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Vision Screening in School Children in a Rural Area of Kano State, Nigeria

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ABSTRACT

Visual impairment among school-age children is a significant but preventable public health issue, particularly in rural areas with limited eye health programs. This study assessed its prevalence and screening outcomes among school children in Gabasawa LGA, Kano State, Nigeria. A cross-sectional descriptive study was conducted among 422 pupils aged 6–18 years (mean 12.47 ± 3.74 years), selected by multistage stratified random sampling from six public schools spanning primary, junior secondary, and senior secondary levels. All pupils underwent standardized vision screening comprising distance visual acuity testing, pinhole assessment, external ocular examination, corneal light reflex test, and direct ophthalmoscopy. An unaided VA of $\leq 6/9$ in either eye constituted a screening failure and triggered pinhole testing. Improvement with the pinhole indicated probable refractive error and prompted referral for detailed refractive evaluation (Phase 2). Visual impairment was classified using ICD-11 criteria. Out of the 422 pupils, 21 (5.0%) failed vision screening. Visual impairment was detected in 18 pupils (4.3%). Critically, 98.8% of pupils had never undergone a prior eye examination and none were wearing spectacles at the time of screening. These findings demonstrate a substantial undetected burden of visual impairment in this rural population and provide the evidence base for implementing a sustainable school eye health programme in Gabasawa LGA and comparable settings across Kano State. Routine school-based vision screening should be implemented in rural areas, along with access to affordable eye care for early detection and management of visual impairment.

Keywords: Vision screening, Refractive error, Visual impairment, School children, ruralarea.

1.0 INTRODUCTION

Visual impairment in children is a global public health challenge. The World Health Organization (WHO) estimates that approximately 13 million children aged 5–15 years worldwide are visually impaired from uncorrected refractive error (URE) (Sharma *et al.*, 2012). The majority of causes of childhood visual impairment can either be managed or prevented if detected early, making school-based vision screening widely recognized as a pivotal health intervention strategy which is critical in preventing long term developmental, educational, and social consequences (Sharma *et al.*, 2012; WHO, 2024). In Nigeria, a recent systematic review and meta-analysis of 28 school-based studies identified a pooled refractive error prevalence of 5.9% among children under 18 years in school-based and population-based studies, with regional variation (Adebusoye *et al.*, 2024). Studies from the North-West geopolitical zone, the region encompassing the current study area, have reported refractive error prevalence ranging from 8.0% in Zaria to 9.7% in Sokoto, alongside other ocular co-morbidities such as allergic conjunctivitis, glaucoma suspect, color vision deficiencies, and high rates of untreated and uncorrected cases (Abahet *et al.*, 2011; Olatunji *et al.*, 2020). The consequences of undetected visual disorders in school-age children extend well beyond ophthalmological morbidity. Reduced visual acuity has been directly associated with impaired classroom performance, reading difficulties, and diminished quality of

life (Hopkins *et al.*, 2019; Kelly *et al.*, 2015). A study from Sokoto, North-West Nigeria, quantified this relationship precisely, finding that the average academic performance score of children with uncorrected refractive error ($49.54\% \pm 10.49\%$) was significantly lower than that of their peers with normal vision ($71.08\% \pm 10.09$) (Olatunji *et al.*, 2020). Despite this evidence, 90.3% of the children in that study had never had a prior eye examination, which reflects a gap in school eye health services across the region.

Globally, school-based vision screening programme have demonstrated effectiveness when properly resourced. A large-scale programme in Queensland, Australia, screened 164,890 children and confirmed visual abnormalities in 69.4% of those referred, achieving substantial yield for the public health investment (Li *et al.*, 2024). In Africa-Botswana, innovative approaches including smartphone-based screening technology (using PEEK Acuity application) have been deployed to overcome the critical barriers of cost, portability, and a shortage of eye care professionals. The programme achieved a 96% follow-up attendance rate among referred children (Andersen *et al.*, 2020).

Hospital-based data from Kano State indicate a high burden of ocular disorders among pediatric patients, with overall prevalence of 59.7%. The major causes were ocular trauma (23.6%) as the leading cause, followed closely by refractive errors (22.0%) and allergic conjunctivitis (14.1%) (Nwakuche *et al.*, 2022). Among children with special needs

in Kano State, the prevalence of refractive error has been recorded at an extraordinary 88.2% (Nwakuche *et al.*, 2023). These figures underscore the scale of unmet need in the region. Despite this, to the best of the author's knowledge, no community or school-based vision screening study has been conducted in Gabasawa LGA, a predominantly rural area with 11 wards with many schools, and a predominantly agrarian population with limited access to eye care services. This study aimed to address the lack of local data on visual impairment among school children in rural areas. It involved a structured school-based vision screening in Gabasawa LGA to generate epidemiological data on demographics, screening outcomes, and the prevalence and patterns of visual impairment among these children.

2.0 MATERIALS AND METHODS

A cross-sectional descriptive study was conducted in Gabasawa Local Government Area (LGA), Kano State, Nigeria. Gabasawa LGA is a rural LGA in the North-West geopolitical zone, comprising 11 wards and characterized by predominantly agrarian livelihoods, limited health infrastructure, and the absence of any structured school eye health programme. A two-phase protocol was employed: Phase 1 comprised standardized vision screening of all sampled pupils; Phase 2 comprised detailed refractive evaluation restricted to children who failed Phase 1. Only Phase 1 findings are reported in this paper.

A multistage stratified random sampling technique was used to select pupils. A complete list of all schools in Gabasawa LGA was obtained from the Gabasawa Local Government Education Authority (LGEA) and constituted the sampling frame. Schools were stratified into primary, Junior Secondary, and Senior Secondary. Within each stratum, two schools were selected by simple random balloting, yielding six schools in total. The six schools span six distinct wards, providing broad geographic coverage across the LGA. Within each selected school, pupils were recruited by systematic random sampling proportionate to school enrolment. The minimum sample size was calculated as 422.

All 422 sampled pupils were examined. The following eye test was conducted: Distance visual acuity (VA) was assessed monocular for each eye using the Snellen Letter chart or Tumbling-E chart (Based on literacy level) at 6 meters in an adequately lit outdoor area, with the fellow eye fully occluded. An unaided VA of $\leq 6/9$ in either eye constituted a screening failure and triggered pinhole testing. Improvement with the pinhole indicated probable refractive error and prompted referral for detailed refractive evaluation (Phase 2). No improvement indicated a likely non-refractive cause. External eye examination was

performed using a penlight. The corneal light reflex test was performed to screen for strabismus. Internal eye examination using ophthalmoscope and the Brückner test was used in non-cooperative pupils.

Visual impairment (VI) was classified according to the International Classification of Diseases, 11th Revision (ICD-11) in 2018 (WHO, 2014). Mild visual impairment is defined as visual acuity worse than (6/12) but not worse than (6/18). Moderate visual impairment is defined as visual acuity worse than (6/18) but not worse than (6/60). Severe visual impairment is defined as visual acuity worse than (6/60) but not worse than (3/60), while blindness is defined as visual acuity worse than (3/60). Right eye (RE) data are presented as primary findings, with left eye (LE) data reported separately, in accordance with recommendations for managing inter-eye correlation (Karakosta *et al.*, 2012).

Ethical approval for this study was obtained from the Health Research Ethics Committee of the Kano State Ministry of Health. Written administrative permission was obtained from the Gabasawa LGEA and from each selected school. Informed consent was obtained from parents/guardians of the children who participated in the study through the school and children with significant ocular findings were referred to a nearby government hospital for further evaluation and management. Data were entered and analyzed using SPSS version 25.

3.0 RESULTS

3.1 Demographic Characteristics

A total of 422 pupils were enrolled and examined in their respective schools. The age range of the participants was from 6 to 18 years, with a mean age of 12.47 ± 3.74 years. Of the 422 pupils, 198 (46.9%) were male and 224 (53.1%) were female gender, giving a male-to-female ratio of approximately 1:1.13. The age group 15–16 years was the most represented (18.2%), followed by 17–18 years (17.8%) and 9–10 years (16.6%).

3.2 Prior Eye Exam History

Among the 422 participants, only 5 (1.2%) had ever undergone a prior eye examination, while 417 (98.8%) had never received any form of eye care. None of the participants (0%) were wearing spectacles at the time of screening. Chi-squared analysis demonstrated a statistically significant association between prior eye examination and screening outcome ($\chi^2 = 96.621$, $df = 1$, $p < 0.001$): all 5 pupils who had received a prior eye examination were among those who failed Phase 1 screening, whereas the remaining 16 who failed came from the group with no prior examination as in Table 1.

Table 1: Screening outcome by prior eye examination history

Screening Outcome	No Prior Exam (n = 417)	Prior Exam (n = 5)	Total	Chi-square statistic
Fail	16	5	21	$\chi_1^2 = 96.621$

Screening Outcome	No Prior Exam (n = 417)	Prior Exam (n = 5)	Total	Chi-square statistic
Pass	401	0	401	$p < 0.001$ (Pearson & Fisher's exact)
Total	417	5	422	

3.3 Vision Screening Outcomes

Out of the 422 pupils screened, 401 (95.0%) passed Phase 1 vision screening and 21 (5.0%) failed (unaided VA $\leq 6/9$ in either eye). Of the 21 who failed, 7 (3.5%) were male and 14 (6.3%) were female. Chi-squared

analysis revealed no statistically significant association between screening failure and sex ($\chi^2 = 1.114$, $p = 0.291$). Screening outcomes by sex are presented in Table 2.

Table 2: Vision screening outcomes by sex.

Sex	Pass	Fail	Total	p-value
Male	191	7	198	0.291
Female	210	14	224	
Total	401	21	422	

Pass = unaided VA $> 6/9$ in both eyes; Fail = unaided VA $\leq 6/9$ in at least one eye.

3.4 Prevalence of Visual Impairment

Out of the 422 pupils examined, the overall prevalence of visual impairment (VI) was 18 (4.3%). In the right eye, 7 pupils (1.7%) had mild VI, 4 (0.9%) had moderate VI, 2 (0.5%) had severe VI, and 5 (1.2%) met the

criterion for blindness. In the left eye, 4 pupils (0.9%) had mild VI, 2 (0.5%) moderate VI, 2 (0.5%) severe VI, and 2 (0.5%) blindness. Of the 18 pupils with VI in at least one eye, 4 were male and 14 were female. The distribution of VI categories is presented in Table 3.

Table 3: Distribution of visual impairment by eye and category (ICD-11 classification).

Category of VI (ICD-11)	RE n (%)	LE n (%)
Mild VI ($< 6/12$ to $6/18$)	7 (1.7)	4 (0.9)
Moderate VI ($< 6/18$ to $6/60$)	4 (0.9)	2 (0.5)
Severe VI ($< 6/60$ to $3/60$)	2 (0.5)	2 (0.5)
Blindness ($< 3/60$)	5 (1.2)	2 (0.5)
Total VI	18 (4.3)	10 (2.4)

RE = Right Eye; LE = Left Eye; VI = Visual Impairment. ICD-11 criteria applied.

4.0 DISCUSSION

This school-based study provides baseline epidemiological data on vision screening outcomes and prevalence of visual impairments among school children in a rural LGA of Kano State, Nigeria. A total of 422 pupils were examined across primary, junior secondary, and senior secondary schools. The mean age of 12.47 ± 3.74 years, with participants ranging from 6 to 18 years, reflects the broad school-going age spectrum targeted by the study. The near-equal sex distribution (46.9% male, 53.1% female) is consistent with school-based enrolment ratios reported in comparable studies in Kano State and across Nigeria (Nwakuche *et al.*, 2022; Abah *et al.*, 2011). The slight female preponderance likely reflects higher female enrolment in the senior secondary schools sampled. The overall screening failure rate of 5.0% is comparable to rates reported in other Nigerian and African school-based

screening studies. Opubiri & Pedro-Egbe (2013) reported a VA-based screening failure rate of 2.3% in primary school children in Bayelsa State, while (Abah *et al.*, 2011) identified 8.0% with uncorrected refractive error in Zaria schools. The study revealed a significant number of children suffering from different levels of visual impairment 4.3%. 1.7% had mild VI, 0.9% had moderate VI, and 0.5% had severe VI, and 1.2% legally blind. The notable representation VI in this rural sample likely reflects the absence of any prior access to eye care, as evidenced by the near-total lack of prior eye examination history 98.8%. These rates showcased the need for early detection and intervention to reduce the burden of childhood visual impairment. Several similar studies indicated that prompt detection and correction of eye disorders can reduce visual impairment and improve children's educational outcomes and quality of life (Aldebasi, 2014; Pirindhavellie *et al.*,

2023; Al-Rasheed & Elmadina, 2020). The findings from this study are broadly consistent with VI prevalence reported in Nigerian school-based studies and other places: Ezegwui *et al.* (2021) recorded a pre-correction VI prevalence of 3.6% in Enugu State. In Addis Ababa (Asmelashet *et al.*, 2025) reported a prevalence of VI of 5.24%. Several other similar prevalence of pupils with an uncorrected visual acuity of 6/12 or less was reported as 1% (Opubiri & Pedro-Egbe; 2013), 1.4% (Naido *et al.*, 2003) 2.9% (Pokharel *et al.*, 2000). However, (Hassan; 2023) reported a bit higher prevalence of 14% with impaired visual acuity and 6% with severe VI in Kashmir. Andersen *et al.* (2020) in Botswana also reported the prevalence of VI of 16%. In China, (Zhao *et al.*, 2000) reported the prevalence to be 12.8%. These higher prevalence's may be attributed to the different methodology and higher sample size been used in the studies.

A striking finding of this study is the extreme underutilization of eye care services: 98.8% of pupils had never had a prior eye examination and none were wearing spectacles. This mirrors the 90.3% never-examined rate reported by (Olatunji *et al.*, 2020) in Sokoto and is consistent with the broader pattern of limited eye care access in rural Northern Nigeria. The absence of any spectacle wear, even among the minority with known refractive error, suggests poor utilization and accessibility to eye care, and absence of structured referral pathways remain profound in this setting.

Although no statistically significant sex differences were found in screening failure ($p = 0.291$), the numerically higher failure rate in females (6.3% vs. 3.5%) merit attention in future studies with larger sample sizes. Similar trends have been observed in some Nigerian studies (Abah *et al.*, 2011) and may reflect differential patterns of visual work, outdoor activity, and healthcare-seeking behavior or is as a result of more females sampled in this study.

5.0 CONCLUSION

This study demonstrates a significant undetected burden of visual impairment among school children in a rural LGA of Kano State, Nigeria. Visual impairment was detected in 4.3% of pupils, and the near-total absence of prior eye care utilisation (98.8% never examined; 0% wearing spectacles) underscores a profound unmet need in this population. These findings provide the evidence base necessary to advocate for, design, and implement a sustainable school eye health programme in Gabasawa LGA and comparable rural settings across Kano State. Future research should extend beyond school-going children to capture the out-of-school population, assess other wide range of ocular morbidities, and evaluate the long-term impact of vision correction on educational outcomes in this setting. Routine school-based vision screening programs should be implemented in rural areas, accompanied by effective referral systems and access to affordable eye care services. Additionally, the government and stakeholders should

integrate school eye health into primary healthcare and expand outreach services to include out-of-school children.

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CONFLICT OF INTEREST

The authors declares no conflict of interest.

ETHICAL STATEMENT

Ethical approval was obtained from the Health Research Ethics Committee of the Kano State Ministry of Health. Written informed consent was obtained from parents/guardians of all participating children, and verbal assent was obtained from each child prior to examination. The study was conducted in accordance with the Declaration of Helsinki.

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