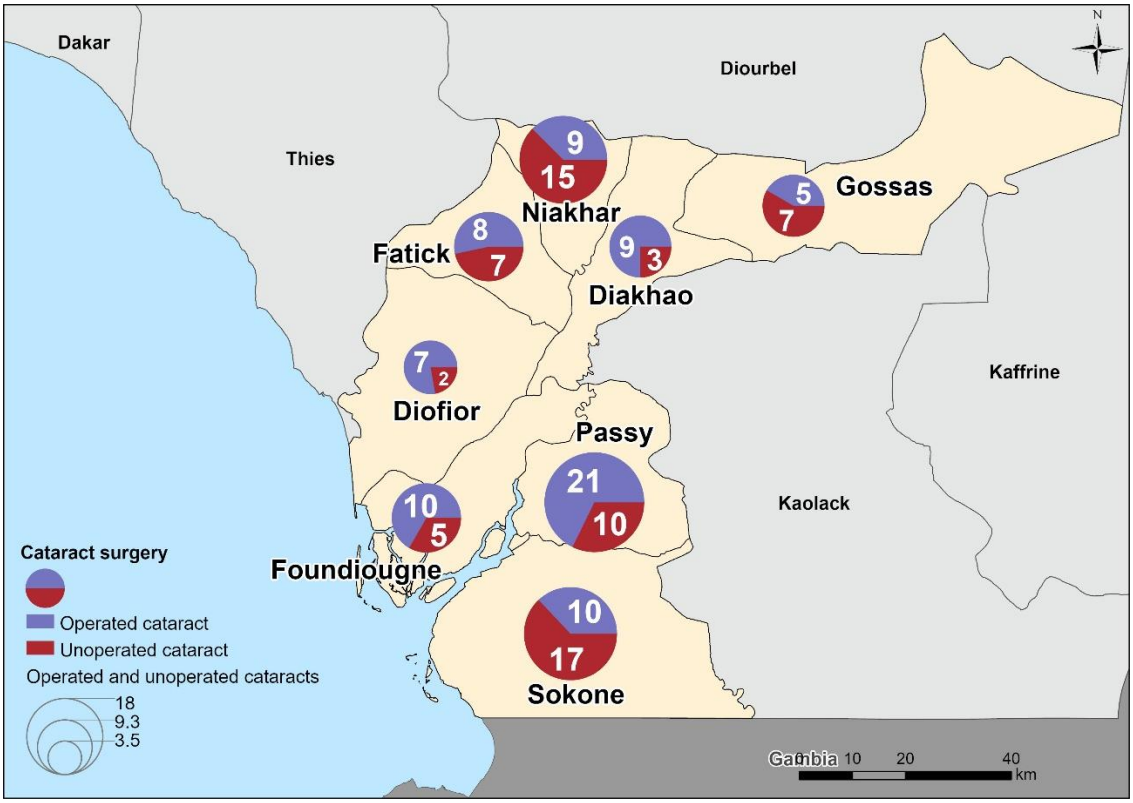


Table 11 shows that 1.7% (95% CI [0.8-2.5]) of people aged 50 years and over in Fatick region are bilaterally blind with cataracts and 3.1% (95% CI [2.0-4.3]) have severe visual impairment due to

cataracts. This translates to approximately 1,667 blind people and 3,084 people with SVI due to cataract across Fatick.

It appears that the prevalence of blindness and SVI due to cataract were not statistically different between men and women, although such comparisons of prevalence of blindness should always be treated with caution due to the relatively small number of people in the sample.

Table 11: Prevalence of best corrected visual impairment and cataract among males and females in Fatick region, adjusted for age and sex

	Males	Females	Total
Blindness: best corrected vision			
Bilateral cataract	634	1,033	1,667
	1.4% [0.4-2.5]	1.9% [0.9-2.9]	1.7% [0.8-2.5]
Unilateral cataract	2,796	3,019	5,815
	6.3% [4.7-7.9]	5.6% [4.5-6.7]	5.9% [4.8-7.0]
Total eyes with cataract	4,065	5,085	9,150
	4.6% [3.1-6.1]	4.7% [3.5-6.0]	4.7% [3.5-5.8]
SVI			
Bilateral cataract	1,158	1,926	3,084
	2.6% [1.2-4.0]	3.6% [2.3-4.8]	3.1% [2.0-4.3]
Unilateral cataract	3,359	3,021	6,380
	7.6% [5.9-9.2]	5.6% [4.5-6.7]	6.5% [5.4-7.6]
Total eyes with cataract	5,675	6,871	12,546
	6.4% [4.6-8.2]	6.4% [4.9-7.8]	6.4% [5.1-7.6]
MVI			
Bilateral cataract	3,259	5,014	8,273
	7.3% [4,7-9,9]	9.3% [7.6-11.1]	8.4% [6.7-10.1]
Unilateral cataract	4,632	4,897	9,529
	10,4% [8,3-12,5]	9,1% [7,3-10,9]	9,7% [8,1-11,3]
Total eyes with cataracts	11,150	14,928	26,078
	12,5% [9,7-15,4]	13,9% [11,6-16,1]	13.3% [11.3-15.2]
EVI			
Bilateral cataract	5,101	9,147	14,248
	11.5% [8.3-14.7]	17.0% [14.2-19.8]	14.5% [12.0-17.0]
Unilateral cataract	5,006	5,567	10,573
	11.3% [8.9-13.6]	10.3% [8.2-12.5]	10.8% [9.0-12.5]
Total eyes with cataracts	15,206	23,860	39,066
	17.1% [13.7-20.4]	22.2% [19.4-25.0]	19.9% [17.4-22.3]

More than 88.5% of all operated eyes had an intraocular lens (IOL) implanted. Of the 161 eyes with IOLs, more than 53% had very good (33.5%) or good (19.9%) visual outcomes (see Table 12). With the best corrected visual acuity, this figure increased to 68.3%. About 25.5% of operated eyes with an IOL had borderline visual outcomes and 21.1% had poor visual outcomes (VA<1/10). Among the eyes operated in the past three years, 56.5% had very good or good visual outcomes. However, 26.1% of eyes operated in this period had poor visual outcomes. The majority of surgeries (67.6%) took place in a government hospital.

Table 12: Visual acuity in operated eyes - characteristics of surgeries in Fatick region

	Very good: can see 5/10	Good: can see 3/10	Borderline: can see 1/10	Poor: cannot see 1/10	Total
Type of surgery by presenting visual acuity					
IOL	54 (33.5%)	32 (19.9%)	41 (25.5%)	34 (21.1%)	161 (88.5%)
Non-IOL	0	0	0	6 (100.0%)	6 (3.3%)
Couching	0	1 (6.7%)	1 (6.7%)	13 (86.7%)	15 (8.2%)
Total	54 (29.7%)	33 (18.1%)	42 (23.1%)	53 (29.1%)	182
Type of surgery by best corrected visual acuity					
IOL	81 (50.3%)	29 (18.0%)	27 (16.8%)	24 (14.9%)	161 (88.5%)
Non-IOL	0	0	1 (16.7%)	5 (83.3%)	6 (3.3%)
Couching	0	1 (6.7%)	1 (6.7%)	13 (86.7%)	15 (8.2%)
Total	81 (44.5%)	30 (16.5%)	29 (15.9%)	42 (23.1%)	182
Years since surgery by presenting visual acuity					
3 years	25 (36.2%)	14 (20.3%)	12 (17.4%)	18 (26.1%)	69 (37.9%)
4-6 years	13 (35.1%)	6 (16.2%)	7 (18.9%)	11 (29.7%)	37 (20.3%)
7+ years	16 (21.1%)	13 (17.1%)	23 (30.3%)	24 (31.6%)	76 (41.2%)
Clinical setting of surgery by presenting visual acuity					
Government hospital	36 (29.3%)	27 (22.0)	30 (24.4%)	30 (24.4%)	123 (67.6%)
Voluntary hospital	1 (50.0)	1 (50.0%)	0	0	2 (1.1%)
Private hospital	9 (40.9%)	3 (13.6%)	5 (22.7%)	5 (22.7%)	22 (12.1%)
Eye camp	8 (40.0%)	1 (5.0%)	6 (30.0%)	5 (25.0%)	20 (11.0%)
Traditional setting	0	1 (6.7%)	1 (6.7%)	13 (86.7%)	15 (8.2%)
Causes of visual outcomes less than very good					
Surgical complications	n/a	13 (17.3%)	23 (20.7%)	39 (52.0%)	75 (58.6%)
Spectacles	n/a	18 (66.7%)	8 (29.6%)	1 (3.7%)	27 (21.1%)
Sequelae	n/a	2 (10.0%)	7 (35.0%)	11 (55.0%)	20 (15.6%)
Selection	n/a	0	4 (66.7%)	2 (33.3%)	6 (4.7%)

When looking at eCSC, we found that the proportion of people who had surgery - and a good visual outcome from surgery out of all those who needed it - was low at 23.7% overall (see Table 13). It was slightly higher among males (27.6%) than females (19.7%).

Table 13: Effective coverage of cataract surgery (person, percentage), adjusted for age and sex

	Male	Female	Total
VA < 1/20	27.6	19.7	23.7
VA < 1/10	23.7	14.1	18.7
VA < 3/10	14.2	7.3	10.5
VA < 5/10	12.9	5.1	8.3

Barriers to cataract surgery

The main reason given by people with bilateral unoperated cataracts for not having cataract surgery was not knowing that treatment was possible (29.3%), followed by being unable to afford the operation (25.9%) a need not felt (16.4%) and fear (12.1%) (see Table 14).

Table 14: Barriers to cataract surgery in people with bilateral VA <6/60 due to cataract in Fatick region (some participants gave more than one reason)

	Male	Female	Total
Unaware that treatment is possible	13 (34.2%)	21 (26.9%)	34 (29.3%)
Cannot afford operation	13 (34.2%)	17 (21.8%)	30 (25.9%)
Need not felt	4 (10.5%)	15 (19.2%)	19 (16.4%)
Fear for surgery or poor result	4 (10.5%)	10 (12.8%)	14 (12.1%)
Beliefs / God's will	3 (7.9%)	7 (9.0%)	10 (8.6%)
No access to treatment	0	5 (6.4%)	5 (4.3%0
Treatment denied by provider	1 (2.6%)	3 (3.8%)	4 (3.4%)
Total	**38**	**78**	**116**

Among people with unilateral unoperated cataracts, the major reason cited was not feeling a need (27.5%), not knowing that treatment was possible (21.6%) and beliefs or God's will (20.2%) (see Table 15).

Table 15: Barriers to cataract surgery in people with unilateral VA <6/60 due to cataract in Fatick region (some participants gave more than one reason)

	Male	Female	Total
Need not felt	26 (24.8%)	34 (30.1%)	60 (27.5%)
Unaware that treatment is possible	25 (23.8%)	22 (19.5%)	47 (21.6%)
Beliefs / God's will	26 (24.8%)	18 (15.9%)	44 (20.2%)
Cannot afford operation	21 (20.0%)	19 (16.8%)	40 (18.3%)
Fear for surgery or poor result	5 (4.8%)	19 (16.8%)	24 (11.0%)
Treatment denied by provider	2 (1.9%)	1 (0.9%)	3 (1.4%)
No access to treatment	0	0	0
Total	**105**	**113**	**218**

Changes in eye health in Fatick between 2010 and 2022

The RAAB carried out in 2010 aimed to enrol 2,600 people and achieved a response rate of 96.7% or 2,514 participants. Compared to the general population (2010 projection of the general population census of 2003) (23), men and people in the younger age groups were under-represented in the study sample, similar to the RAAB conducted in 2022. It is therefore important to compare the age- and sex-standardised results of the two studies to ensure that differences due to sampling are taken into account. The 2010 RAAB did not collect data on early visual impairment, wealth, or disability.

Table 16 shows the age- and sex-adjusted prevalence of visual impairment in the Fatick region in 2010 and the estimated number of people affected.

Table 16: Estimated burden of presenting visual impairment among men and women in Fatick region, adjusted for age and sex of the 2010 population

	Male	Female	Total
Blindness: presenting vision			
Bilateral	1,959	2,764	4,723
	5.5% [4.1-7.0]	7.3% [5.8-8.8]	6.4% [5.3-7.6]
All eyes	7,738	8,925	16,663
	10.9% [9.3-12.6]	11.8% [10.3-13.3]	1.4% [10.1-12.6]
SVI			
Bilateral	885	1,120	2,005
	2.5% [1.3-3.7]	3.0% [2.1-3.9]	2.7% [2.0-3.5]
All eyes	2,680	3,088	5,768
	3.8% [2.7-4.8]	4.1% [3.1-5.1]	3.9% [3.2-4.7]
MVI			
Bilateral	2,466	3,742	6,208
	7,0% [5.1-8.9]	9,9% [8.1-11.7]	8,5% [7.2-9.7]
All eyes	5,569	7,519	13,088
	7.9% [6.3-9.4]	9,9% [8.6-11.3]	8.9% [7.9-9.9]

Figure 13 shows the change in age- and sex-adjusted prevalence of VI between 2010 and 2022. The estimated prevalence of bilateral blindness in people aged 50 years and over decreased from 6.4% (95% CI [5.3 to 7.6]) in 2010 to 4.4% (95% CI [3.1 to 5.6]) in 2022. The prevalence of SVI remained unchanged at 2.7%. The prevalence of MVI increased from 8.5% (95% CI 7.2 - 9.7]) in 2010 to 11.6% (95% CI 9.2 - 14.0) in 2022.

All confidence intervals around the 2010 and 2022 estimates overlap, indicating that the differences are not significant. The differences between specific estimates among men and women, and for the eyes, follow a similar trend and no significant differences are observed there either.

Despite the decrease in the prevalence of blindness, the estimated absolute number of people and eyes affected by visual impairment in Fatick region remains similar in both years, reflecting the fact that increased capacities of eye-care services over these years have been counteracted by a higher number of older people alive in 2022.

Figure 13: Age- and sex-adjusted prevalence of visual impairment in Fatick region in 2010 and 2022

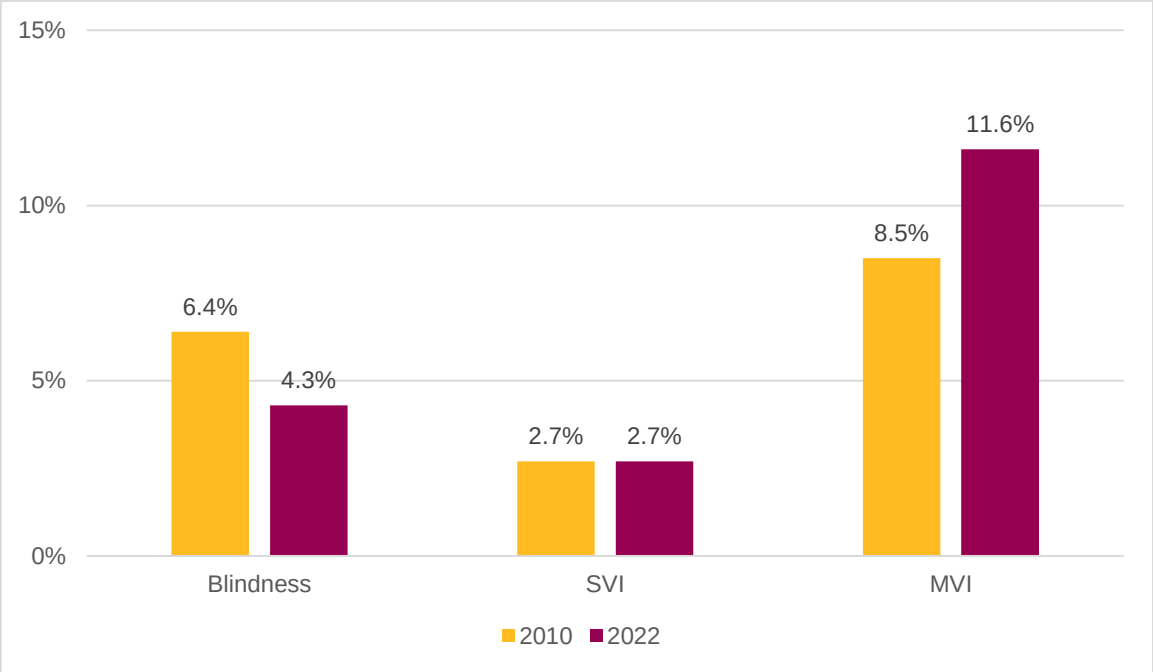
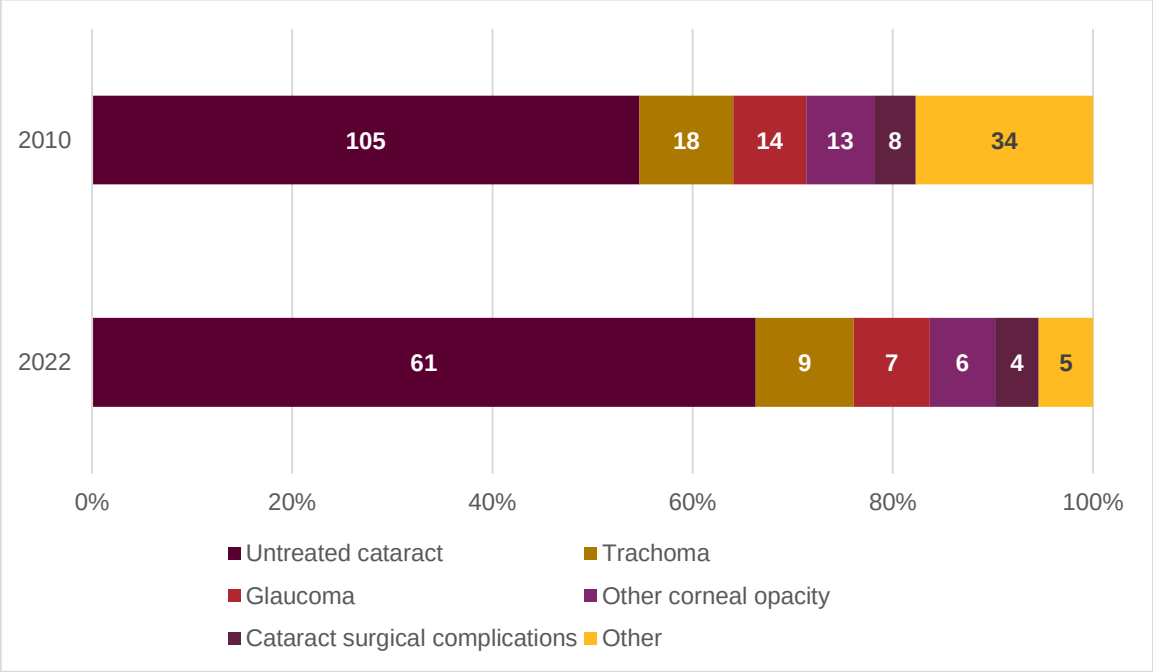


Figure 14 shows that unoperated cataract was the leading cause of blindness in 2010 with 54.6% of the sample (105 cases) as well as in 2022 at 66.3% (61 cases), followed by trachoma with 9.4% (18 cases) in 2010 and 9.8% (nine cases) in 2022. Glaucoma, other corneal opacities, and surgical complications of cataracts accounted for 7.3% (14 cases), 6.8% (13 cases) and 4.2% (eight cases) in 2010 and 7.6% (seven cases), 6.5% (six cases) and 4.3% (four cases) respectively in 2022.

Figure 14: Main causes of blindness in Fatick region in 2010 and 2022



In both years, unoperated cataract is the main cause of severe VI. It is responsible for 90.2% (55 cases) in the 2022 sample compared to 68.8% (53 cases) in 2010.

Figure 15: Main causes of severe visual impairment in Fatick region in 2010 and 2022

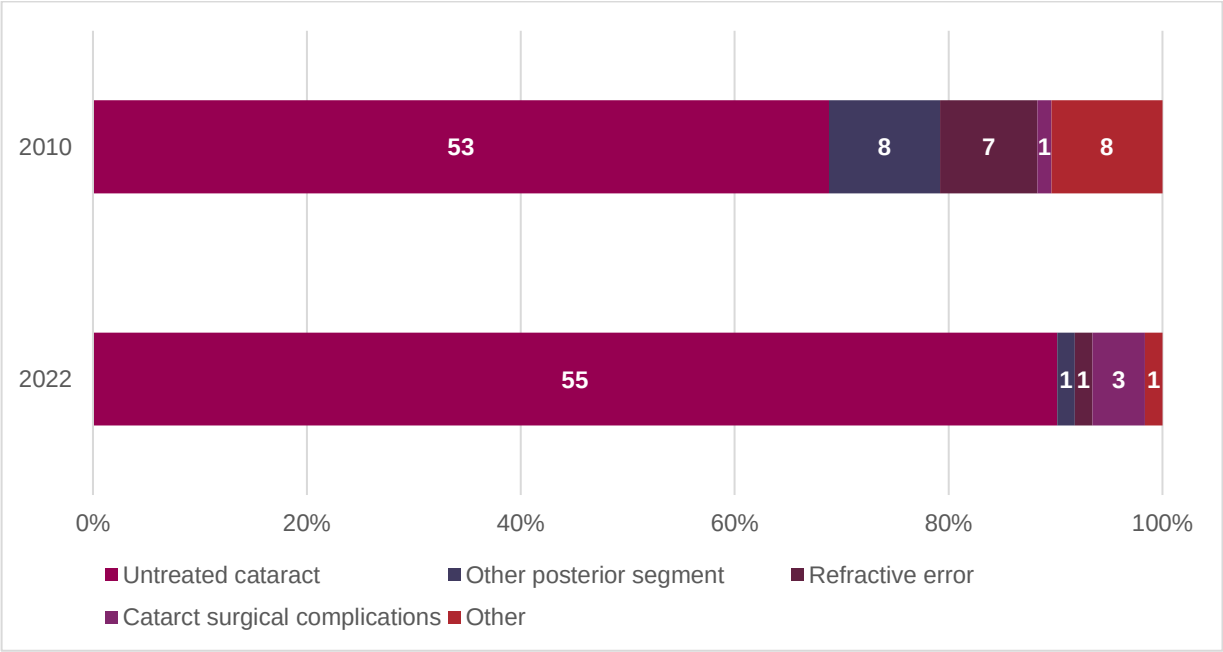
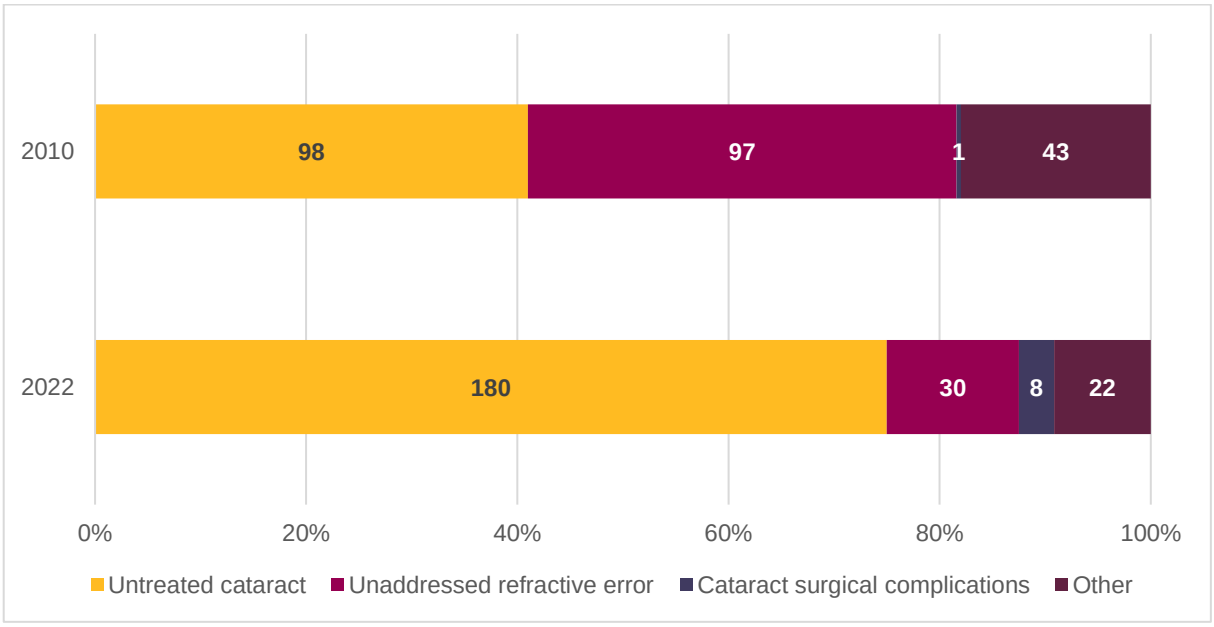


Figure 16 shows that unoperated cataract is the leading cause of moderate VI with its contribution greater in 2022 with 75.0% (180 cases) compared to 41.0% (98 cases) in 2010. The unaddressed refractive error contributed more to MVI in 2010 with 40.6% (97 cases) compared to 12.5% (30 cases) in 2022.

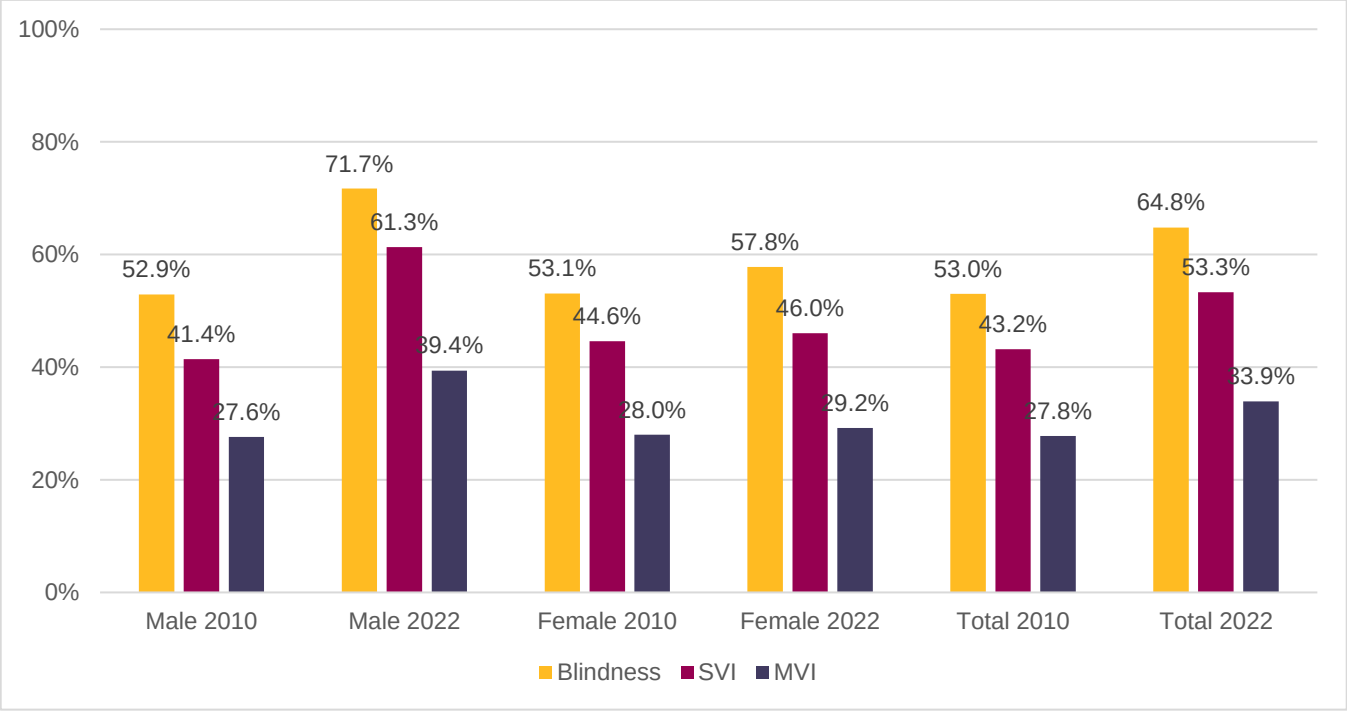
Figure 14: Main causes of moderate visual impairment in Fatick region in 2010 and 2022



Overall, we observed a 11.8%-point increase in cataract surgical coverage (using the updated definitions) between 2010 and 2022. CSC increased from 53.0% in 2010 to 64.8% in 2022

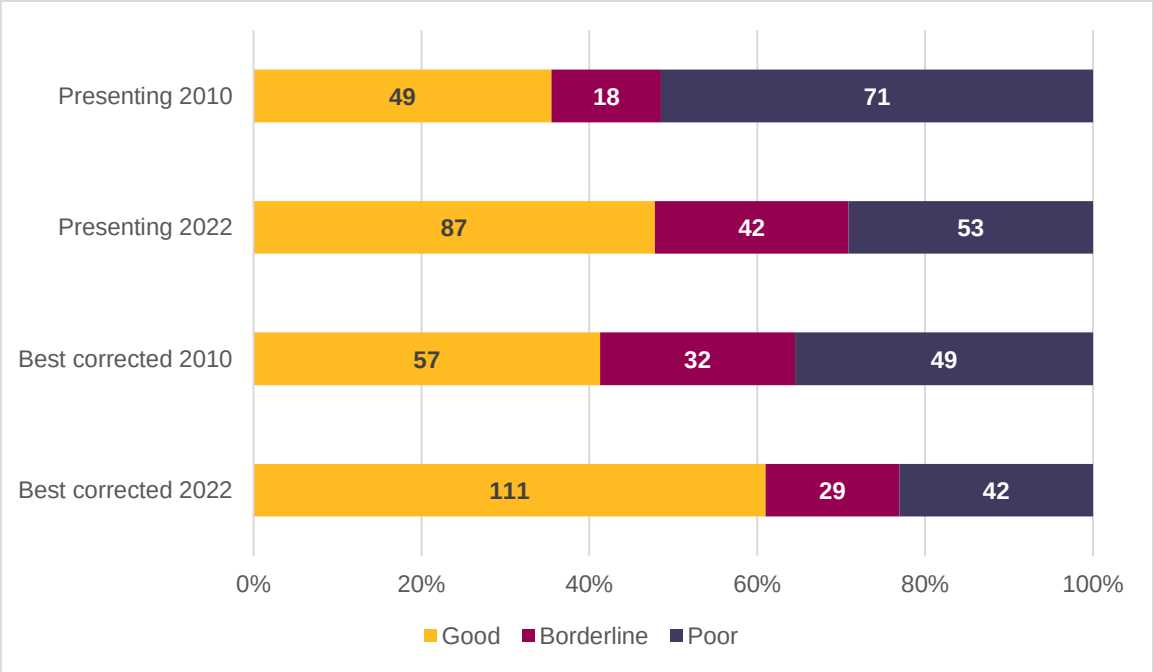
(VA<1/20) and from 43.2% in 2010 to 53.3% in 2022 (VA<1/10) (see Figure 17). A closer look shows that the increase in CSC was higher among men, with the proportion of men requiring and receiving surgery increasing from 52.9% in 2010 to 71.7% in 2022. Among women, coverage increased from 53.1% in 2010 to 57.8% in 2022.

Figure 15: Cataract surgical coverage between men and women at different levels of visual impairment in 2010 and 2022



The quality of visual outcomes among operated eyes improved significantly between 2010 and 2022; the proportion of those presenting “good” vision (VA>3/10) increased from 35.5% (49 cases) to 47.8% (87 cases), and best corrected “good” vision increased from 41.3% (57 cases) to 61.0% (111 cases) (see Figure 18). Unfortunately, the proportion of those with “poor” visual outcomes (VA<1/10) remains high. In 2010, 35.5% (49 cases) of operated patients had "poor" vision. Even with the best possible correction, this number decreased slightly in 2022 to 23.1% (42 cases).

Figure 16: Visual outcomes of operated eyes (presenting and best corrected vision) in Fatick region in 2010 and 2022



Results: Kaolack

Demographic characteristics of participants

1,771 participants were examined, representing a response rate of 88.6%. 89.8% of female participants were examined compared to 86.4% of male.

Table 17: Exam status of participants by sex in Kaolack region

	Examined	Unavailable	Refused	Unable to communicate	Total
Male	633	37	38	25	733
	86.4 %	5.0%	5.2%	3.4%	100%
Female	1,138	31	58	40	1,267
	89.8 %	2.4%	4.6%	3.2%	100%
Total	1,771	68	96	65	2,000
	88.6%	3.4%	4.8%	3.3%	100%

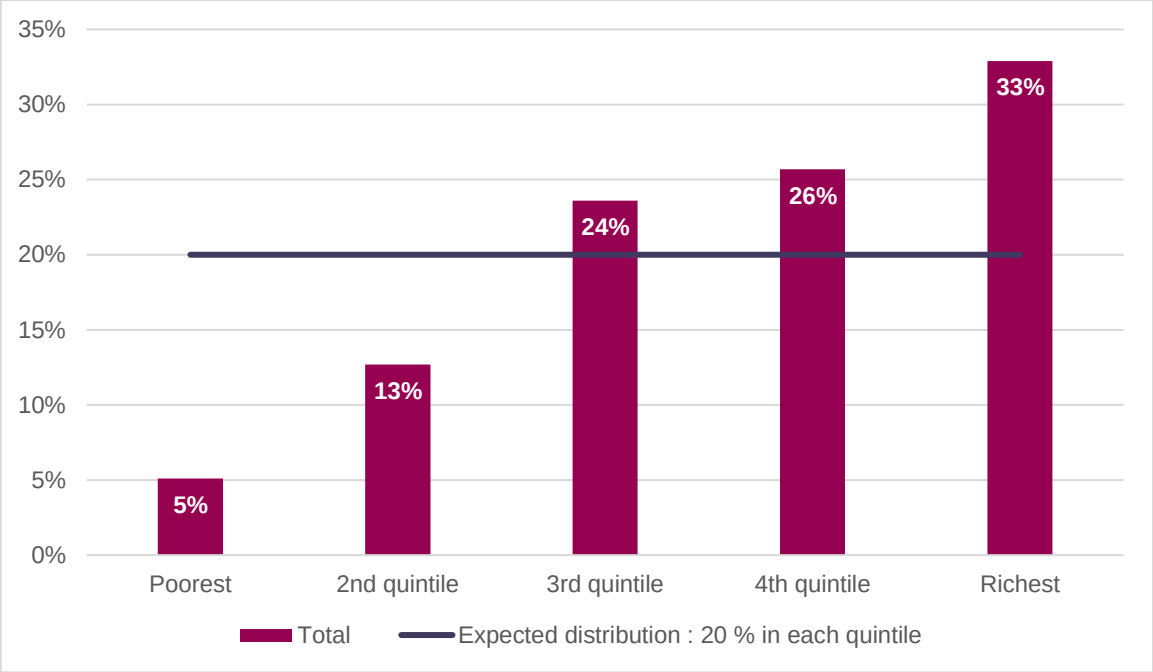
Table 18 shows the distribution by sex and age of the participants examined. The majority of people examined (753; 42.5%) were aged between 50 and 59 years and 64.3% of the sample were women. Compared to data from the National Statistics and Demography Agency, older people and females were over-represented among the sampled population. This means the sample results may overestimate 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 18: Table 18: Participants examined by sex and age group in Kaolack region, compared to the total population of the region (2022 projection)

	Study participants			Region population (2022 projection)		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
50-59	218	535	753	27,571	33,267	60,838
	34.4%	47.0%	42.5%	47.6%	48.5%	48.1%
60-69	221	312	533	18,370	20,700	39,070
	34.9%	27.4%	30.1%	31.7%	30.2%	30.9%
70-79	124	193	317	8,398	10,039	18,437
	19.6%	17.0%	17.9%	14.5%	14.6%	14.6%
80+	70	98	168	3,523	4,522	8,044
	11.1%	8.6%	9.5%	6.1%	6.6%	6.4%
Total	**633**	**1,138**	**1,771**	**57,861**	**68,528**	**126,389**

Compared to the national population, the study population appears to be relatively wealthier, with 59% of participants belonging to the two richest quintiles compared to 18% belonging to the two poorest quintiles (see Figure 19).

Figure 17: Household wealth of participants examined in Kaolack region



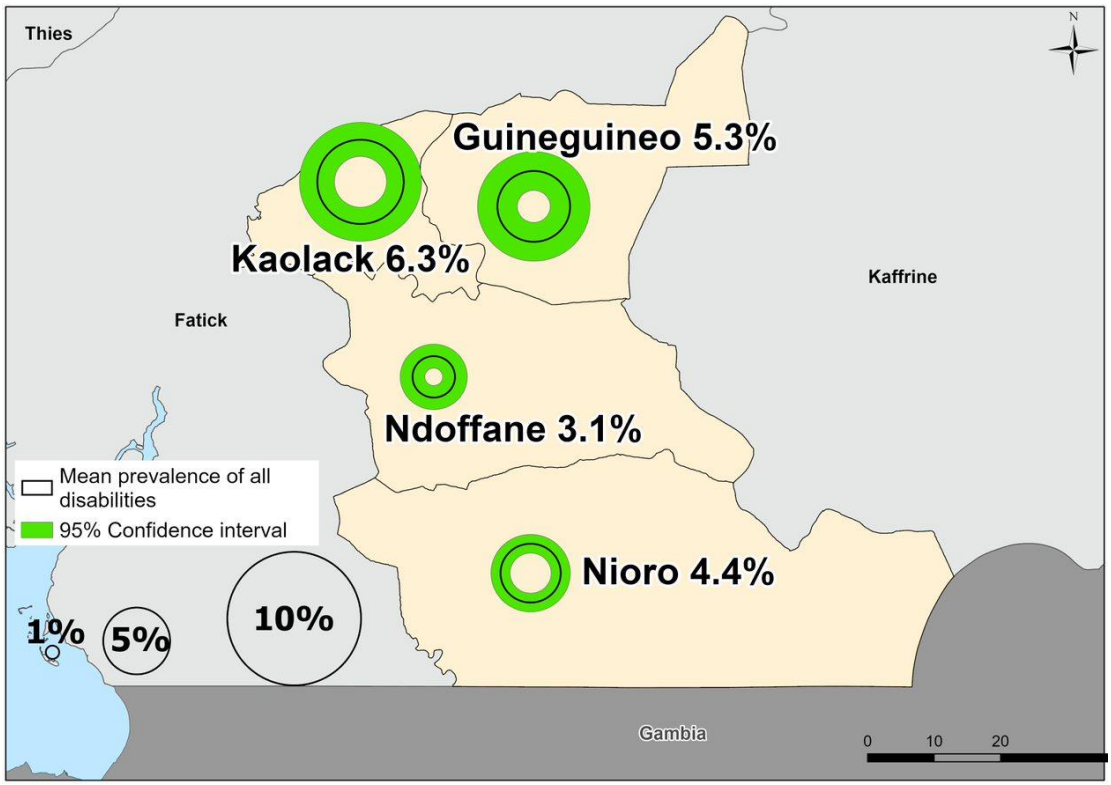
The prevalence of disability in Kaolack was 9.0% and was slightly higher among males (9.5%) than females (8.7%). The prevalence of disability excluding difficulties seeing was 4.6% (see Table 19).

Table 19: Prevalence of disability: all domains and disabilities excluding visual difficulties by sex in Kaolack region

	Male	Female	Total
Disability: all domains	60	99	159
	9.5% [7.4-12.0]	8.7% [7.2-10.5]	9.0% [7.7-10.4]
Disability: excluding vision domain	30	52	82
	4.7% [3.3-6.7]	4.6% [3.5-5.9]	4.6% [3.7-5.7]

Figure 20 shows the average prevalence of disability by health district in the Kaolack region. The prevalence of disability ranged from 3.1% in Ndoffane district to 6.3% in Kaolack district.

Figure 18: Average prevalence of disability (all domains) by district in Kaolack region



Prevalence of blindness and visual impairment

Of the 1,771 participants examined, 64 participants (3.6%) were bilaterally blind. Using the pinhole occluder to obtain best corrected VA, 60 participants (3.4%) were blind. Severe VI was observed in 53 participants (3%), moderate VI in 193 participants (10.9%) and early VI in 140 participants (7.9%) (see Table 20).

Table 20: Prevalence of visual impairment by sex in Kaolack region

	Male	Female	Total
Blindness: best corrected vision	20	40	60
	3.2% [2.0-4.8]	3.5% [2.6-4.8]	3.4% [2.6-4.3]
Blindness: presenting vision	21	43	64
	3.3% [2.2-5.0]	3.8% [2.8-5.1]	3.6% [2.8-5.0]
SVI	16	37	53
	2.5% [1.6-4.1]	3.3% [2.4-4.5]	3.0% [2.3-3.0]
MVI	72	121	193
	11.4% [9.1-14.1]	10.6% [9.0-12.6]	10.9% [9.5-12.4]

EVI	46	94	140
	7.3% [5.5-9.6]	8.3% [6.8-10.0]	7.9% [6.7-9.3]

Adjusting for age and sex, the prevalence of blindness among people aged 50 years and over is estimated to be 3.0% (95%CI 2.3%-3.7%). Extrapolating this to the general population, it is estimated that there are 3,756 blind people aged 50 and above in Kaolack. In total, it is estimated that 7.7% of the eyes of people aged 50 and above are blind, which accounts for a total of 19,516 eyes (see Table 21).

Severe visual impairment adjusted for age and sex affects about 3,030 people (2.4%) and 7,782 eyes in total. Moderate visual impairment adjusted for age and sex affects 12,068 people (9.5%) and 24,513 eyes in total. Age- and sex-adjusted early visual impairment affects 9,033 people (7.1%) and 18,802 eyes.

Table 21: Extrapolated burden of VI in people aged 50 years and above in Kaolack region, adjusted for age and sex

	Male	Female	Total
Blindness (presenting VA)			
Bilateral cases	1,529	2,227	3,756
	2.6% [1.2-4.1]	3.2% [2.3-4.2]	3.0% [2.3-3.7]
All eyes	9,275	10,241	19,516
	8.0% [6.0-10.0]	7.5% [6.2-8.7]	7.7% [6.6-8.9]
SVI			
Bilateral cases	1,080	1,950	3,030
	1.9% [0.8-2.9]	2.8% [1.6-4.1]	2.4% [1.4-3.3]
All eyes	3,061	4,721	7,782
	2.6% [1.7-3.6]	3.4% [2.4-4.5]	3.1% [2.3-3.9]
MVI			
Bilateral cases	5,156	6,912	12,068
	8.9% [6.6-11.2]	10.1% [8.2-11.9]	9.5% [8.1-11.0]
All eyes	10,529	13,984	24,513
	9.1% [7.2-11.0]	10.2% [8.7-11.7%]	9.7% [8.4-11.0]
EVI			
Bilateral cases	3,542	5,491	9,033
	6.1% [4.1-8.2]	8.0% [6.3-9.8]	7.1% [5.7-8.6]
All eyes	7,090	11,712	18,802
	6.1% [4.7-7.6]	8.5% [6.9-10.2]	7.4% [6.0-8.8]

Figure 21 shows the average prevalence of bilateral blindness among people aged 50 and over from all causes by district in the region of Kaolack. The average prevalence of bilateral blindness from all causes ranged from 3.1% in Nioro du Rip district to 5.3% in Guinguineo district.

Figure 19: Average prevalence in the sample of all-cause blindness in Kaolack region

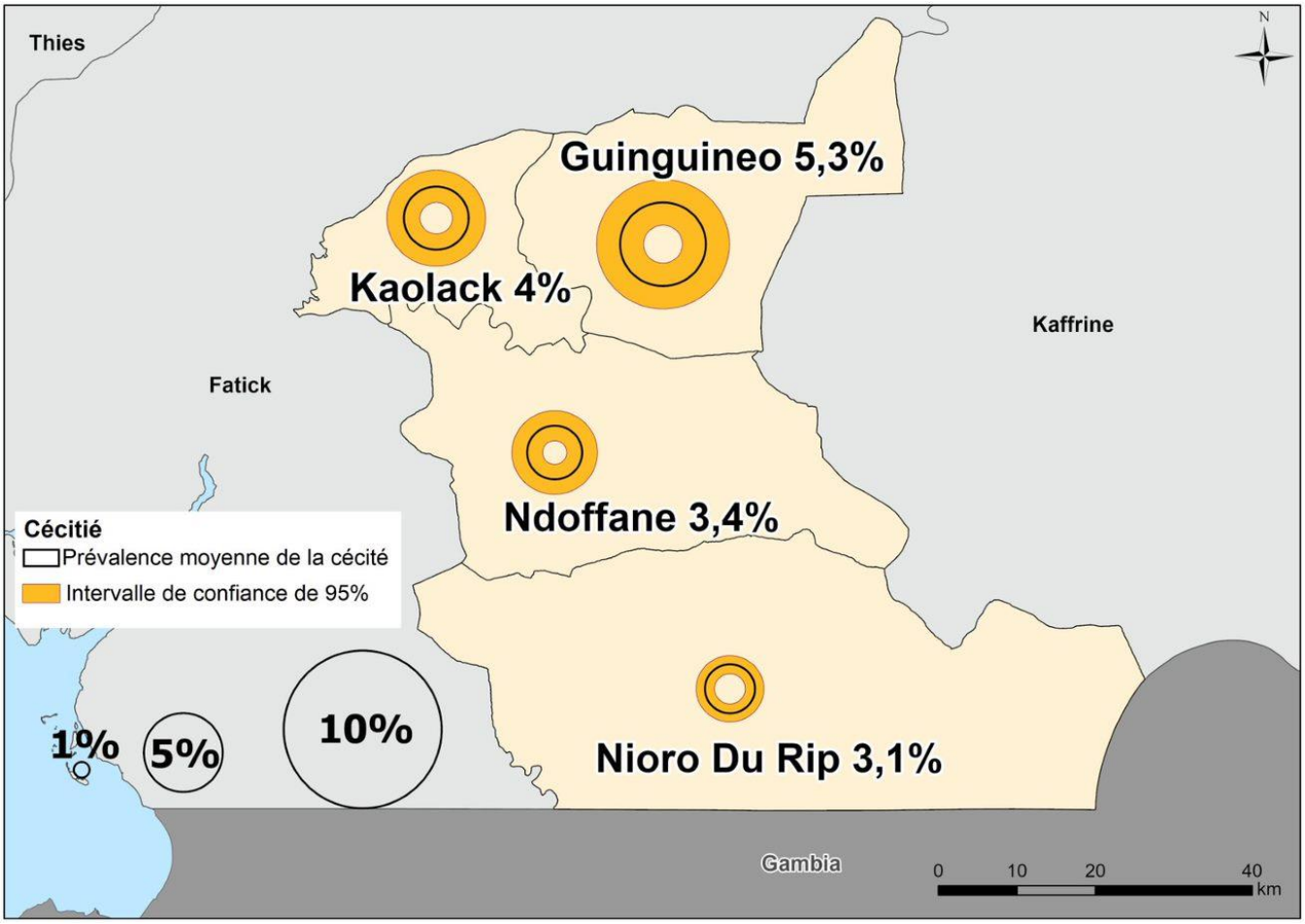
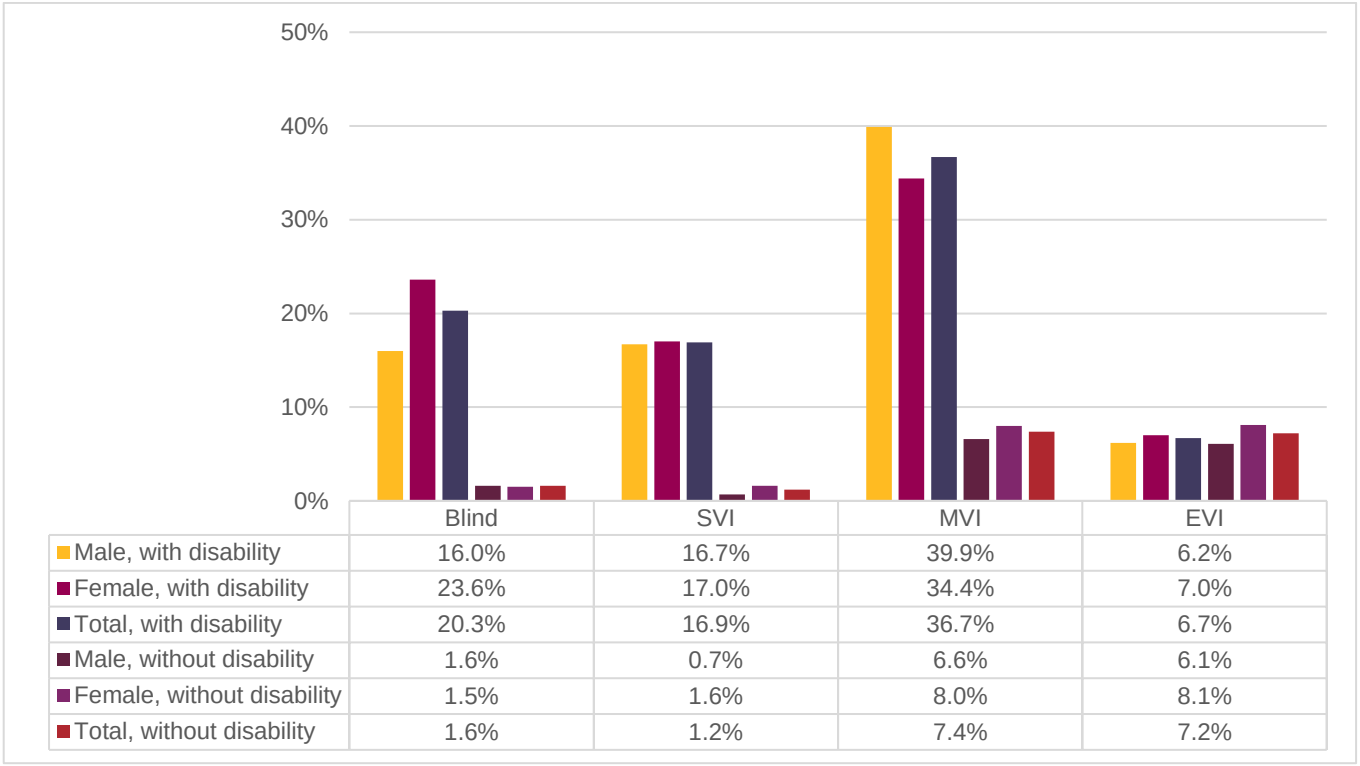


Figure 22 shows the age- and sex-adjusted prevalence of visual impairment by disability and sex. Men and women with disabilities were more likely to be visually impaired than individuals without disabilities. These differences were more striking for more severe forms of visual impairment, particularly blindness. For example, 23.6% of women with disabilities were blind compared to 1.5% of women without disabilities.

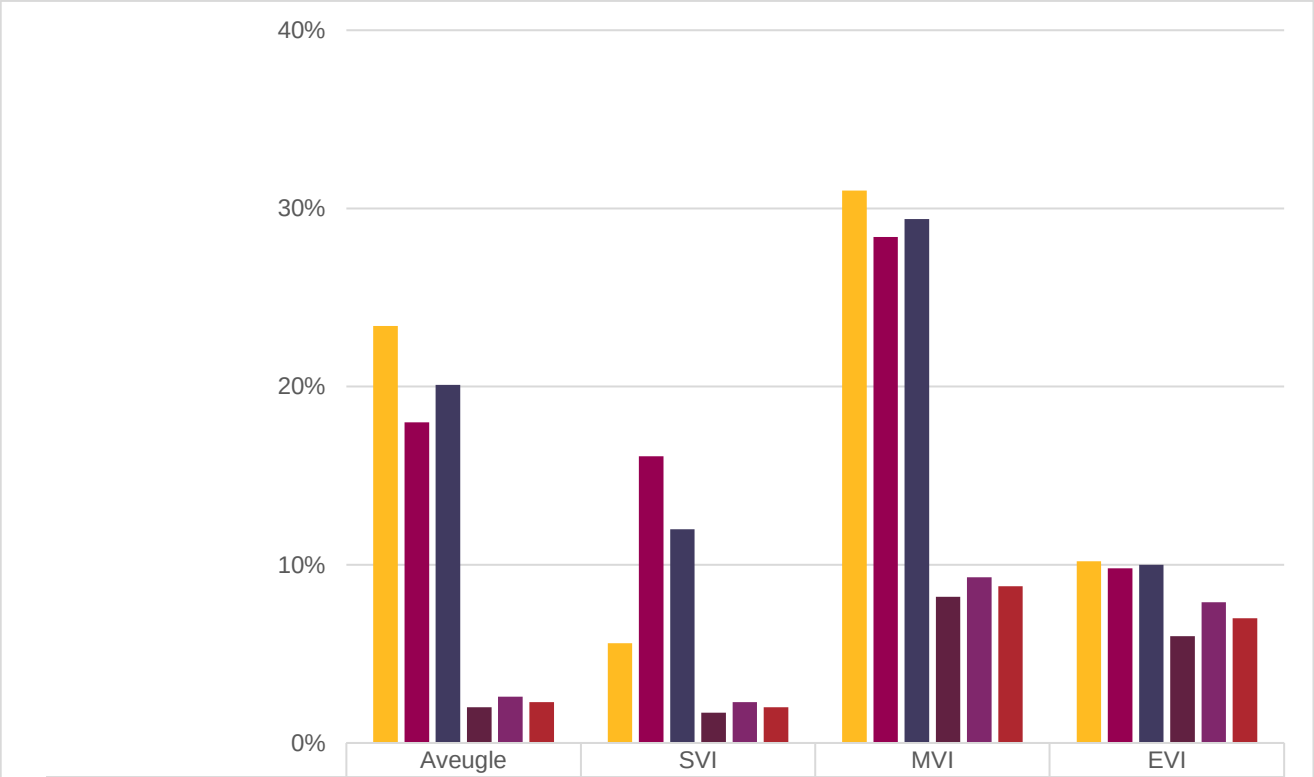
Figure 20: Prevalence of visual impairment by disability in all domains in Kaolack region adjusted for age and sex



	Blind	SVI	MVI	EVI
Male, with disability	16.0%	16.7%	39.9%	6.2%
Female, with disability	23.6%	17.0%	34.4%	7.0%
Total, with disability	20.3%	16.9%	36.7%	6.7%
Male, without disability	1.6%	0.7%	6.6%	6.1%
Female, without disability	1.5%	1.6%	8.0%	8.1%
Total, without disability	1.6%	1.2%	7.4%	7.2%

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 23 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 high: 23.4% of men with a disability (excluding "difficulty in seeing") were blind, as opposed to 2.0% of men without disabilities.

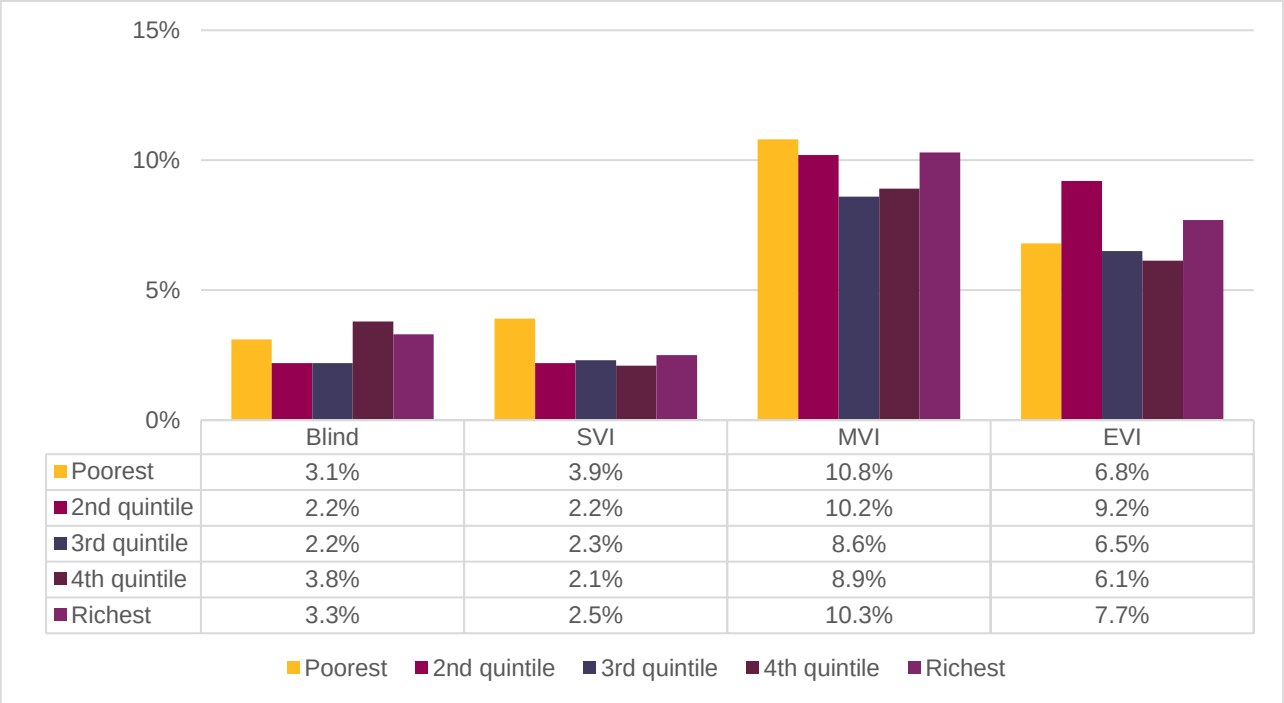
Figure 21: Prevalence of visual impairment by disability (excluding vision domain) in Kaolack region, adjusted by age and sex



	Aveugle	SVI	MVI	EVI
Male, with disability	23.4%	5.6%	31.0%	10.2%
Female, with disability	18.0%	16.1%	28.4%	9.8%
Total, with disability	20.1%	12.0%	29.4%	10.0%
Male, without disability	2.0%	1.7%	8.2%	6.0%
Female, without disability	2.6%	2.3%	9.3%	7.9%
Total, without disability	2.3%	2.0%	8.8%	7.0%

Figure 24 shows no definitive pattern in the relationship between VI and relative wealth. The prevalence of blindness was 3.1% among people in the poorest economic quintile and 3.3% among people in the wealthiest quintile. The prevalence of SVI was slightly higher among those in the poorest quintile (3.9%) than those in the wealthiest (2.5%).

Figure 22: Prevalence of visual impairment and disability by wealth quintile in Kaolack region, adjusted for age and sex



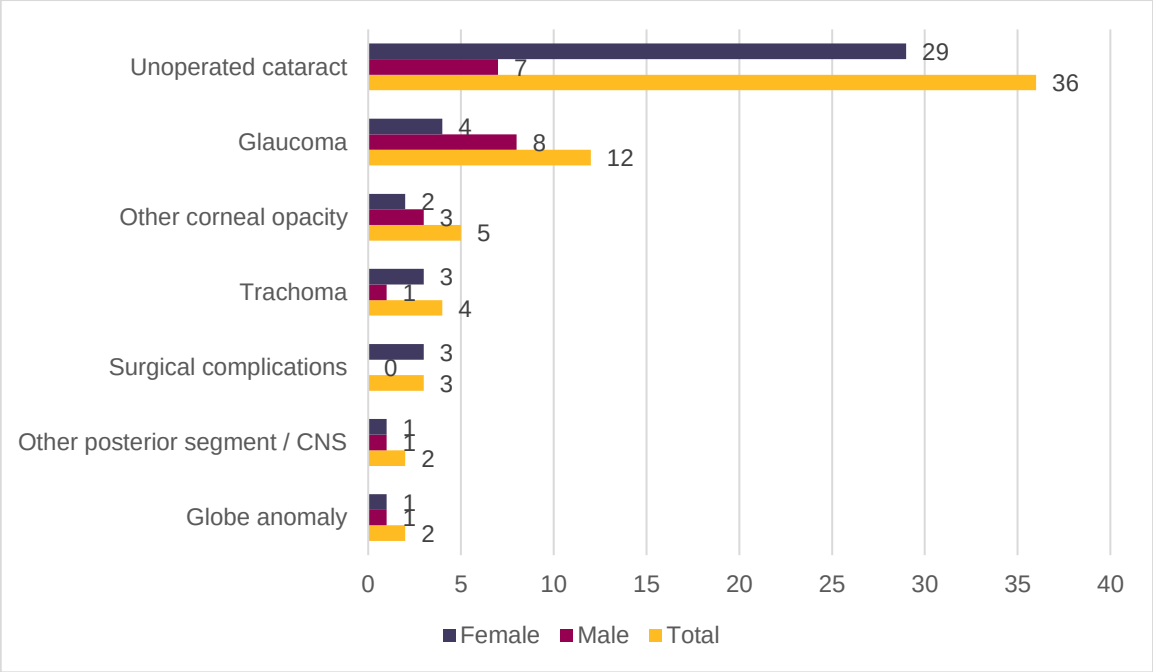
	Blind	SVI	MVI	EVI
Poorest	3.1%	3.9%	10.8%	6.8%
2nd quintile	2.2%	2.2%	10.2%	9.2%
3rd quintile	2.2%	2.3%	8.6%	6.5%
4th quintile	3.8%	2.1%	8.9%	6.1%
Richest	3.3%	2.5%	10.3%	7.7%

Causes of visual impairment

In Kaolack, the main cause of blindness was unoperated cataract (N=36 cases; 56.3%), followed by glaucoma (N=12 cases; 18.8%) and other corneal opacities (N=5 cases; 7.8%) (see Figure 25).

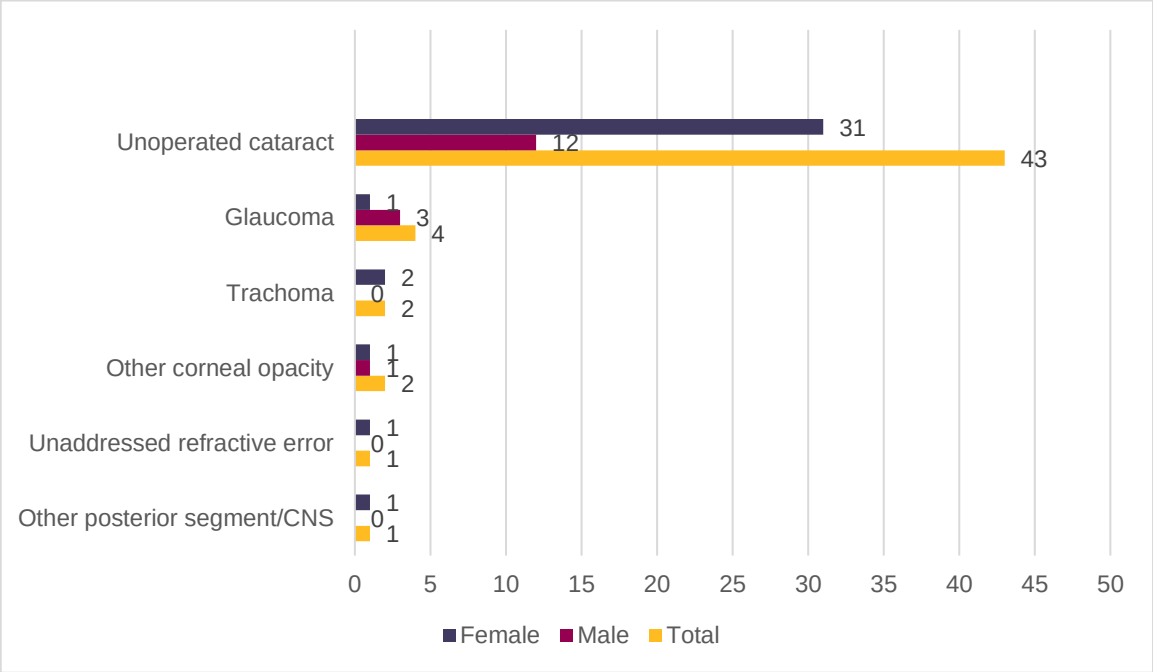
It is important to remember that RAAB methodology only allows a single cause (the most easily treatable) to be assigned to each eye or person. Comparisons between groups should be made with caution, as the results do not show the full distribution of causes of VI in the study population. When a significant proportion of the population has unoperated cataract or unaddressed refractive error, these causes will be most likely listed as leading causes of VI independent of other comorbidities.

Figure 23: Main causes of blindness among males and females examined in Kaolack region



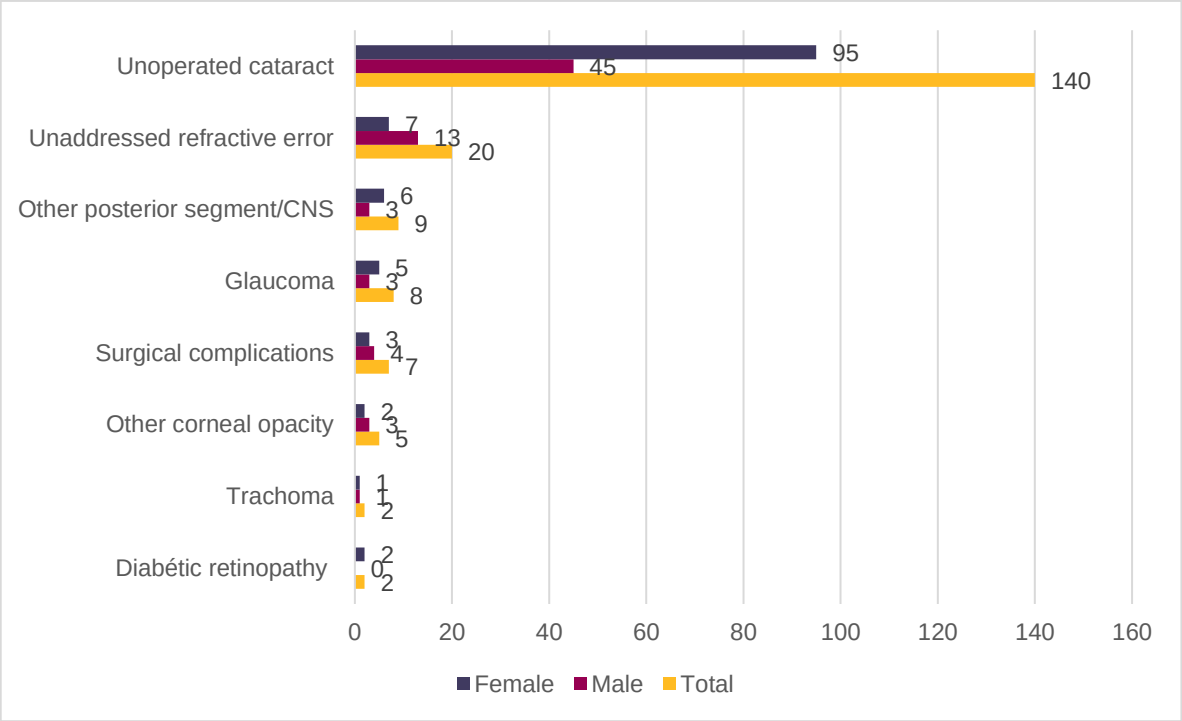
Unoperated cataract was also the main cause of severe VI (43 cases; 81.1%), followed by glaucoma (four cases; 7.5%) (see Figure 26).

Figure 24: Main causes of severe visual impairment among males and females examined in Kaolack region



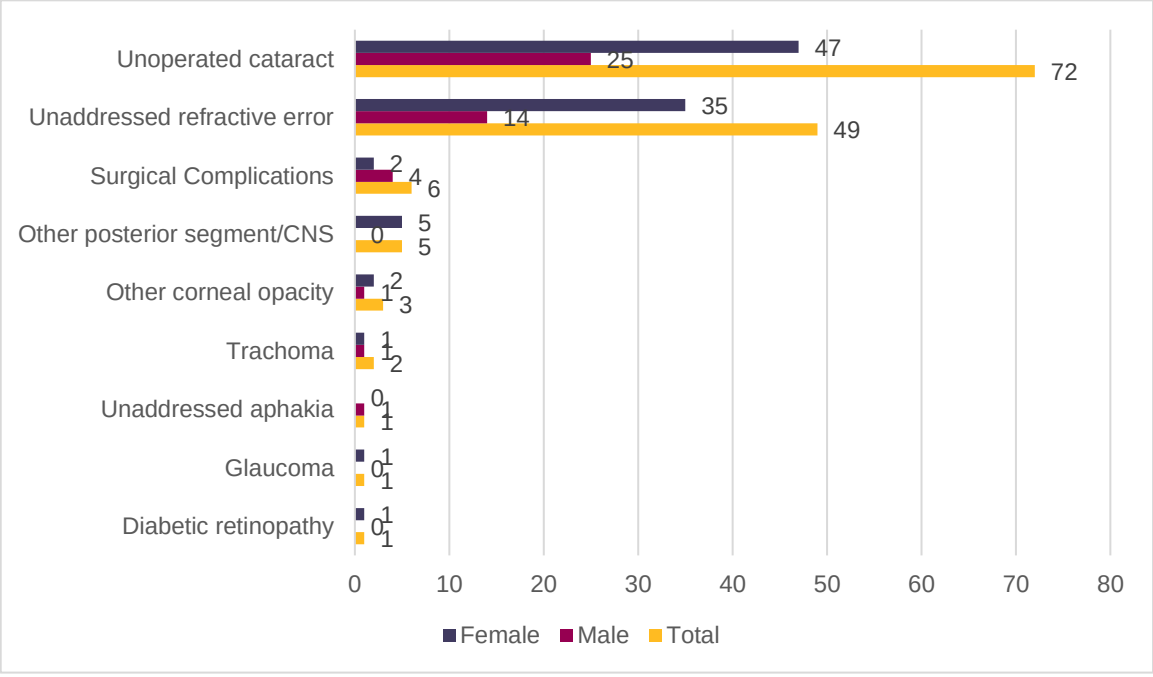
Unoperated cataract was the main cause of moderate VI (140 cases; 72.5%), followed by unaddressed refractive error (20 cases; 10.4%) and other posterior segment pathologies (nine cases; 4.7%) (see Figure 27).

Figure 25: Main causes of moderate visual impairment among males and females examined in Kaolack region



Unoperated cataract was the main cause of early VI (72 cases; 51.4%), followed by unaddressed refractive error (49 cases; 35.0%) (see Figure 28).

Figure 26: Main causes of early visual impairment among males and females examined in Kaolack region



Cataract: prevalence, service coverage and visual outcomes

Cataract surgical coverage (CSC) was estimated at 74.1% for persons at VA <1/20 (see Table 22). At VA<1/10, the estimate was 62.9% among persons. CSC was higher among males than females, 78.3% versus 51.1% at VA<1/20 and 67.2% versus 40.1% at VA<1/10. This means that 67% of men who are blind or severely visually impaired due to cataract have had surgery, compared to just 40% of women (40.1%).

Table 22: Cataract surgical coverage (person, percentage) in Kaolack region adjusted by sex and age

	Male	Female	Total
VA < 1/20	78.3	51.1	74.1
VA < 1/10	67.2	40.1	62.9
VA < 3/10	40.1	24.9	38.0
VA < 5/10	27.9	16.6	26.4

Figure 29 shows the distribution of operated and unoperated cataracts by health district in Kaolack region. The number of operated cataract cases varies from seven cases of cataracts in the Guinguineo district to 36 cases of cataracts in Nioro Du Rip district. On the other hand, the number of cases of unoperated cataracts varied from seven cases in Guinguineo district to 17 cases in Nioro Du Rip district.

Figure 27: Operated and unoperated cataracts by health district in Kaolack region

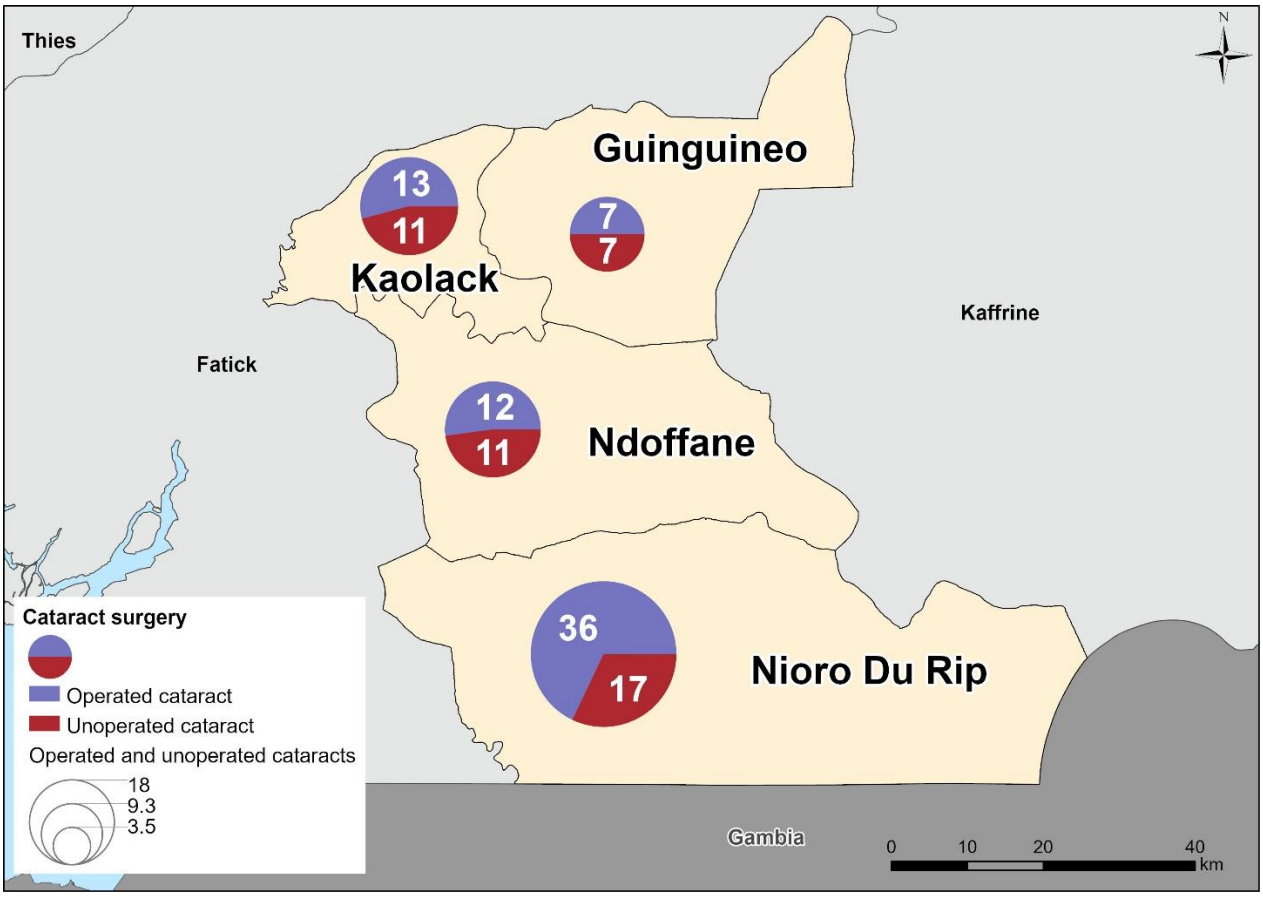


Table 23 shows that 1.2% (95% CI 0.6-1.8) of people aged 50 years and more in Senegal are bilaterally blind with cataracts and 2% (95% CI 1.1-2.8) have severe VI with cataracts. This translates to approximately 1,485 blind people and 989 people with severe VI due to cataract in Kaolack.

It appears that the prevalence of blindness and SVI with cataract were not statistically different between men and women.

Table 23: Estimated prevalence and number of men and women with visual impairment and cataracts in Kaolack region, adjusted for age and sex

	Males	Females	Total
Blindness: best corrected vision			
Bilateral cataract	352	1,133	1,485
	0.6% [0.0-1.3]	1.7% [0.8-2.5]	1.2% [0.6-1.8]
Unilateral cataract	2,443	2,907	5,350
	4.2% [3.0-5.5]	4.2% [3.3-5.2]	4.2% [3.5-5.0]
Total eyes with cataract	3,148	5,172	8,320
	2.7% [1.7-3.7]	3.8% [2.8-4.8]	3.3% [2.5-4.1]
SVI			
Bilateral cataract	787	1,687	2,474
	1.4% [0.4-2.4]	2.5% [1.3-3.6]	2.0% [1.1-2.8]
Unilateral cataract	2.658	3.746	6.404
	4.6% [3.3-5.9]	5.5% [4.3-6.6]	5.1% [4.2-5.9]
Total eyes with cataract	4,232	7,119	11,351
	3.7% [2.4-5.0]	5.2% [3.9-6.5]	4.5% [3.4-5.5]
MVI			
Bilateral cataract	2,743	5,096	7,839
	4.7% [2.7-6.8]	7.4% [5.7-9.2]	6.2% [4.7-7.7]
Unilateral cataract	4,488	5,082	9,570
	7.8% [6.1-9.4]	7.45 [6.2-8.6]	7.6% [6.6-8.5]
Total eyes with cataract	9,977	15,275	25,252
	8.6% [6.5-10.7]	11.1% [9.2-13.1]	10.0% [8.4-11.6]
EVI			
Bilateral cataract	5,225	9,256	14,481
	9.0% [6.7-11.4%]	13.5% [11.0-16.0]	11.5% [9.4-13.5]
Unilateral cataract	4,084	4,840	8,924
	7.1% [5.1-9.0]	7.1% [5.4-8.7]	7.1% [5.8-8.3]
Total eyes with cataract	14,534	23,351	37,885
	12.6% [10.1-15.0]	17.0% [14.3-19.8]	15.0% [12.8-17.1]

More than 91.9% of all operated eyes had an intraocular lens (IOL) implanted. Of the 133 eyes with IOLs, more than 57.1% had very good (37.6%) or good (19.5%) visual outcomes (see Table 24). With the best corrected visual acuity, this figure increased to 66.9%. About 18.8% of operated eyes with an IOL had borderline visual outcomes and 24.1% had poor visual outcomes (VA<1/10). Among the eyes operated on in the past three years, 47.8% had very good or good visual outcomes. However, 25% of eyes operated on in the same period had poor visual outcomes. The majority of surgeries took place in a government hospital (65.7%).

Table 24: Visual acuity in operated eyes - characteristics of surgeries in Kaolack region

	Very good: can see 5 /10	Good: can see 3/10	Borderline: can see 1/10	Poor: cannot see 1/10	Total
Type of surgery by presenting visual acuity					
IOL	50 (37.6%)	26 (19.5%)	25 (18.8%)	32 (24.1%)	133 (91.9%)
Non-IOL	0	0	0	5 (100.0%)	5 (3.4%)
Couching	0	0	1 (12.5%)	7 (87.5%)	8 (5.5%)
Total	50 (34.2%)	26 (17.8%)	26 (17.8%)	44 (30.1%)	146
Type of surgery by best corrected visual acuity					
IOL	64 (48.1%)	25 (18.8%)	17 (12.8%)	27 (20.3%)	133 (91.9%)
Non-IOL	0	1 (20.0%)	0	4 (80.0%)	5 (3.4%)
Couching	1 (12.5%)	1 (12.5%)	0	6 (75.0%)	8 (5.5%)
Total	65 (44.5%)	27 (18.5%)	17 (11.6%)	37 (25.3%)	146
Years since surgery by presenting visual acuity					
3 Years	16 (36.4%)	5 (11.4%)	12 (27.3%)	11 (25.0%)	44 (30.1%)
4-6 Years	12 (31.6%)	10 (26.3%	6 (15.8%)	10 (26.3%)	38 (26.0%)
7+ Years	22 (34.4%)	11 (17.2%)	8 (12.5%)	23 (35.9%)	64 (43.8%)
Clinical setting of surgery by presenting visual acuity					
Government hospital	32 (33.7%)	21 (22.1%)	15 (15.8%)	27 (28.4%)	95 (65.7%)
Voluntary hospital	2 (66.7%)	0	1 (33.3%)	0	3 (2.1%)
Private hospital	8 (47.1%)	2 (11.8%)	3 (17.6%)	4 (23.5%)	17 (11.6%)
Eye camp	8 (34.8%)	3 (13.0)	6 (26.1%)	6 (26.1%)	23 (15.8%)
Traditional setting	0	0	1 (12.5%)	7 (87.5%)	8 (5.5%)
Causes of visual outcomes less than very good					
Surgical complications	n/a	14 (25.9%)	13 (24.1%)	27 (50.0%)	54 (56.3%)
Spectacles	n/a	6 (37.5%)	9 (56.3%)	1 (6.3%)	16 (16.7%)
Sequelae	n/a	4 (20.0%)	3 (15.0%)	13 (65.0%)	20 (20.8%)
Selection	n/a	2 (33.35)	1 (16.7%)	3 (50.0%)	6 (6.3%)

When looking at effective cataract surgery coverage (eCSC), we found that the proportion of people who had been operated on and had a good visual outcome from surgery out of all of those who needed it was low at 30.5% overall (see Table 25). Gender differences in eCSC were particularly striking in this region, as eCSC was more than twice as high among males (33.5%) than females (13.8%).

Table 25: Effective coverage of cataract surgery (person, percentage), adjusted for age and sex

	Males	Females	Total
VA < 1/20	33.5	13.8	30.5
VA < 1/10	28	10.9	25.2
VA < 3/10	16.9	6.7	15.5

VA < 5/10	11.5	4.5	10.5

The main reason given by people with bilateral unoperated cataracts for not having cataract surgery was not knowing that treatment was possible (35.1%), followed by being unable to afford the operation (25.7%), local beliefs (14.9%) and fear (13.5%) (see Table 26).

Table 26: Barriers to cataract surgery in people with bilateral VA <6/60 due to cataract in Kaolack region (some participants gave more than one reason)

	Male	Female	Total
Unaware that treatment is possible	7 (35.0%)	19 (35.3%)	26 (35.1%)
Cannot afford operation	7 (35.0%)	12 (22.2%)	19 (25.7%)
Beliefs / God's will	4 (20.0%)	7 (13.0%)	11 (14.9%)
Fear of surgery or poor result	1 (5.0%)	9 (16.7%)	10 (13.5%)
Need not felt	1 (5.0%)	6 (11.1%)	7 (9.5%)
Treatment denied by provider	0	1 (1.9%)	1 (1.4%)
Total	**20**	**54**	**74**

Among people with unilateral unoperated cataracts, the major reason cited was not knowing that treatment was possible (28.4%), beliefs or "God's will" (20.7%) and need not felt (20.1%) (see Table 27).

Table 27: Barriers to cataract surgery in people with unilateral VA <6/60 due to cataract in Kaolack region (some participants gave more than one reason)

	Male	Female	Total
Unaware that treatment is possible	26 (40.0%)	22 (21.25)	48 (28.4%)
Beliefs / God's will	10 (15.4%)	25 (24.0%)	35 (20.7%)
Need not felt	14 (21.5%)	20 (19.2%)	34 (20.1%)
Cannot afford operation	8 (12.3%)	20 (19.2%)	28 (16.6%)
Fear of surgery or poor result	2 (3.1%)	12 (11.5%)	14 (8.3%)
Treatment denied by provider	5 (7.7%)	3 (2.9%)	8 (4.7%)
No access to treatment	0	2 (1.9%)	2 (1.2%)
Total	**65**	**104**	**169**

Changes in eye health in Kaolack between 2010 and 2022

The 2010 RAAB aimed to enrol 2,900 people and achieved a response rate of 97.7% or 2,834 participants. Compared to the general population (2010 projection of the general population census of 2003) (23) men and people in the younger age groups were under-represented in the study sample, similar to the RAAB conducted in 2022. It is therefore important to compare the age and sex standardised results of the two studies to ensure that differences due to sampling are taken into account. The 2010 RAAB did not collect data on early visual impairment, wealth, or disability.

Table 28 shows the age- and sex-adjusted prevalence of visual impairment in the Kaolack region in 2010 and the estimated number of people affected.

Table 28: Estimated burden of presenting visual impairment among men and women in Kaolack region, adjusted for age and sex of the 2010 population

	Male	Female	Total
Blindness: presenting vision			
Bilateral	2,029	3,221	5,250
	5.3% [3.9-6.8]	7.6% [6.0-9.2]	6.5% [5.3-7.7]
All eyes	9,125	11,506	20,631
	11.9% [10.3-13.6]	13.6% [11.8-15.4]	12.8% [11.5-14.2]
SVI			
Bilateral	1,202	1,648	2,850
	3.1% [2.0-4.3]	3.9% [2.8-5.0]	3.5% [2.7-4.4]
All eyes	2,924	3,772	6,696
	3.8% [2.9-4.7]	4.5% [3.6-5.4]	4.2% [3.4-4.9]
MVI			
Bilateral	2,671	2,809	5,480
	7.0% [5.3-8.7]	6.6% [5.3-7.9]	6.8% [5.6-8.1]
All eyes	5,869	6,321	12,190
	7.7% [6.1-9.3]	7.5% [6.2-8.8]	7.6% [6.4-8.7]

Figure 30 shows the change in age- and sex-adjusted prevalence of VI between 2010 and 2022. The estimated prevalence of bilateral blindness among people 50+ years decreased significantly from 6.5% (95% CI 5.3 to 7.7) in 2010 to 3.0% (95% CI 2.3-3.7) in 2022. The prevalence of SVI slightly decreased from 3.5% (95% CI 2.7-4.4) in 2010 to 2.4% (95% CI 1.5-3.3) in 2022. The prevalence of MVI has increased from 6.8% (95% CI 5.6-8.1) in 2010 to 9.5% (95% CI 8.1-11.0) in 2022.

The confidence intervals around blindness and MVI estimates do not overlap, indicating that the differences between 2010 and 2022 are significant. Differences between estimates specific to men and women, and for eyes, follow a similar trend.

Despite the decrease in the prevalence of blindness, the estimated absolute number of people and eyes affected by visual impairment in Kaolack remains similar in both years, reflecting the fact that increased capacities of eye-care services have been counteracted by a higher number of older people alive in 2022.

Figure 28: Age- and sex-adjusted prevalence of visual impairment in Kaolack region in 2010 and 2022

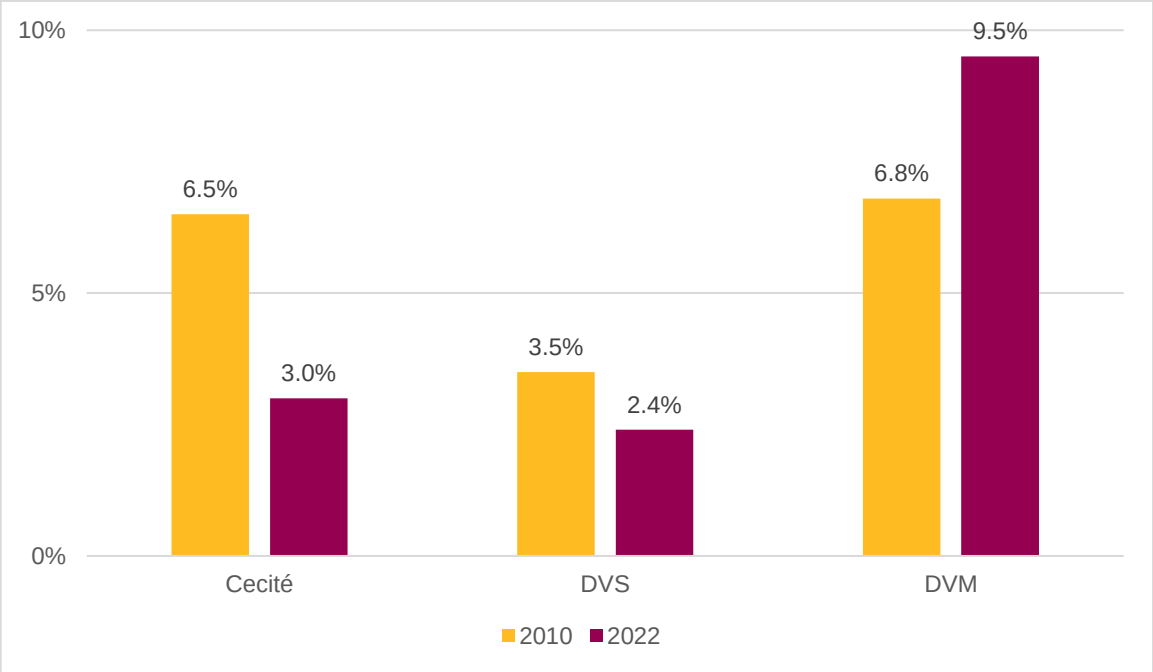
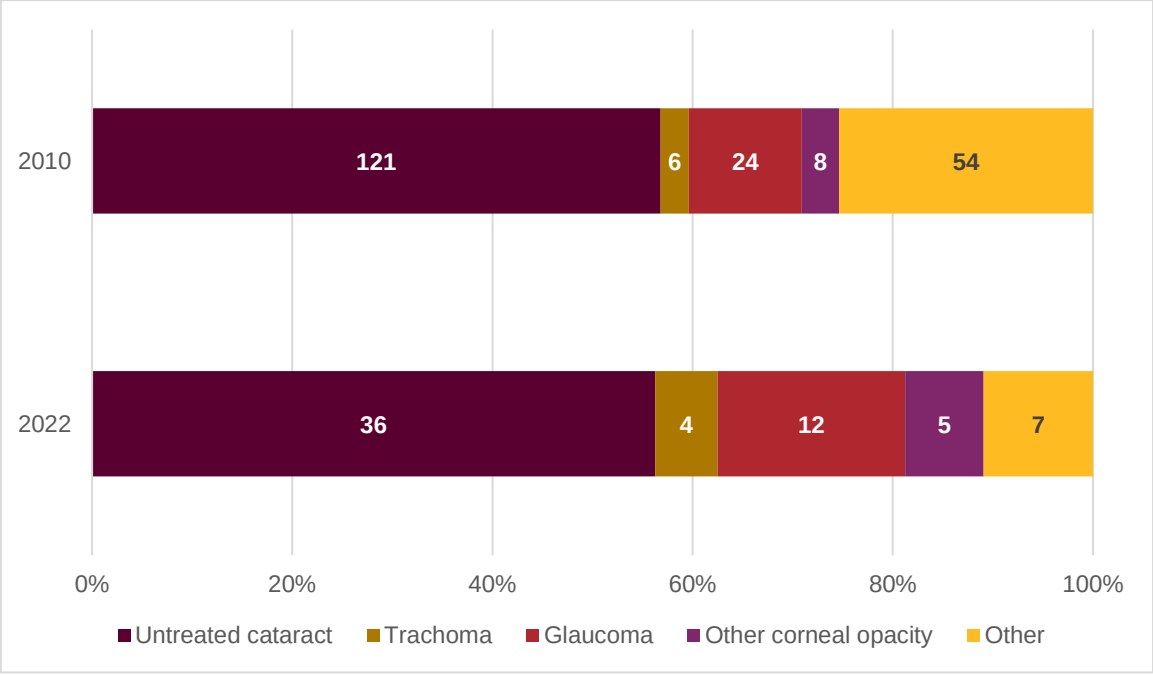


Figure 31 shows that unoperated cataract was the main cause of blindness in 2010 (56.8%; 121 cases) and the same as in 2022 (56.3%; 36 cases), followed by glaucoma (10.0%; 24 cases in 2010 and 18.8%; 12 cases in 2022). 'Other' corneal opacities and trachoma represented 3.8% (eight cases) and 2.8% (six cases) in 2010 and 7.8% (five cases) and 6.3% (four cases) in 2022.

Figure 29: Main cause of blindness in Kaolack region in 2010 and 2022



Unoperated cataract is the main cause of severe VI. It was responsible for 49.1% (54 cases) in 2010 and 81.1% (43 cases) in 2022 (see Figure 32).

Figure 30: Main cause of severe visual impairment in Kaolack region in 2010 and 2022

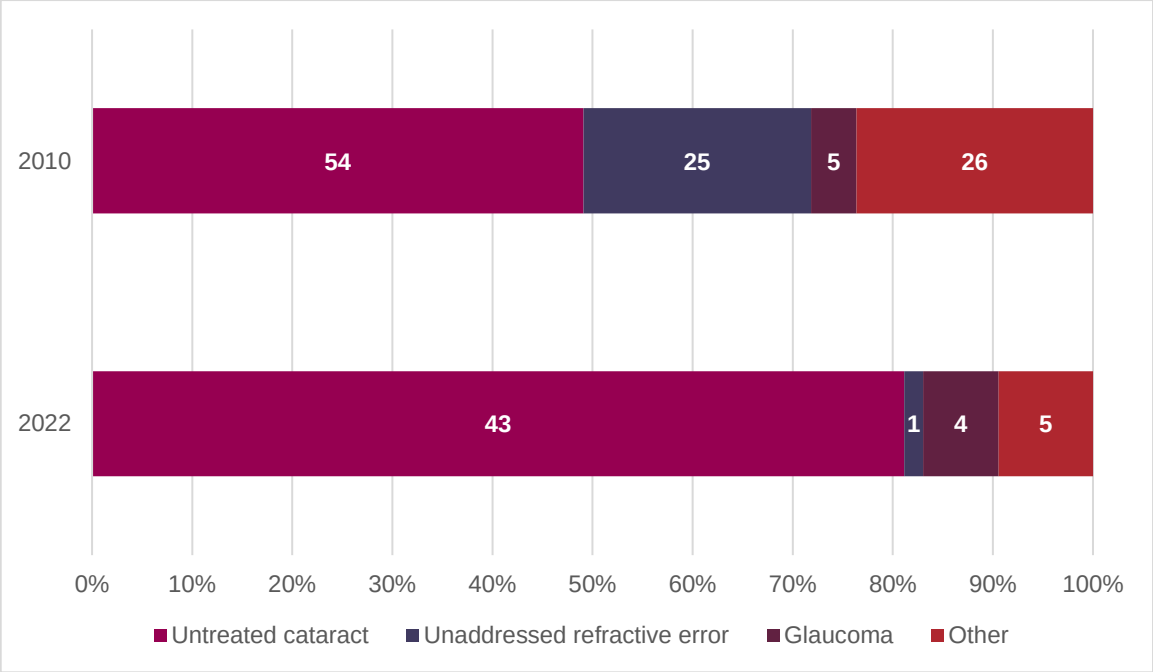
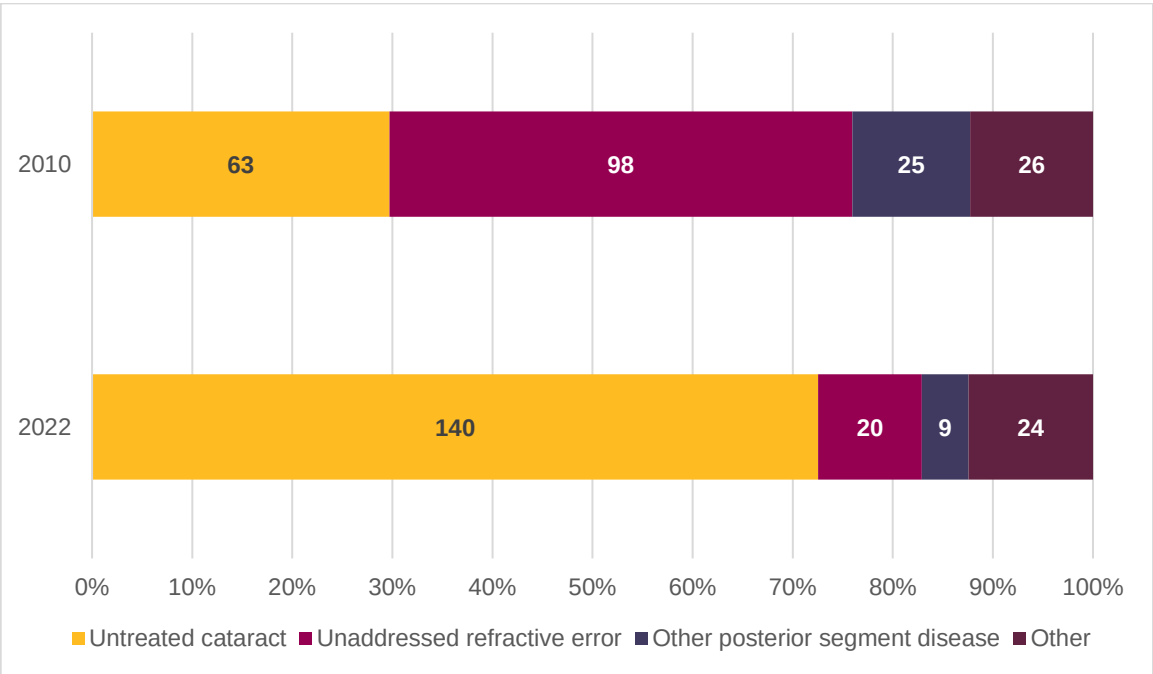


Figure 33 shows that unoperated cataract is the leading cause of moderate VI, and its contribution is greater in 2022 with 72.5% (140 cases) compared with 29.7% (63 cases) in 2010. Untreated refractive error contributed more to moderate VI in 2010 with 46.2% (98 cases) compared with 10.4% (20 cases) in 2022.

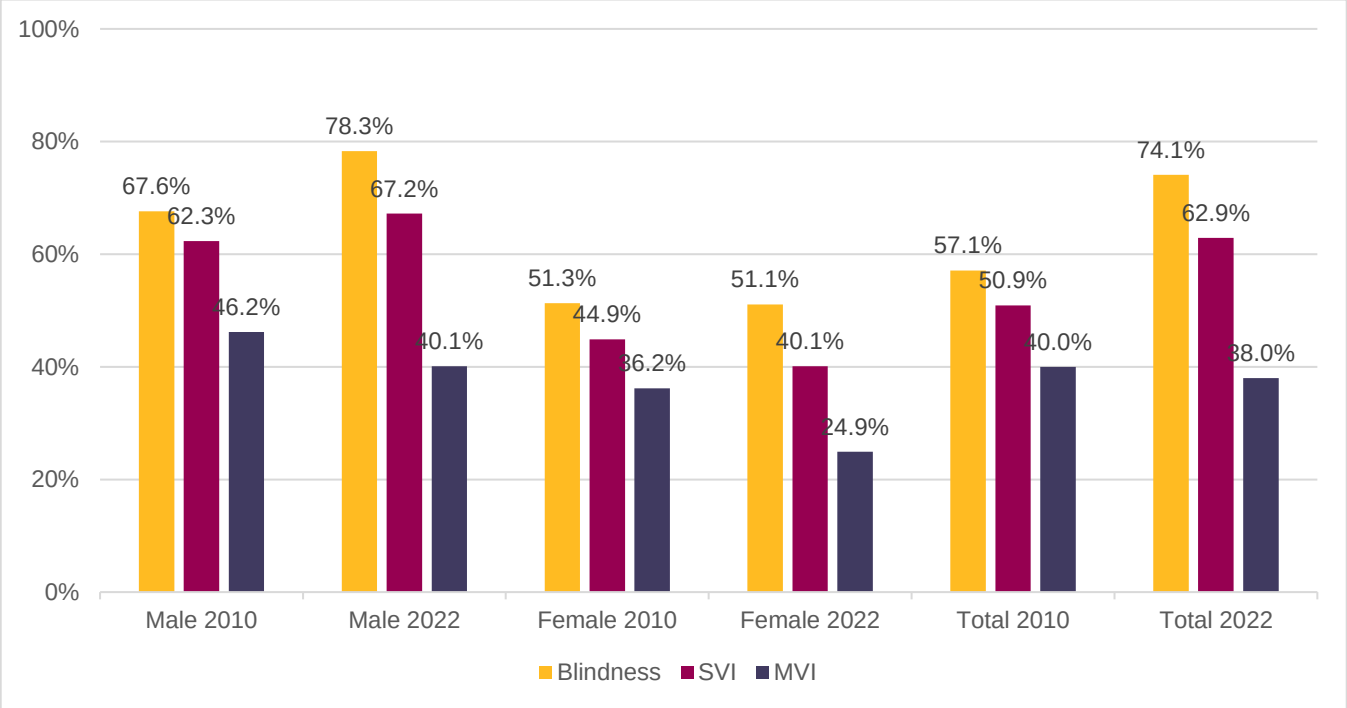
Figure 31: Leading cause of moderate visual impairment in Kaolack region in 2010 and 2022



Overall, we observed a 17.0 percentage point increase in cataract surgical coverage (the proportion of people with operable cataracts who had undergone surgery - see Figure 34). CSC increased from 57.1% in 2010 to 74.1% in 2022 at VA <1/20 and from 50.9% in 2010 to 62.9% in

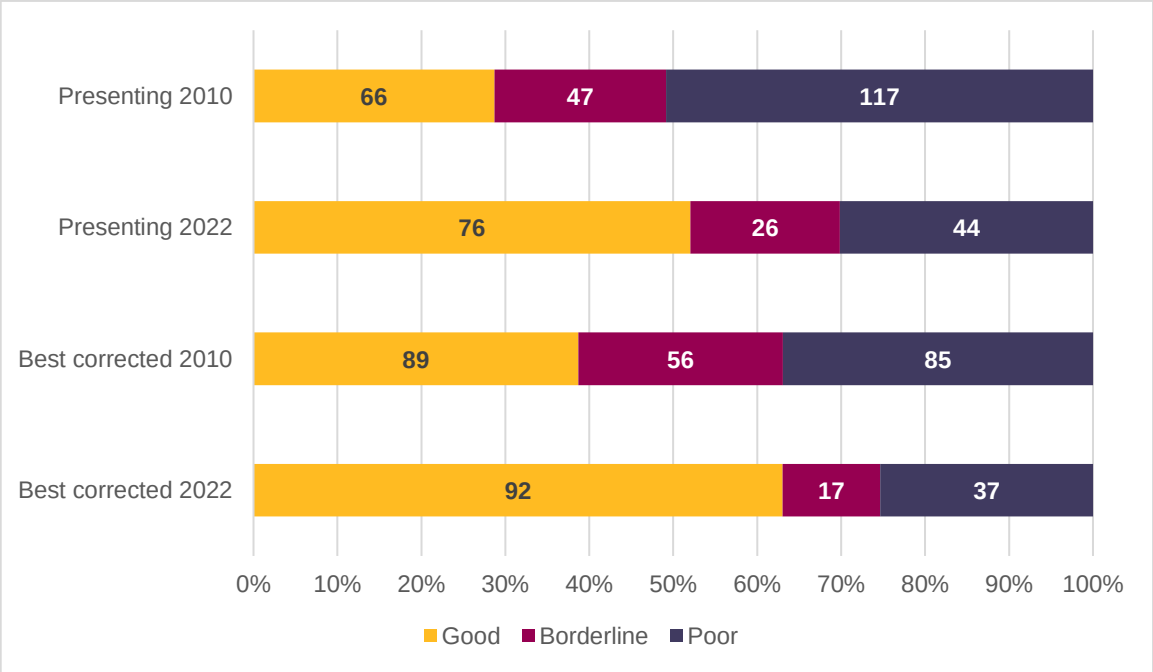
2022 at VA <1/10. A closer look shows that the increase in CSC was greater among men, with the proportion of men requiring and receiving surgery increasing from 67.6% in 2010 to 78.3% in 2022. Among women, coverage remained stable at 51.3% in 2010 and 51.1% in 2022.

Figure 32: Cataract surgical coverage between men and women at different levels of visual impairment in 2010 and 2022



The quality of visual outcomes among operated eyes improved significantly between 2010 and 2022. The proportion of those presenting "good" vision (VA>3/10) increased from 28.7% (66 cases) to 52.1% (76 cases), and the best correction “good” vision increased from 38.7% (89 cases) to 63.0% (92 cases) (see Figure 35). Similarly, there is a decrease in the proportion of those with "poor" VA results from 36.9% (85 cases) in 2010 to 25.3% (37 cases) in 2022.

Figure 33: Visual outcomes of operated eyes (presenting and best corrected vision) in Kaolack region in 2010 and 2022



Discussion

The objective of this study was to estimate the prevalence and causes of visual impairment in people aged 50 and above in the regions of Fatick and Kaolack in Senegal.

The results of this study showed that the prevalence of blindness among people aged 50 years and above was 5.2% [3.9-6.4] in Fatick and 3.6% [2.8-5.0] in Kaolack. The prevalence of severe visual impairment (SVI) was 3.4% in Fatick and 3% in Kaolack. The moderate visual impairment (MVI) was 13.5% in Fatick and 10.9% in Kaolack and early visual impairment (EVI) was 9.5% in Fatick and 7.9% in Kaolack. We observed no difference between men and women in the overall prevalence of visual impairment.

When comparing the results of the RAAB conducted in 2010 with the results of 2022 in these two regions of Senegal, the prevalence of visual impairment in Fatick remained stable among people aged 50 and above, also among men and women. On the other hand, in the Kaolack region we observed a significant drop in the prevalence of blindness and SVI in this age group.

The absolute number of people living with visual impairment also remained stable over ten years in both regions. Demographic changes observed since 2010 show that there is currently an ageing of the population in Senegal (more people aged 50 and over), which would be reflected in the total number of people affected by VI. Our findings suggest that the eye-care services in these two regions operate at a relatively good pace to prevent a significant increase in the number of blind and severely visually impaired patients due to these demographic changes. The pace, however, is not sufficient to revert the trend and reduce the number of people with SVI or blindness.

During the RAAB conducted in 2010 in the regions of Fatick and Kaolack, data on disability and equity was not collected. However, in 2022 in these two regions, the results indicate that people with disabilities - including people with non-visual disabilities - were more likely to have a visual impairment, particularly severe forms such as blindness. The distribution of visual impairment among the five quintiles within the population did not show any specific pattern in the relationship between VI and relative wealth. It is, however, important to specify that the equity tool used in this study is that of 2013 which may not really reflect the current level of poverty within the country.

With regards to disability, although the results on disability should be treated with caution, there is an indication that people with non-visual disabilities may be at higher risk of severe VI and blindness.

The spatial data collected during this study showed geographic differences between different districts in Fatick region in terms of blindness prevalence and cataract surgery coverage. The district of Sokone located in the south of Fatick and that of Niakhar in the north had a high prevalence of blindness compared to the other districts. Overall, the cataract surgical coverage was high in both regions - 64.8% in Fatick and 74.1% in Kaolack. In Fatick, there is a slight disparity between the districts of Gossas, Niakhar and Sonkone where the number of operated cataracts is slightly lower than the other districts. In Kaolack, there was no difference between districts in the distribution of cataract surgical coverage. In general, the results of the surgery remain mixed; in Fatick and Kaolack respectively, 46.6% and 42.9% of the operated eyes had “limited” (borderline)

or “poor visual” results. Similarly, surgical complications of cataracts remain high in both regions: 58.6% and 56.3% of the operated eyes with poor outcomes in Fatick and Kaolack respectively were due to complications.

As in 2010, the results of the RAAB carried out in 2022 show that cataract remains the main cause of blindness: 54.6% (2010) against 66.3% (2022) in Fatick and 56.8% (2010) against 56.3% (2022) in Kaolack. It is also the main cause of SVI and MVI in both regions.

Other causes of VI varied between the two regions. In Fatick, trachoma was the second main cause of blindness (9.8%), followed by glaucoma (7.6%), while in Kaolack, glaucoma was the second main cause (18.8%) followed by other corneal opacities (7.8%) and trachoma (6.3%). Data on other causes of VI should be treated with caution as RAABs assign only one cause per eye or visually impaired individual, and it must be the easiest to treat.

Overall, the CSC increased by about 12% and 17% between 2010 and 2022 respectively in Fatick and Kaolack, from 53.0% to 64.8% in Fatick and 57.1% to 74.1% in Kaolack. However, the increase in the CSC was higher in men in both regions. In Fatick, CSC for men was 71.7% in 2022 against 52.9% in 2010; for women, CSC was 57.8% in 2022 against 53.1% in 2010. The same observation was made in Kaolack: among men, CSC was 78.3% in 2022 against 67.6% in 2010, and among women CSC was 51.1% against 51.3%.

These gender differences are considerable. In order to develop more gender-sensitive strategies, it is therefore important to identify and understand the characteristics of women who do not have access to cataract surgery services and the reasons for that. Overall, the eCSC remained low in both regions: 23.7% in Fatick and 30.5% in Kaolack. Limited access to cataract services (particularly for women) and a significant proportion of surgeries with poor visual outcomes are important contributing factors to these figures. Given the strong global focus on eCSC as an indicator of universal eye-health coverage, it is critical to address both the access to and quality of surgery. Otherwise, achieving WHO recommendation of 30 per cent increase in eCSC by 2030 (6), will be a challenge in Senegal.

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Appendices

Appendix A: Rapid Assessment of Avoidable Blindness tool

APPRÉCIATION RAPIDE DE LA CÉCITÉ ÉVITABLE AU SÉNÉGAL

A. Information Générale Année – Mois: ____ - ____

Secteur d'enquête: _____ Numéro grappe : ___ Numéro sujet: ___

Nom: _____ Sexe: homme: O (1) Age (années): ___

femme: O (2)

Non: O (1) Statut de l'examen:

Oui: O (2) Examiné: O (1) (aller à B) Refus: O (3) (aller à E)

Non disponible: O (2) (aller à E) Non capable communiquer: O (4) (aller à E)

Antecedent de traitement des yeux ***Non*** *O* ***Oui*** *O (Si chirurgie de la cataracte remplir C et G)*

B. VISION - avec la correction portée

Usage lunettes de loin **Non:** O (1) **Oui:** O (2)

Usage lunettes près **Non:** O (1) **Oui:** O (2)

		Œil droit	**Œil gauche**
Voit 5/10	6/18	O (1)	O (1)
Ne voit pas 5/10	6/18		
mais voit 3/10	6/60	O (2)	O (2)
Ne voit pas 3/10	6/60		
mais voit 1/10	3/60	O (3)	O (3)
Ne voit pas 1/10	3/60		
mais voit 1/20	1/60	O (4)	O (4)
Ne voit pas 1/20	1/60		
mais CLD 1m		O (5)	O (5)
PL+		O (6)	O (6)
PL-		O (7)	O (7)

VISION - avec trou sténopéïque

	Œil droit	**Œil gauche**
Voit 5/10	O (1)	O (1)
Ne voit pas 5/10		
mais voit 3/10	O (2)	O (2)
Ne voit pas 3/10		
mais voit 1/10	O (3)	O (3)
Ne voit pas 1/10		
mais voit 1/20	O (4)	O (4)
Ne voit pas 1/20		
mais CLD 1m	O (5)	O (5)
PL+	O (6)	O (6)
PL-	O (7)	O (7)

C. Examen du cristallin

	Œil droit	**Œil gauche**
Cristallin normal/opacité minimale:	O (1)	O (1)
Opacité évidente du cristallin:	O (2)	O (2)
Cristallin absent (aphakie):	O (3)	O (3)
Pseudophakie sans OCP:	O (4)	O (4)
Pseudophakie avec OCP:	O (5)	O (5)
Cristallin non visible:	O (6)	O (6)

D. Cause principale de vision <5/10

(cochez une réponse par œil)

	Œil droit	**Œil gauche**	**Cause principale personne**
Vice de la réfraction:	O (1)	O (1)	O (1)
Aphakie non corrigée:	O (2)	O (2)	O (2)
Cataracte, non traitée	O (3)	O (3)	O (3) **(F)**
Complications de la chirurgie:	O (4)	O (4)	O (4)
Trachome:	O (5)	O (5)	O (5)
Autre opacité cornéenne:	O (6)	O (6)	O (6)
Phthysis	O (7)	O (7)	O (7)
Onchocerciasis:	O (8)	O (8)	O (8)
Glaucome:	O (9)	O (9)	O (9)
Rétinopathie diabétique :	O (10)	O (10)	O (10)
Dégénérescence maculaire (age):	O (11)	O (11)	O (11)
Autre path. segment post. / SNC:	O (12)	O (12)	O (12)
Anomalie du globe:	O (13)	O (13)	O (13)
Non examiné (voit 5/10)	O (14)	O (14)	O (14)

E. Interrogatoire, si non examiné

(Des proches ou voisins)

Supposé:	**Œil droit**	**Œil gauche**
Voyant	O (1)	O (1)
Aveugle par cataracte	O (2)	O (2)
Aveugle par autre cause	O (3)	O (3)
Opéré de la cataracte	O (4)	O (4)

F. Raisons pour lesquelles l'opération de la cataracte n'a pas été réalisée

(Marquer pas plus de 2 réponses, si AV< 5/10, ne s'améliorant pas avec le trou sténopéïque, avec l'opacité évidente du cristallin dans un ou les deux yeux)

Besoin non ressenti	O (1)
Peur	O (2)
Incapable de payer pour l'opération	O (3)
Opération contre indiquée	O (4)
Ne sais pas que le traitement est possible	O (5)
Problème d'accessibilité	O (6)
Autre	O (7)

G. Détails sur chirurgie de la cataracte

	Œil droit	**Œil gauche**
Age à l'opération (années)		
Lieu de l'opération		
Hôpital gouvernemental	O (1)	O (1)
Hôpital bénévole / de charité	O (2)	O (2)
Hôpital privé	O (3)	O (3)
Camp de cataracte	O (4)	O (4)
Contexte traditionnel	O (5)	O (5)
Type d'opération		
Sans implant	O (1)	O (1)
Avec implant	O (2)	O (2)
Abaissement de la cataracte	O (3)	O (3)
Coût de l'opération		
Totalement gratuit	O (1)	O (1)
Partiellement gratuit	O (2)	O (2)
Entièrement payant	O (3)	O (3)
Cause de vision<5/10 après chirurgie de cataracte		
Autre désordre de l'oeil-comorbidité	O (1)	O (1)
Complications de l'operation	O (2)	O (2)
Troubles de la réfraction	O (3)	O (3)
Complications long terme - sequelle	O (4)	O (4)
Ne s'applique pas - peut voir 5/10	O (5)	O (5)

Appendix B: Washington Group Short Set – Enhanced

Preamble to the WGSS Enhanced:

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

VISION		
VIS_1	[Do/Does] [you/he/she] have difficulty seeing, even when wearing [your/his/her] glasses]?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
HEARING		
HEAR_1	[Do/Does] [you/he/she] have difficulty hearing, even when using a hearing aid(s)]?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
MOBILITY		
MOB_1	[Do/Does] [you/he/she] have difficulty walking or climbing steps?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
COMMUNICATION		
COM_1	Using [your/his/her] usual language, [do/does] [you/he/she] have difficulty communicating, for example understanding or being understood?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
COGNITION (REMEMBERING)		
COG_1	[Do/does] [you/he/she] have difficulty remembering or concentrating?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
SELF-CARE		
SC_SS	[Do/does] [you/he/she] have difficulty with self-care, such as washing all over or dressing?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
UPPER BODY		
UB_1	[Do/Does] [you/he/she] have difficulty raising a two-litre bottle of water or soda from waist to eye level?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all
UB_2	[Do/Does] [you/he/she] have difficulty using [your/his/her] hands and fingers, such as picking up small objects, for example, a button or pencil, or opening or closing containers or bottles?	1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all

AFFECT (ANXIETY AND DEPRESSION)	*Interviewer: If respondent asks whether they are to answer about their emotional states after taking mood-regulating medications, say: "*Please answer according to whatever medication [you were/he was/she was] taking."	
ANX_1	How often [do/does] [you/he/she] feel worried, nervous, or anxious?	1. Daily 2. Weekly 3. Monthly 4. A few times a year 5. Never
ANX_2	Thinking about the last time [you/he/she] felt worried, nervous, or anxious, how would [you/he/she] describe the level of these feelings?	1. A little 2. A lot 3. Somewhere in between a little and a lot
DEP_1	How often [do/does] [you/he/she] feel depressed?	1. Daily 2. Weekly 3. Monthly 4. A few times a year 5. Never
DEP_2	Thinking about the last time [you/he/she] felt depressed, how depressed did [you/he/she] feel?	1. A little 2. A lot 3. Somewhere in between a little and a lot

Appendix C: Senegal Equity Tool (SET)

	Question	Option 1	Option 2	Option 3	Option 4
	Does your household have…				
Q1	… a TV?	Yes	No		
Q2	… a refrigerator?	Yes	No		
Q3	… an MMDS/TV5 antenna?	Yes	No		
Q4	… a non-mobile telephone?	Yes	No		
Q5	… electricity?	Yes	No		
Q6	… a CD/DVD player?	Yes	No		
Q7	… an Internet connection?	Yes	No		
Q8	… a CANAL television subscription?	Yes	No		
Q9	… a computer?	Yes	No		
Q10	Does any member of your household own … their own vehicle?	Yes	No		
Q11	… cart?	Yes	No		
Q12	Does any member of this household have a bank account or account with another financial institution (mutual savings and credit, savings account…)?	Yes	No		
Q13	What type of fuel does your household primarily use for cooking?	Bottled gas	Wood, straw	Other	
Q14	What is the main source of drinking water for members of your household?	Piped into dwelling	Unprotected wall	Other	
Q15	What kind of toilet facility do members of your household usually use?	Flushed to piped sewer system	Flush to septic tank	Traditional latrine	Other
Q16	What is the primary material of the floor of your dwelling?	Cement	Ceramic tile	Earth/sand/ dung	Other
Q17	What is the primary material of the roof of your dwelling?	Cement	Calamine/cement fibre	Other	
Q18	What is the primary material used in the construction of the exterior walls of your dwelling?	Cement	Bamboo/cane /palm/trunks/dirt	Other	