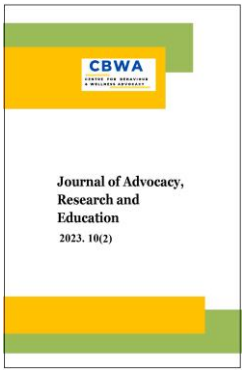
Publisher: Centre for Behaviour and Wellness Advocacy, Ghana
Co-publisher: Cherkas Global University, USA
Has been issued since 2014
ISSN 2410-4981. E-ISSN 2508-1055
2023. 10(2): 59-67

DOI: 10.13187/jare.2023.2.59

Journal homepage:
http://kadint.net/our-journal.html



Articles

Visual Impairment among Public School Children in the Biadan and Kato Circuits in the Berekum Municipality, Bono Region, Ghana

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Abstract

The aim of the study was to determine the prevalence and causes of visual impairment (VI) among primary school children in the Biadan and Kato circuits in the Berekum Municipality, Bono Region, Ghana. A cross-sectional and a two-stage random sampling technique was employed to recruit 299 study participants. Visual acuity, retinoscopy, examination of the anterior segment, media and fundus were conducted on each participant. A modified refractive error survey in children (RESC) protocol was used in collecting data. A presenting visual acuity of ≤ 6/12 in the better eye was diagnosed as having VI with a cause. Prevalence was estimated, and binary logistic regression was used to determine the strength of the association between visual impairment and independent variables at a 95 % confidence interval. Two hundred and ninety-five (295) children with a mean age of 10.08 ± 2.18 years were able to go through all examinations. The prevalence of VI was 8.14 %. Twenty-four children were visually impaired, of whom 17 (70.83 %) were females and 7 (29.17 %) were males. Refractive error was the cause in 67 % of visually impaired children, cataracts in 8 %, and amblyopia in 4 %. Age was found to be associated with VI (OR=0.77; 95 % CI:0.63-0.95), while gender showed no association. Uncorrected refractive error is a common cause of VI among school children in the Biadan and Kato circuits. Age was negatively associated with visual impairment, suggesting the vulnerability of younger school children. Early detection and provision of affordable eye health services may help curb preventable VI.

Keywords: causes, Ghana, prevalence, public school, school children, visual impairment.

1. Introduction

Visual impairment (VI) remains a public health concern amongst different population groups. In school children, it considerably impacts learning and academic achievement, especially in under-served and under-resourced communities (Ovenseri-Ogbomo, Omuemu, 2010). Global estimates indicate that there are approximately 19 million visually impaired children worldwide, with many of them living in Africa (Alrasheed et al., 2016). Of these, 1.4 million are blind, and 17.5 million have low vision. According to the World Health Organization (WHO, 2013), visual impairment in children is defined as visual acuity (VA) of less than, or equal to, 6/12 (0.3LogMAR) in the better eye.

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The prevalence of childhood visual impairment varies between countries and over time. Surveys have found the prevalence of visual impairment amongst primary school children to be 19.9 % in Nigeria (Bezabih et al., 2017), 7.24 % in Ethiopia (Ayanniyi et al., 2010), and 3.5 % in a sample of private school children in the Ashanti Region of Ghana (Kumah et al., 2013). According to Bezabih et al. (2017), the prevalence in these populations is due to the low level of prevention techniques, such as low level of awareness about the early detection of, and intervention in, visual impairment and the non-availability of advanced health services.

The major cause of blindness in children varies widely from region to region, largely determined by socioeconomic development and the availability of primary health and eye care services. In sub-Saharan Africa, refractive errors (REs), trachoma and vitamin A deficiency are the commonest causes of VI among school children. In other low- and middle-income countries (LMICs), such as Brazil, Ethiopia and India, studies have shown a significantly higher prevalence of VI due to RE, ranging from 65.9 % to 92.5 % (Mehari, 2013). These suggest that RE is one of the leading causes of VI in school children in LMICs, and this is concerning, as it is correctable. There is a continuing need for population-based studies to provide an up-to-date characterisation of the magnitude and nature of visual impairment problems in order to develop local programmes and supra-national, continental and global prevention strategies. However, there is no known documented data on the prevalence of visual impairment amongst public school children in the Berekum Municipality in Ghana.

Therefore, this study aimed to provide baseline data on the prevalence and causes of visual impairment amongst public school children in Berekum, specifically in the Biadan and Kato circuits. The results of this study may aid in informing the planning and monitoring of sustainable eye health programmes. They may also help the government to implement preventive measures for visual impairment in school-going children.

2. Method

Design

A cross-sectional study design was adopted to determine the prevalence and causes of visual impairment among school children.

Population

Our study targeted in-school children in the Kato and Biadan circuits in the Berekum Municipality, Bono Region, Ghana. According to the Ghana Statistical Service Report (2014), the number of basic schools in the Berekum Municipality in 2016 was 121. The number of primary school children attending both public and private schools in the municipality in 2016 was 47,777, of which 23,885 were males and 23,892 were females; thus, 36.7 % of the population were school children. The Berekum education directorate is divided into eight circuits; two circuits (Biadan and Kato) were selected for the study. The Biadan circuit has seven (7) schools, and the Kato circuit has ten (10) schools. The total number of school children in both circuits in 2016 was 3,658. The municipality was also served by various health facilities which provide different services, including eye care services.

Sampling and sample size

Multi-stage random sampling was used in selecting participants. Four (4) schools from the Biadan circuit and five (5) schools from the Kato circuit were randomly selected, summing up to nine (9) schools from both circuits. Simple random sampling was then employed to select the children from those schools.

A sample size of 360 was calculated using Slovin's formula, in consultation with a statistician, where n = N/1+ Ne^2, N = population and e =error of tolerance. In this case, N = 3,658, e = 0.05, and a confidence level of 95 % was used. However, only 299 children participated in this study after sampling. All male and female Primary One to Six school-going children present during data collection were included in the study. All children without signed, written informed consent from parents or guardians were excluded from the study. Also, primary school children younger than six years were excluded from the study.

Data collection

Primary One to Six children were enumerated by name, age and gender. Detailed information regarding clinical examinations was included. All examinations and procedures were done according to the refractive error study in children (RESC) protocol (WHO, 2007), with specific

modifications to serve the purpose of this study and to accommodate the availability and affordability of instruments. Three local optometrists and one nurse conducted the eye examinations.

Monocular visual acuity testing was performed using an ETDRS LogMAR chart at 4 metres from the participant, with natural daylight room illumination. The right eye was tested first, followed by the left eye. The eye not being tested was occluded with the participant's palm while ensuring that the participant was not pressing on their eye. This procedure was carried out by researcher ID#4.

The eyelids, conjunctiva, cornea, iris, and pupils were examined with a magnifying loupe and torch light by researcher ID#3. In addition, the lens, vitreous humour and retina of children presenting with visual acuity of 0.3LogMar (20/40), or worse, in either eye, were examined for abnormalities using an ophthalmoscope in a darkened room. All abnormalities seen in the structures of the eye were noted and recorded.

The cover test was conducted by researcher ID#2 at both 0.5 m and 4 m. All ocular alignment assessments were performed without spectacles, as their use may affect the magnitude of the deviations present. Initially, ocular alignment was determined using Hirschberg corneal reflections, followed by a cover/uncover test using an occluder and performed at 0.5m and 4 m. All heterotropias identified were classified as esotropia, exotropia or vertical tropia.

In all participants presenting with visual acuity of 0.3 LogMAR (6/12), or worse, a principal cause was assigned by researcher ID#1. According to the protocol used, refractive error was assigned as the cause if acuity improved to 0.2LogMar (20/32) or better with subjective refraction. Hyperopia was defined as a spherical power of ≥ + 0.75 D in both eyes or in one eye if the other eye was emmetropic. Myopia was assigned as a spherical power of ≥ – 0.50 D in both eyes or one eye if the other eye was emmetropic. A cylindrical power of ≥– 0.50 D in both eyes or one eye, if the other eye was emmetropic, was also considered astigmatism. Amblyopia was also classified as a subnormal visual acuity, with or without improvement with a pinhole, where no ocular pathology was found. In the absence of refractive errors, opacities in the lens found in participants presenting with visual acuity of 0.3 LogMAR or worse were noted and classified as cataracts. Participants who were found to have minor eye problems, such as allergic conjunctivitis, were treated accordingly, whilst those who needed further management were referred to the nearest eye care facility.

Ethical considerations

Approval for the study was obtained from the Biomedical Research Ethics Committee (BREC) (with ID number BE401/14) of the University of Kwazulu-Natal and the Ghana Health Service Ethics Committee (protocol ID GHS-ERC 10/10/14). Permission was also sought from the municipal education directorate and selected school heads. Informed consent was obtained from parents or legal guardians before data collection.

Data Analysis

Data analysis, with the assistance of a biostatistician, was conducted using STATA 11. All data gathered were analysed using descriptive statistic tools such as means, standard deviations, frequencies and percentages, where appropriate. The Pearson chi-square test and the independent sample t-test were also used to test for the statistical significance of differences in observations. A p-value of less than, or equal to, 0.05 was considered statistically significant. A binary logistic regression statistical model was fitted between demographic characteristics (age and gender) and visual impairment.

3. Results

Demographic characteristics of the study sample

As shown in Table 1, of the 360 school children randomly selected from nine schools in Biadan and Kato circuits, 299 (83.1 %) participated in the study. However, there were complete datasets for only 295 (81.9 %) children which were analysed. The 295 children were aged between 6 and 16 years, with a mean age of 10.08 ± 2.18 years. The participants were divided into four groups: group 1 (6-8 years) with a mean age of 5.5 years; group 2 (9-11 years) with a mean age of 9.0 years; group 3 (12-14 years) with a mean age of 12.0 years; and group 4 (15-16 years) with a mean age of 15.0 years. There were 135 (45.76 %) males and 160 (54.24 %) females. The males had a mean age of 10.28 ± 2.20 years (range: 6-16 years), while the females had a mean age of 9.91 ± 2.16 years

(range: 5-15 years). Of the children, 110 (37.3 %) were from the Biadan circuit, and 185 (62.7 %) were from the Kato circuit. All participants were from primary schools in the public domain.

Table 1. Demographic characteristics of the study sample, n = 295

Characteristics	Frequency	Percentage (%)
Sex		
Female	160	54.2
Male	135	45.8
Age (years)		
Group 1 (6-8)	37	12.5
Group 2 (9-11)	127	43.0
Group 3 (12-14)	119	40.3
Group 4 (15-16)	12	4.1
Circuits		
Biadan	110	37.3
Kato	185	62.7
Type of School		
Public	295	100
Private	0	0

Prevalence of Visual Impairment

The prevalence of VI was 8.14 % of the overall sample. Of those with visual impairment, 54.17 % had bilateral visual impairment, 25 % had impairment in the left eye, and 20.83 % had impairment in the right eye. Bilateral visual impairment was more prevalent than unilateral visual impairment. See Table 2 for details.

Table 2. Distribution of Visual Impairment among school

Visual Impairment	Frequency	Percentage (%)
Both Eyes	13	54.2
Right Eye only	5	20.8
Left Eye only	6	25.0
Total	24	100

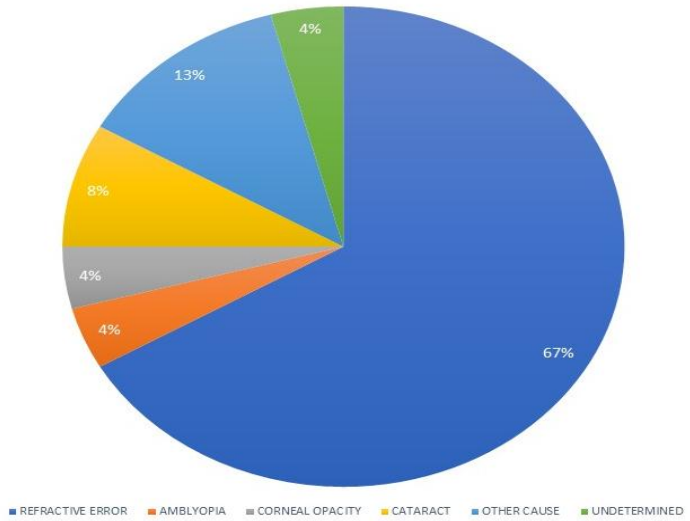

Fig. 1. Causes of visual impairment in children attending public (primary) schools (n= 295)

Causes of Visual Impairment

Figure 1 shows that out of the 24 school children with visual impairment, 16 (67 %) of the children had uncorrected refractive error, followed by cataracts in 2 (8 %) of the children. One child each had visual impairment as a result of amblyopia and corneal opacity. The amblyopia was due to an uncorrected refractive error without any pathology. Hence, the prevalence of refractive error for the entire study population was 5.4 %, followed by cataract, 0.7 % and then amblyopia, 0.3 %.

Pattern of Refractive Error

Table 3 shows that of the children with uncorrected refractive error (16), 9 (56.3%) had myopia, with astigmatism in 25% and hyperopia in 18.75%. Thus, the prevalence of myopia, astigmatism and hyperopia for the study sample was 3.1%, 1.4%, and 1.0%, respectively.

Table 3. Pattern of Refractive Error, n = 295

Type of Refractive Error	Frequency	Percentage (%)
Myopia	9	3.1%
Astigmatism	4	1.0%
Hyperopia	3	1.4%

Factors Affecting Visual Impairment

Direct logistic regression was performed to assess the impact of two factors on the likelihood that participants would be visually impaired. The model contained two independent variables (age and gender). Age was found to be associated with visual impairment, while gender was not, as shown in Table 4. The odds ratio of 0.77 for age suggests if the age of the school children increased by one year, the odds of visual impairment decreased by 23%.

Table 4. Factors Associated with Visual Impairment among Primary School Children

Variables	OR	95% CI	P-value
Age	0.77	0.63 – 0.95	0.014
Gender	0.50	0.20 – 1.25	0.136

4. Discussion

At the end of the study, an overall prevalence of visual impairment observed among children in primary schools in the Biadan and Kato circuits in the Bono Region was 8.14 %. This prevalence was almost three times more than in a study on private school children in the Ashanti Region of Ghana conducted by Kumah et al. (2013), which found a prevalence of 3.66 %. The difference in the results may lie in the geographical location and the characteristics of the population. The Ashanti Region is more developed, with numerous health facilities; its inhabitants, especially those who attend private schools, can afford eye care services more than those in the Biadan and Kato circuits in the Bono Region (formerly Brong Ahafo). The prevalence found in the current study is similar to that (8.0 %) found in a study conducted by Zelalem et al. (2019) amongst school children in three primary schools in Sekela Woreda, north-west Ethiopia. This similarity could be attributed to the same definition of visual impairment in both studies: visual acuity of 6/12, or worse, in either eye or both eyes. Also, the researchers indicated that the study area in the Ethiopian study was rural and remote, with no adequate health care or primary eye care services, which is similar to the situation in the Biadan and Kato circuits. The prevalence in the present study is, however, lower than that (19.9 %) found in a Nigerian study in Ilorin (Nigeria) by Ayanniyi et al. (2010), which may be owing to a stricter definition of VI using visual acuity of ≤ 6/9.

Our results indicate that visual impairment amongst school-aged children is worthy of intervention by the Ministries of Education and Health. Visual impairment is one of the most common forms of disability in children, and children with disabilities are especially disadvantaged in school enrolment, educational attainment and learning (Wodon et al., 2019). To prevent this, it is recommended that health education programmes raise awareness in the community, periodic screening programs should be organised, and primary eye care services should also be made more

available. Uncorrected refractive error was the leading cause of visual impairment among school children in the Biadan and Kato circuits. This impairment may be explained by fewer eye care facilities in the Berekum municipality; thus, accessing refractive services may be challenging. It may also be due to a lack of awareness about the symptoms and use of spectacle correction.

Besides, uncorrected refractive error is a painless visual condition, and children with it may live without complaining to their parents. Unlike children with infectious eye disease, those with uncorrected refractive error may not seek eye care. Furthermore, some parents in developing communities have misconceptions about wearing corrective lenses, and they believe children may become blind later in life if spectacles are worn earlier (Ovenseri-Ogbomo, Assien, 2010). There were similar findings in a study of school-going children in rural Tanzania by Wedner et al. (2000), where uncorrected refractive error was the leading cause of visual impairment. A study by Bezabih et al. (2017) in Ethiopia also found that refractive error was the leading cause of visual impairment in most schoolchildren. The findings from the present study could also be comparable to the study conducted in the Ashanti Region of Ghana by Kumah et al. (2013) on private school children of adolescent age. These similarities lie in the study definitions, age groups and sociodemographic status in the studies. The studies mentioned above and our findings show that refractive error is a preventable yet frequent cause of visual impairment among school children and should be monitored. It, therefore, suggests a gap in eyecare services, which may mandate the need for more refractive, affordable services. Also, children should be encouraged to wear spectacles to reduce the burden of refractive errors, parents need to be educated on the importance of spectacle correction, and the public needs to be educated to destigmatise spectacle use.

The findings from this study have demonstrated a higher prevalence of myopia, followed by astigmatism and then hyperopia. Myopia usually starts in childhood and progresses with age as one engages in more near-work, generally levelling off in the late teens or early twenties (Courtright et al., 2011). A study done among private school children in Kumasi, Ghana, found the prevalence of myopia to be 3.2 % with retinoscopy and 3.4 % with autorefraction (Kumah et al., 2013). This finding is similar to the prevalence of myopia found in the current study, and it may be due to the common definition for myopia used in both studies. The prevalence of hyperopia in this current study is lower than the prevalence (5.0 %) of hyperopia found in Ghana among children attending public and private schools in Agona Swedru (Ovenseri-Ogbomo, Assien, 2010). This could be because the previous study used cycloplegic refraction, which reveals more hyperopia in children, especially those with high accommodative amplitude. The prevalence of astigmatism found in the current study's population was much lower than in studies done in Agona-Swedru (Ovenseri-Ogbomo, Assien, 2010) and Kumasi (Kumah et al., 2013), where the prevalence of astigmatism was found, with retinoscopy, to be 6.6 % and 9.8 %, respectively. Again, the possible reason for the lower prevalence in the current study could be attributed to the larger sample sizes and geographical locations of both previous Ghanaian studies. Another contributing factor could be a difference in the study areas, as the previous Ghanaian studies were conducted in more developed areas than the current study.

Uncorrected refractive error can hamper performance at school, reduce employability and productivity, and generally impair quality of life. Yet correcting refractive errors with appropriate spectacles is among the most cost-effective interventions in eye health care. Therefore, it is suggested that refractive services must be integrated with eye care systems, and refractive corrections must be made accessible and affordable. Furthermore, the association between age and VI suggests that if the school children's age increased by one year, the odds of visual impairment decreased by 23 %. The implications for these school children translate to means younger children are vulnerable. However, this finding does not follow the report by WHO and IAPB (WHO, 2019) that visual impairment will be more with increasing age. This raises concern as visual impairment in children is more critical because of the potentially longer duration of their lives than older people. According to a report by WHO (1992), adequate human resource personnel, strengthening of infrastructure and appropriate technology are some preventive measures that can help reduce visual impairment in children. However, these factors are inadequate in the Kato and Biadan Circuits in the Berekum municipality. Therefore, introducing eye health screening programmes in preschools is recommended for early detection and to help address the issue in Ghanaian Municipalities with a similar profile to Berekum as in other LMICs.

Cataract was also found to be the single cause of visual impairment in 0.7 % of those with VI in the study population. The prevalence found in this study is similar to that found in a study done

on children in India, where the prevalence of cataracts was 0.79 % (Dandona, Dandona, 2006). These studies are comparable because of the similarity in the study areas and age groups. In Nigeria, 0.33 % of children were found to be visually impaired due to cataracts (Duke et al., 2013). The prevalence of cataracts in the present study, compared to the Nigerian study, could be due to the differences in the study definitions and methodology. The previous study used key informants to screen the children to identify the cause of visual impairment. Cataracts can delay or stop normal sight development if left untreated in children, further affecting visual performance (NHS, 2022). It can also lead to an increase in the number of blind years as children have a longer life expectancy (NHS, 2022). Cataract is an avoidable or treatable cause of visual impairment in school children that needs to be monitored. Accessible primary eye care services should also be made available, and eye health education on the need to seek prompt treatment must be intensified, especially in the case of congenital impairments which are not apparent at birth. It is also recommended that periodic school eye health screening programmes be included in the academic curricula and implemented for the early detection and treatment of eye disorders.

In addition to refractive errors and cataracts, a 0.3 % prevalence of amblyopia was found in those in the current study with visual impairment. A Ghanaian study in the Ashanti Region conducted among private school children found that amblyopia was the cause of visual impairment in 9.9 % of the population (Kumah et al., 2013). The lower prevalence in the current study could be attributed to the smaller sample size. Another reason for the difference in prevalent rates could be variations in demographics. Children in urban areas such as the Ashanti Region, where the previous study was conducted, are known to be involved in indoor activities that make them susceptive to developing refractive errors. When these errors are not diagnosed and managed early, they can lead to refractive amblyopia, the commonest type in school children. However, a similar prevalence of 0.4 % was found in a study conducted in Nigeria (Ayanniyi et al., 2010). This is comparable because of the similarity in the age of both study populations.

5. Limitations

The study was conducted in two out of eight circuits. Therefore, the results can only describe the situation in the Biadan and Kato circuits rather than generalising them to the whole municipality. Duplicating this study in all regions of Ghana may help with national statistics to inform whether these findings reflect the greater school population in Ghanaian public schools. The study was conducted among school-going children. This implies that the findings do not reflect the clinical conditions of all children in the community, as some may not be in school due to financial reasons, health problems, or blindness. Hence, all the different causes of visual impairment might not have been considered. In order to not disrupt the learning process of those with visual acuity less than or equal to ≤ 6/12(0.3LogMAR), only dry subjective refraction was used. Cycloplegic refraction is necessary to measure paediatric refraction because it relaxes the accommodation and prevents the overestimation of myopia and the underestimation of hyperopia.

6. Conclusion and Recommendations

The prevalence of visual impairment found in the study sample was 8.14%, with uncorrected refractive error being the leading cause amongst schoolchildren in the Biadan and Kato circuits. Age was negatively associated with visual impairment, suggesting the vulnerability of younger school children. Early detection and provision of affordable eye health services may help curb preventable visual impairment. This provides tangible evidence of the need for refractive services for young children. Furthermore, it underlines the need to create awareness and provide education, periodic screening and affordable eye care services to treat preventable visual impairment. In the absence of other existing data, the study findings could be used to advocate for communities and the government in Ghana to provide adequate vision care in the public health sector to serve vulnerable populations, such as young school children.

7. Declarations

Ethics approval and consent to participate

Ethics approval was granted by the Biomedical Research Ethics Committee (BREC) (with ID number BE401/14) of the University of Kwazulu-Natal and the Ghana Health Service Ethics

Committee (protocol ID GHS-ERC 10/10/14), with permission from the municipal education directorate and the heads of the selected schools and informed consent from parents.

Consent for publication

Not applicable.

Availability of data and materials

Data and materials associated with this study are available upon request.

Conflict of interest statement

The authors report no conflicts of interest.

Funding

Not applicable.

Acknowledgements

The authors are grateful to all who took part in the study. The paper stems from an unpublished master's thesis at the University of KwaZulu-Natal, South Africa. The study was completed in 2019.

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References

Alrasheed et al., 2016 – *Alrasheed, S.H., Naidoo, K.S., Clarke-Farr, P.C.* (2016). Prevalence of visual impairment and refractive error in school-aged children in South Darfur State of Sudan. *African Vision and Eye Health*. 75(1): a355.

Ayanniyi et al., 2010 – *Ayanniyi, A.A., Mahmoud, A.O., Olatunji, F.O.* (2010). Causes and prevalence of ocular morbidity among primary school children in Ilorin, Nigeria. *Nigerian Journal of Clinical Practice*. 13(3): 248-253.

Bezabih et al., 2017 – *Bezabih, L., Abebe, T.W., Fite, R.O.* (2017). Prevalence and factors associated with childhood visual impairment in Ethiopia. *Clinical Ophthalmology*. 11: 1941-1948. DOI: https://doi.org/10.2147/OPTH.S135011

Courtright et al., 2011 – *Courtright, P., Hutchinson, A.K., Lewallen, S.* (2011). Visual impairment in children in middle- and lower-income countries. *Archives of Disease in Childhood*. 96(12): 1129-1134. DOI: https://doi.org/10.1136/archdischild-2011-300093

Dandona, Dandona, 2006 – *Dandona, L., Dandona, R.* (2006). What is the global burden of visual impairment? *BMC Medicine*. 4(6). DOI: https://doi.org/10.1186/1741-7015-4-6

Duke et al., 2023 – *Duke, R.E., Lewallen, S., Courtright, P.* (2023). Estimated prevalence of monocular blindness and monocular severe visual impairment in children of Cross Rivers State, Nigeria. *Nigerian Journal of Ophthalmology*. 22(2): 66-68. DOI: https://doi.org/10.4103/0189-9171.154610

Ghana Statistical Service, 2014 – Ghana Statistical Service. 2010 Population & Housing Census, District Analytical Report, Berekum Municipality. Accra: Ghana Statistical Service, 2014. [Electronic resource]. URL: https://www2.statsghana.gov.gh/docfiles/2010_District_Report/BrongAhafo/BEREKUMMUNICIPAL.pdf

Kumah et al., 2013 – *Kumah, B.D., Ebri, A., Abdul-kabir, M., Ahmed, A., Koomson, N.Y.* (2013). Refractive error and visual impairment in private school children in Ghana. *Optometry & Vision Science*. 90(12): 1456-1461.

Mehari et al., 2013 – *Mehari, Z.A.* (2013). A study of ocular morbidity of patients attending ophthalmic outreach services in rural Ethiopia. *International Journal of Medicine and Medical Sciences*. 3(4): 2167-404.

NHS, 2022 – NHS. Overview: Childhood cataracts, 2022. [Electronic resource]. URL: https://www.nhs.uk/conditions/childhood-cataracts/

Ovenseri-Ogbomo, Assien, 2010 – *Ovenseri-Ogbomo, G.O., Assien, R.* (2010). Refractive error in school children in Agona Swedru, Ghana. *South African Journal of Optometry*. 69(2): 86-92.

Ovenseri-Ogbomo, Omuemu, 2010 – *Ovenseri-Ogbomo, G.O., Omuemu, V.O.* (2010). Prevalence of refractive error among school children in the Cape Coast Municipality, Ghana. *Clinical Optometry*. 2: 59-66. DOI: https://doi.org/10.2147/OPTO.S10583

Wedner et al., 2000 – *Wedner, S.H., Ross, D.A., Balira, R., Kaji, L., Foster, A.* (2000). prevalence of eye diseases in primary school children in a rural area of Tanzania. *British Journal of Ophthalmology*. 84(11): 1291-1297. DOI: https://doi.org/10.1136/bjo.84.11.1291

Wodon et al., 2019 – *Wodon, Q., Male, C., Nayihouba, A., Smith, E.* (2019). Looking Ahead: Visual Impairment and School Eye Health Programs. *The Price of Exclusion: Disability and Education.* World Bank. [Electronic resource]. URL: https://thedocs.worldbank.org/en/doc/880171575325123775-0090022019/original/WorldBankInclusiveEducationVisualImpairmentv7WebReady.pdf

World Health Organisation, 1992 – *World Health Organisation.* (1992). Prevention of childhood blindness. Geneva: World Health Organization. [Electronic resource]. URL: https://apps.who.int/iris/handle/10665/39061

World Health Organisation, 2019 – *World Health Organization.* (2019). *World report on vision*. Geneva: World Health Organization. [Electronic resource]. URL: https://www.who.int/news-room/detail/08-10-2019-who-launches-first-world-report-on-vision

World Health Organization, 2007 – World Health Organization. Assessment of the prevalence of visual impairment attributable to refractive error or other causes in school children. Geneva: World Health Organization, 2007.

World Health Organization, 2013 – World Health Organization. Visual impairment and blindness. World Health Organization, 2013. DOI: https://doi.org/10.1007/SpringerReference_61253

Zelalem et al., 2023 – *Zelalem, M., Abebe, Y., Adamu, Y., Getinet, T.* (2019). Prevalence of visual impairment among school children in three primary schools of Sekela Woreda, Amhara Regional State, North-West Ethiopia. *SAGE Open Medicine*. 7: 205031211984976. DOI: https://doi.org/10.1177/2050312119849769s