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Identifying the key factors influencing the cause of blindness and visual impairment in Sierra Leone: A mixed-methods analysis of epidemiological and socioeconomic determinants

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Abstract

Sierra Leone, a post-conflict nation in West Africa, bears a disproportionately high burden of blindness and visual impairment (BVI), severely impacting human capital and socioeconomic development; this study aimed to identify and analyze the key factors influencing the causes of BVI to inform effective public health interventions. A nationwide, population-based cross-sectional survey was conducted utilizing two-stage cluster random sampling in accordance with WHO's Rapid Assessment of Avoidable Blindness (RAAB) methodology, examining 5,118 participants aged ≥50 years across all four geographic regions, complemented by 32 semi-structured interviews to explore contextual and socioeconomic barriers. The prevalence of blindness (presenting visual acuity less than 3/60) was 4.2% (95% CI: 3.7-4.7), with major causes being cataract (58.3%), glaucoma (14.2%), posterior segment diseases (11.5%), corneal opacities (7.1%), and uncorrected refractive error (5.4%); over 70% of all blindness was avoidable, with key influencing factors including extreme poverty, a critical shortage of ophthalmic personnel, geographical inaccessibility, low surgical output, and persistent cultural beliefs. In conclusion, while cataract remains the leading cause, the high prevalence is sustained by a complex interplay of systemic healthcare weaknesses, profound poverty, and deeply entrenched social barriers, necessitating a multi-faceted national eye health strategy that integrates service delivery with poverty reduction and health education to eliminate avoidable blindness.

Keywords: Blindness; Visual Impairment; Sierra Leone; Cataract; Global Health; Avoidable Blindness

1. Introduction

Blindness and visual impairment (BVI) represent a significant global public health challenge, with an estimated 2.2 billion people living with vision impairment, the majority of which is avoidable or treatable (WHO, 2021). The burden is not distributed equally; it disproportionately affects low- and middle-income countries, particularly in Sub-Saharan Africa, where the prevalence of blindness can be up to ten times higher than in high-income regions (Flaxman et al., 2017). This disparity is a stark indicator of global health inequity, directly linked to poverty, weak health systems, and limited access to essential eye care services. In these settings, vision loss is not merely a health condition but a development issue, intricately linked to poverty, exacerbating cycles of poor educational outcomes, reduced economic productivity, and increased mortality (Burton et al., 2021). Addressing avoidable blindness is, therefore, a critical target within the United Nations Sustainable Development Goals, particularly Goal 3 (Good Health and Well-being).

Sierra Leone, located on the West African coast, is consistently ranked among the world's poorest nations (UNDP, 2022). Its recent history is marred by a devastating civil war (1991-2002) and the catastrophic Ebola Virus Disease outbreak (2014-2016), both of which decimated an already fragile health infrastructure. The nation's health system struggles

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with profound challenges, including critical shortages of healthcare workers, inadequate funding, and limited geographical coverage, especially in rural areas where the majority of the population resides (Kamare et al., 2025).

Within this context, eye care services are severely under-resourced. The country has a negligible number of ophthalmologists serving a population of over 8 million, with ophthalmic services primarily concentrated in the capital, Freetown (St Clair et al., 2024). Previous, smaller-scale studies and situational analyses have pointed to a high prevalence of BVI, with cataract, glaucoma, and untreated infectious diseases like trachoma being major concerns (Jolley et al., 2022). However, a comprehensive, nationwide survey to accurately determine the prevalence and causes, and crucially to analyze the underlying factors that perpetuate this burden, has been lacking.

Understanding the epidemiology of BVI is only the first step. The "what" must be accompanied by the "why." Factors such as the cost of surgery, distance to a health facility, lack of trained personnel, cultural beliefs about blindness and its treatment, and patient awareness levels are critical determinants that influence whether a preventable condition leads to permanent vision loss. In Sierra Leone's unique socio-economic and cultural landscape, identifying these key influencing factors is not an academic exercise but a fundamental prerequisite for designing effective, context-appropriate, and sustainable interventions.

This study, therefore, aims to

- Determine the prevalence and principal causes of blindness and visual impairment among adults aged ≥50 years in Sierra Leone.
- Quantify the proportion of blindness that is avoidable (treatable or preventable).
- Identify and analyze the key socioeconomic, cultural, and health-system-related factors that influence these causes and act as barriers to accessing eye care services.
- The findings of this research will provide the evidence base needed for the Ministry of Health and Sanitation (MoHS) and its partners to prioritize resources, design targeted strategies, and advocate for the integration of eye health into the broader national health and development agenda, ultimately working towards the goals of the World Health Organization's global initiative, "Universal Eye Health: A Global Action Plan 2014-2019."

2. Literature Review

The global magnitude of BVI has been extensively documented in the Global Burden of Disease (GBD) studies. Flaxman et al. (2017) estimated that in 2015, 36 million people were blind and 217 million had moderate to severe visual impairment (MSVI). The leading causes globally for blindness were cataract (35.2%), uncorrected refractive error (21.4%), glaucoma (8.4%), age-related macular degeneration (5.5%), and diabetic retinopathy (4.6%). For MSVI, uncorrected refractive error was the dominant cause (53.4%), followed by cataract (17.7%). Crucially, over 80% of all vision impairment is considered avoidable.

The African Context: The pattern of eye disease in Sub-Saharan Africa (SSA) presents with distinct challenges. While cataract is also the leading cause of blindness, its proportion tends to be higher than the global average, often accounting for over 50% of cases, indicative of poor surgical coverage (Bastawrous & Suni, 2020). Infectious diseases like trachoma and onchocerciasis (river blindness), which have been largely eliminated in other regions, remain significant public health problems in many parts of SSA. Glaucoma is particularly aggressive in populations of African descent and often presents at a younger age with more advanced disease, leading to a higher rate of blindness (Kyari et al., 2018). Furthermore, diabetic retinopathy is an emerging threat due to increasing urbanization and changing lifestyles (Burgess et al., 2013).

The Sierra Leonean Context: Literature specific to Sierra Leone is sparse but revealing. A seminal study by Jolley et al. (2022) conducted a RAAB survey in several districts, finding a blindness prevalence of 4.6% in those ≥50 years, with cataract responsible for 68.8% of cases. They reported a cataract surgical coverage (CSC) of 46.7%, falling short of the WHO recommendation of at least 80%. This low coverage was attributed to factors like cost, lack of awareness, and fear of surgery.

The legacy of the civil war and Ebola continues to cast a long shadow over the health system. Kamare et al. (2025) detailed how the health workforce was crippled, a situation from which it has not fully recovered. For eye care, this translates to an extreme scarcity of human resources. St Clair et al., (2024) noted that Sierra Leone has one of the lowest ratios of ophthalmologists to population in the world, with virtually all situated in Freetown, creating a massive urban-rural disparity in access.

Trachoma has been a historical concern. Despite mapping efforts by the Ministry of Health and partners indicating that Sierra Leone is not hyperendemic for trachomatous trichiasis, pockets of disease persist (MoHS, 2023). Other neglected tropical diseases affecting the eye, such as onchocerciasis, are also endemic in certain regions.

The role of poverty is a recurring theme in the literature on health in Sierra Leone. Several literature linking poverty to health outcomes, demonstrating that the poorest quintiles have significantly worse access to all forms of healthcare, including eye care. The direct costs of surgery (even when nominally "free," due to associated transport and accommodation costs) and the indirect costs of lost income during recovery are prohibitive for many (Phull et al., 2021).

Cultural beliefs and health-seeking behavior form another critical layer. A qualitative study by Macfarlane (2005) in neighboring Guinea (which shares similar cultural traditions) found that blindness is often perceived as a spiritual affliction or a normal part of aging, leading individuals to seek treatment from traditional healers before, or instead of, seeking biomedical care. This delay often results in presentation at advanced, inoperable stages of disease.

Gap in Knowledge: While existing literature provides snapshots of the problem, there is a critical lack of a comprehensive, national-level analysis for Sierra Leone that synthesizes epidemiological data with a deep investigation into the multifaceted barriers. Previous studies are either localized (e.g., Bo District only) or focus on a single disease. A holistic understanding that quantifies the burden while qualitatively exploring the influencing factors from the perspective of patients, communities, and healthcare providers is necessary to move beyond description to effective action. This study seeks to fill that gap.

3. Methodology

3.1. Study Design

This research employed a convergent parallel mixed-methods design. The primary component was a population-based, cross-sectional survey (quantitative) to determine the prevalence and causes of BVI. Concurrently, a qualitative component was conducted to explore the contextual barriers and facilitators influencing eye health-seeking behavior and service delivery. The two datasets were collected independently and then integrated during the interpretation phase to provide a comprehensive analysis.

3.2. Study Setting and Population

The study was conducted in Sierra Leone across all four provinces (Western Area, Northern, Southern, and Eastern) and the fourteen districts. The quantitative survey targeted all non-institutionalized individuals aged 50 years and older, the age group in which the majority of blindness and visual impairment occurs. The qualitative component targeted key informants, including:

- eye care patients and individuals with BVI;
- ophthalmic clinical staff (nurses, community health officers, ophthalmologists);
- hospital administrators; and
- community and religious leaders.

3.3. Sampling and Sample Size

Quantitative: A two-stage cluster random sampling method, based on the WHO/RAAB methodology, was used (WHO, 2020). In the first stage, 100 clusters (villages/neighborhoods) were selected from each district with probability proportional to size. In the second stage, 50 individuals aged ≥50 years were selected from each cluster through compact segment sampling. Assuming a blindness prevalence of 4.5%, a precision of 0.02, a design effect of 1.5, and a non-response rate of 15%, a minimum sample size of 4,250 was required. We aimed for 5,000 participants (100 clusters x 50 people) to ensure adequate power.

Qualitative: Purposive sampling was used to ensure a diverse range of perspectives from across the different regions and stakeholder groups. A total of 32 semi-structured interviews were conducted until thematic saturation was reached.

3.4. Data Collection

Quantitative: A team of enumerators and ophthalmic nurses was trained over a two-week period. Data collection tools were adapted from the standard RAAB protocol. The process in each cluster involved

- Visual Acuity (VA) Measurement: Presenting and pinhole VA was measured for each eye using a tumbling "E" chart.
- Lens Examination: Using a torchlight and a +2.5 Diopter loupe to assess the clarity of the lens for cataract.
- Diagnosis: For all participants with VA < 6/18 in the better eye, a basic eye examination was performed to determine the primary cause of visual impairment. The cause was assigned based on the major anatomical site of the abnormality.
- Questionnaire: A standardized questionnaire collected data on demographics, barriers to access, and previous eye surgery.

Qualitative: Semi-structured interview guides were developed for each stakeholder group, focusing on themes of knowledge, attitudes, and practices regarding eye health; perceived barriers to care; and suggestions for improvement. Interviews were conducted in Krio or local languages by trained qualitative researchers, audio-recorded, transcribed, and translated into English.

3.5. Data Analysis

Quantitative: Data were entered into the RAAB6 software and analyzed using Stata version 17. Prevalence rates of blindness (VA <3/60), severe visual impairment (SVI, VA <6/60 to ≥3/60), and moderate visual impairment (MVI, VA <6/18 to ≥6/60) were calculated with 95% confidence intervals. Causes were presented as proportions of all causes within each category of vision loss. Cataract Surgical Coverage (CSC) was calculated as a proportion of eyes that had undergone surgery out of all eyes that would have benefited from it. Multivariate logistic regression was used to identify independent predictors of blindness.

Qualitative: Transcripts were analyzed using thematic analysis, following the framework approach by Braun and Clarke (2006). This involved familiarization, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. NVivo software was used to manage the data.

3.6. Ethical Considerations

Ethical approval was granted by the Sierra Leone Ethics and Scientific Review Committee. Informed consent was obtained from all participants. For those with illiteracy, the information sheet was read aloud, and a thumbprint was obtained in the presence of a witness. All data were anonymized. Participants requiring medical attention were referred to the nearest eye clinic, and financial support was provided for transportation and surgery where needed.

4. Results

4.1. Demographic Characteristics

A total of 5,118 individuals were examined from 102 clusters, yielding a response rate of 93.1%. The mean age of participants was 65.4 years (SD ± 11.2), and 57.3% were female. The demographic distribution was broadly representative of the national population aged 50 and over.

4.2. Prevalence of Blindness and Visual Impairment

The age- and sex-adjusted prevalence of blindness (presenting VA <3/60 in the better eye) was 4.2% (95% CI: 3.7-4.7). The prevalence of Severe Visual Impairment (SVI) was 2.1% (95% CI: 1.8-2.4), and Moderate Visual Impairment (MVI) was 8.9% (95% CI: 8.2-9.6). Prevalence increased sharply with age, with the odds of blindness being 5.4 times higher (95% CI: 4.1-7.0) in those aged 70+ compared to those aged 50-59.

4.3. Causes of Blindness and Visual Impairment

Table 1 Causes of Blindness (Presenting VA <3/60) in the Better Eye

Causes	Number (n)	Percentage (%)
Cataract	125	58.3%
Glaucoma	30	14.2%
Posterior Segment Disease	25	11.5%
Corneal Opacity	15	7.1%
Uncorrected Refractive Error	12	5.4%
Others	7	3.5%
Total	214	100%

Cataract was the leading cause across all categories of vision loss. For MSVI (MVI + SVI), uncorrected refractive error was the second leading cause (28.4%), followed by cataract (27.1%) and glaucoma (11.3%).

4.4. Avoidable Blindness

The term avoidable blindness encompasses both preventable (the disease could have been stopped from occurring) and treatable (the blindness caused by the disease can be cured or reversed through medical intervention).

Over 70% of all blindness can be classified as avoidable: cataract, uncorrected refractive error, some corneal opacities, and glaucoma (with early intervention). With adequate resources, infrastructure, and education, the vast majority of blind people in Sierra Leone do not need to be.

4.5. Cataract Surgical Coverage (CSC) and Outcomes

The CSC (persons) was 48.2%, meaning less than half of those who needed cataract surgery had received it. Among those who had undergone surgery, only 45.6% achieved a good outcome (VA >6/18), with a significant proportion having poor outcomes due to surgical complications, uncorrected aphakia, or posterior capsule opacification.

4.6. Qualitative Themes on Influencing Factors

The analysis of the 32 interviews revealed five overarching themes that act as key influencing factors

- The Economic Barrier: The overwhelming barrier cited was cost. Even when surgery was offered for free by NGOs, the "hidden costs" of transport, food, and accommodation for both the patient and a family member were described as insurmountable. "They say the operation is free, but to get to Freetown from my village, I must pay for a bike, then a poda-poda (minibus). I must feed myself and my son who guides me. Where will I find that money?" (Male patient, 68, Northern Province).
- Health System Deficiencies: Participants universally described a lack of available services. The severe shortage of ophthalmic personnel, especially outside Freetown, was a critical issue. Long waiting times, stock-outs of essential medications (e.g., glaucoma drops), and a lack of functional equipment were frequently reported by clinical staff. "We have one ophthalmologist for the entire Eastern Province. We can only do outreach clinics quarterly, and we never have enough lenses for all the patients we list." (Ophthalmic Nurse, Eastern Province).
- Geographical and Physical Access: The poor state of roads, especially during the rainy season, and the lack of affordable transportation effectively isolated rural communities from eye care facilities, which are almost exclusively located in district towns or the capital.
- Knowledge and Health Beliefs: A significant knowledge gap regarding the causes and treatability of eye diseases was evident. Many participants normalized vision loss as an inevitable part of aging. Others attributed it to spiritual causes (e.g., witchcraft, divine will) or environmental factors (e.g., heat, dust), leading them to seek help first from traditional healers or pastors. "My father went blind slowly. We thought it was just his time. We did not know a simple operation could bring his sight back." (Community Leader, Southern Province).
- Social and Gender Dynamics: Women often faced additional barriers, needing permission from husbands or male relatives to travel or spend household money on healthcare. They were also less likely to be prioritized for family resources when a choice had to be made about who received care.

5. Discussion

This study provides the first comprehensive, nationally representative data on the prevalence, causes, and key determinants of BVI in Sierra Leone. The findings confirm that the country faces a severe burden of avoidable blindness, largely driven by cataract, but sustained by a complex web of systemic and socioeconomic failures.

The blindness prevalence of 4.2% is significantly higher than the global average (0.6%) and the WHO African Region average (1.05%) for all ages, but is consistent with rates found in other post-conflict and fragile states in SSA (Flaxman et al., 2017). The fact that cataract accounts for 58.3% of blindness is not unusual for the region; however, it is a stark indicator of a health system failing to deliver a simple, cost-effective, and curative intervention at the required scale. The low Cataract Surgical Coverage of 48.2% and the poor surgical outcomes (only 45.6% with good vision) highlight a dual crisis of both access and quality.

The findings move beyond mere epidemiology to dissect the "why" behind these statistics. The qualitative data powerfully illustrate how the quantitative results are a direct consequence of the five key influencing factors.

First, extreme poverty is the fundamental determinant. It amplifies all other barriers. The out-of-pocket expenses for transport and sustenance, even for "free" surgery, are catastrophic for families living on less than $2 a day. This finding aligns with the theory of "impoverishing healthcare expenditure" and is a major barrier to achieving Universal Health Coverage (UHC) in Sierra Leone.

Second, the crumbling health system, characterized by a critical human resource crisis and weak infrastructure, is the proximal cause of low service availability. With one of the lowest densities of ophthalmologists globally, the system lacks the core capacity to address the backlog of cataract blindness, let alone manage other complex conditions like glaucoma. This shortage is a legacy of brain drain and under-investment, exacerbated by the civil war and Ebola outbreak (Kamare et al., 2025).

Third, geographical isolation compounds the problem, creating a tiered system where urban populations have marginally better access while rural communities are effectively left in the dark. This inequity is a common feature of health systems in low- and middle-income countries but is particularly acute in Sierra Leone due to its challenging terrain and poor infrastructure.

Fourth, socio-cultural beliefs and low health literacy create a "help-seeking pathway" that often leads away from biomedical care. The perception of blindness as a natural or spiritual event results in critical delays in presentation, by which time surgery may be more complex or, in the case of glaucoma, entirely futile. This underscores the necessity of community-based health education that is culturally sensitive and delivered by trusted local figures (Macfarlane 2005).

Finally, the gender disparity reveals how blindness is not just a health issue but a development and rights issue. The barriers faced by women ensure that they bear a disproportionate burden of disease, which in turn affects their productivity, autonomy, and ability to care for their families.

The interplay of these factors creates a vicious cycle: poverty causes blindness, and blindness exacerbates poverty by reducing an individual's ability to work and increasing household dependency. Breaking this cycle requires a multi-pronged approach that addresses all levels of the problem simultaneously.

- **Limitations**: The study's focus on adults above 50 years old, meaning the burden of childhood blindness is not captured. Furthermore, the diagnosis of glaucoma was based on clinical examination without perimetry, potentially leading to under-diagnosis. The qualitative sample, while diverse, may not capture every unique community perspective.

Nomenclature

- BVI: Blindness and visual impairment;
- CI: Confidence interval;
- CSC: Cataract surgical coverage;
- GBD: Global burden of disease;
- MOHS: Ministry of Health and Sanitation;
- MSVI: Moderate to severe visual impairment;
- MVI: Moderate visual impairment;

- NGO: Non-Governmental Organization;
- RAAB: Rapid Assessment of Avoidable Blindness;
- SD: Standard deviation;
- SSA: Sub-Saharan Africa;
- SVI: Severe visual impairment;
- UHC: Universal health coverage;
- VA: Visual acuity;
- WHO: World Health Organization;

6. Conclusion

This study conclusively identifies cataract as the leading cause of blindness in Sierra Leone and, more importantly, reveals that the high prevalence is not an inevitable tragedy but a failure of the health system and a reflection of profound social and economic inequities. The key factors influencing the cause of BVI are multifaceted and interlocking, encompassing economic barriers, critical health system weaknesses, geographical inaccessibility, deeply ingrained cultural beliefs, and discriminatory social norms.

The burden of avoidable blindness in Sierra Leone is therefore a symptom of broader systemic failures. Addressing it requires more than occasional surgical outreach campaigns. It demands a fundamental strengthening of the entire eye health system within the broader context of poverty reduction and health system reform. A business-as-usual approach will not suffice. The findings of this study serve as an urgent call to action for the government, international partners, and civil society to prioritize eye health as an integral component of national development and Universal Health Coverage.

Recommendations

Based on the findings, the following recommendations are proposed

For the Ministry of Health and Sanitation (Moh's)

- Develop and Fund a National Eye Health Strategy: Integrate eye health into the Essential Health Package and Primary Health Care system. This strategy must explicitly aim to increase Cataract Surgical Coverage to >80% and improve surgical outcomes.
- Invest in Human Resources: Establish a dedicated training program for mid-level ophthalmic personnel (Ophthalmic Clinical Officers, Nurses) to expand service delivery at the district level. Create incentives for ophthalmologists to work in public facilities outside Freetown.
- Strengthen Supply Chains: Ensure reliable availability of essential ophthalmic consumables (e.g., glaucoma medications) at all secondary and tertiary health facilities.

For Eye Care Service Providers (NGOs & Public Facilities)

- Decentralize Services: Move beyond capital-centric models. Establish permanent, well-equipped eye units in regional hospitals and integrate eye care into routine mobile health clinics.
- Subsidize Access: Implement a transparent system to cover not just the cost of surgery but also the associated transport and accommodation costs for patients and their guides from low-income households.
- Improve Surgical Quality: Adopt standardized protocols, provide continuous training for surgeons, and ensure robust follow-up systems to monitor and improve surgical outcomes.

For Community and Awareness Programs

- Launch Nationwide Health Education Campaigns: Use local radio, community leaders, and religious figures to disseminate messages in local languages that demystify cataract surgery, challenge harmful beliefs, and promote early help-seeking.
- Target Women Specifically: Design outreach programs that address the specific barriers faced by women, including facilitating community support for their travel and care.

For Further Research

Conduct a similar survey to determine the prevalence and causes of childhood blindness.

Implement operational research to test the effectiveness of different service delivery models (e.g., mobile surgical units vs. static clinics) and financing mechanisms (e.g., voucher schemes) in the Sierra Leonean context.

Compliance with ethical standards

Statement of ethical approval

Ethical approval for this study was granted by the National Ethics Committee.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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