

Original Research Article

School-based vision screening for early detection of refractive errors among children aged 5-14 years in Mathare and Kibera, Nairobi, Kenya

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ABSTRACT

Background: Uncorrected refractive errors are a major cause of avoidable visual impairment among school-aged children, yet many children in underserved urban settings remain undiagnosed. This study evaluated school-based vision screening for early detection of refractive errors among children aged 5-14 years in Mathare and Kibera, Nairobi, Kenya.

Methods: A descriptive analytical cross-sectional study using a mixed-methods approach was conducted from 17th April to 30th May 2026 in seven selected primary schools. A total of 1,050 children underwent visual acuity screening and confirmatory refraction where indicated. Quantitative data were analyzed using descriptive statistics, chi-square tests and logistic regression in STATA 17. Qualitative data from focus group discussions and key informant interviews were analyzed thematically.

Results: Overall, 201 children had refractive errors, representing 19.1% of those screened (95% CI: 16.9-21.6). Myopia was the predominant refractive error (86.1%), followed by hyperopia (12.9%) and astigmatism (1.0%). Refractive error proportions differed significantly across schools ($p=0.001$). Public school attendance was associated with lower odds of refractive error compared with private school attendance (OR=0.64, 95% CI: 0.42-0.98; $p=0.040$), while increasing age was associated with higher odds (OR=1.07, 95% CI: 1.01-1.14; $p=0.032$). Key barriers to referral uptake included cost, limited awareness, stigma, weak follow-up systems and transport constraints.

Conclusions: School-based vision screening was feasible and identified a substantial burden of previously undiagnosed refractive errors. Integration of routine eye screening into school health services, strengthened referral systems and affordable spectacles are needed in informal settlements.

Keywords: Children, Informal settlements, Kenya, Myopia, Refractive errors, School-based vision screening

INTRODUCTION

Refractive errors are among the leading causes of avoidable visual impairment in children and are readily detectable and correctable with spectacles.^{1,2} Myopia, hyperopia and astigmatism can reduce distance or near vision, interfere with classroom learning and affect psychosocial well-being when left uncorrected.^{3,4} Schools provide a practical platform for early identification

because they reach large numbers of children during critical developmental and educational periods.

Global evidence supports school-based vision screening as a public health strategy when screening is linked to refraction, referral and provision of affordable spectacles.^{5,6} In low- and middle-income countries, however, the benefits of screening are often limited by weak referral systems, low parental awareness, cost of

care, stigma related to spectacle use and limited availability of eye-care personnel.^{4,7} These barriers may be more pronounced in urban informal settlements, where households face poverty, overcrowding and competing priorities.

In Kenya, school health policies provide opportunities for integrating eye health into routine child health services, but implementation remains uneven, particularly in low-resource urban communities.^{8,9} Mathare and Kibera are large informal settlements in Nairobi where access to preventive and specialist eye-care services remains limited. Existing initiatives are often fragmented and dependent on external outreach support, resulting in limited local evidence on how school-based screening performs in these settings.

This study evaluated school-based vision screening as a strategy for identifying refractive errors among children aged 5-14 years in selected schools in Mathare and Kibera, Nairobi, Kenya. The study specifically assessed the proportion and types of refractive errors identified, factors associated with refractive errors, referral pathways and barriers and facilitators influencing screening implementation.

METHODS

Study design and setting

A descriptive analytical cross-sectional study using a mixed-methods approach was conducted from April to May 2026 in selected public and private primary schools in Mathare and Kibera informal settlements, Nairobi County, Kenya. The quantitative component measured the proportion and distribution of refractive errors identified through school-based screening, while the qualitative component explored referral pathways and implementation barriers.

Study population and sampling

The study population comprised school-going children aged 5-14 years enrolled in selected primary schools. Seven schools (three in Mathare and four in Kibera) were purposively selected for geographic representation, accessibility, willingness to participate and operational feasibility. Eligible children present during the screening period were invited after written parental or guardian consent and child assent. A total of 1,050 children were screened, exceeding the minimum target sample size and supporting subgroup analysis by age, sex and school type.

Selection criteria

Eligible children were aged 5-14 years, enrolled in a selected school, present during screening, and had parental or guardian consent and child assent.

Children absent or unwell during screening were excluded. Qualitative participants were consenting parents or guardians, teachers, school health coordinators and eye-health providers with relevant experience; those declining or withdrawing consent were excluded.

Vision screening procedures

Distance visual acuity was assessed monocularly using Snellen charts at 6 metres under standard lighting conditions. Tumbling-E or Lea symbols charts were used for younger or non-literate children where appropriate. Children with visual acuity worse than 6/9 in either eye underwent pinhole testing. Children who improved by two or more lines with pinhole proceeded to objective refraction using retinoscopy, followed by subjective refinement with trial lenses. Significant refractive error was defined as presenting visual acuity worse than 6/12 in either eye that improved with pinhole or refraction, or refraction meeting predefined thresholds for myopia, hyperopia or astigmatism.

Qualitative data collection

Focus group discussions and key informant interviews were conducted with parents or guardians, teachers, school health coordinators and eye-health providers. Interviews explored perceptions of child eye health, referral mechanisms, barriers to uptake of care and facilitators of school-based screening. Interviews were audio-recorded with consent, transcribed and analysed thematically.

Data analysis

Quantitative data were entered, cleaned and analysed using STATA version 17. Descriptive statistics summarized participant characteristics, refractive error proportions and refractive error types. Chi-square tests assessed bivariate associations. Logistic regression estimated factors associated with refractive error, reporting odds ratios (ORs), 95% confidence intervals (CIs) and p values. Mixed-effects models were used to account for clustering by school. Qualitative data were coded and grouped into themes aligned with the study objectives and conceptual framework.

Ethical considerations

Ethical approval was obtained from the Amref International University Ethics and Scientific Review Committee, and research authorization was obtained from the National Commission for Science, Technology and Innovation. Permission was also obtained from education and school authorities. Written consent was obtained from adult participants and parents or guardians, while child assent was obtained before screening. Confidentiality was maintained through use of unique identification codes.

RESULTS

Characteristics of participants

A total of 1,050 children were screened across seven schools. The mean age was 10.39 years (SD 2.56). Females comprised 55.8% of participants and males 44.2%. Most participants attended public primary schools (85.7%), while 14.3% attended private primary schools. Upper primary learners formed the largest grade category (61.6%), followed by lower primary learners (31.1%).

Proportion of refractive errors

Overall, 201 children were identified with refractive errors, giving a proportion of 19.1% (95% CI: 16.9-21.6). This indicates that approximately one in five screened children had a previously undiagnosed refractive error requiring corrective intervention. Significant variation was observed across schools ($p=0.001$), with school-level factors accounting for part of the variation in refractive error status.

Table 1: Characteristics of screened children (n=1,050).

Variables	Category	Frequency	Percentage
School type	Private primary	150	14.3
	Public primary	900	85.7
Sex	Female	586	55.8
	Male	464	44.2
Grade category	Lower primary (Grades 1-3)	327	31.1
	Upper primary (Grades 4-8)	647	61.6
	Other (PP/special/9+)	76	7.2
Age group (years)	5-6	92	8.8
	7-8	177	16.9
	9-10	241	23.0
	11-12	268	25.5
	13-14	272	25.9
Age, mean (SD)	Years	10.39 (2.56)	-

Table 2: Proportion and types of refractive errors among screened children.

Outcome	Frequency	Percentage	95% CI
No refractive error	849	80.9	78.4-83.1
Any refractive error	201	19.1	16.9-21.6
Myopia among affected children	173	86.1	80.5-90.4
Hyperopia among affected children	26	12.9	8.7-18.4
Astigmatism among affected children	2	1.0	0.1-3.6

Table 3: Selected factors associated with refractive errors.

Variables	Comparison/estimate	Result	P value
School differences	Seven schools	Chi-square $p=0.001$	0.001
School type	Public versus private	OR=0.64 (95% CI: 0.42-0.98)	0.040
Age	Per one-year increase	OR=1.07 (95% CI: 1.01-1.14)	0.032
Sex	Female versus male	20.3% vs 17.7%	0.281
School clustering	Mixed-effects model	LR test significant; ICC=4.6%	0.014

Types of refractive errors

Myopia was the most common refractive error, accounting for 173 of 201 affected children (86.1%). Hyperopia accounted for 26 cases (12.9%), while astigmatism was rare, with two cases (1.0%). The distribution of refractive error type differed significantly by school type ($p=0.011$), although myopia remained the dominant refractive error in both public and private schools.

Factors associated with refractive errors

In multivariable analysis, children attending public schools had lower odds of refractive error compared with those in private schools (OR=0.64, 95% CI: 0.42-0.98; $p=0.040$). Increasing age was associated with higher odds of refractive error (OR=1.07, 95% CI: 1.01-1.14; $p=0.032$). Gender alone was not significantly associated with refractive error, although the study observed an age-

by-gender interaction, with increasing risk more evident among older girls.

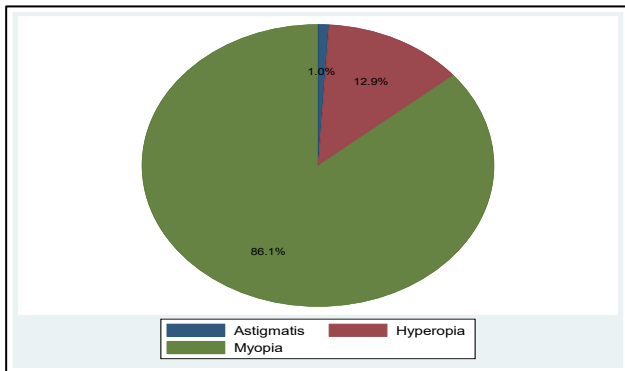


Figure 1: Distribution of refractive error types among affected children.

Referral pathways and barriers

Qualitative findings showed that referral pathways were present but largely informal and weakly monitored. Children identified with visual problems were referred to public, faith-based or NGO-linked facilities, including major eye-care facilities in Nairobi. However, referral completion was limited by the cost of spectacles, transport costs, long waiting times, competing household needs, low parental awareness and stigma associated with spectacle wear. Teachers were important facilitators because they helped identify learners with visual difficulties and communicated screening findings to parents, but many lacked formal training in child eye health.

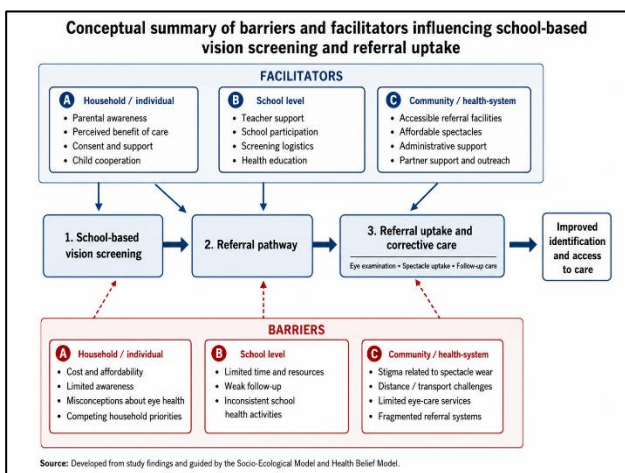


Figure 2: Conceptual summary of barriers and facilitators influencing school-based vision screening and referral uptake.

Facilitators of implementation

Participants viewed school-based screening positively and reported that schools provided a convenient platform for

reaching children. Key facilitators included teacher involvement, collaboration with eye-care providers and NGOs, availability of free or subsidized screening, provision of affordable spectacles and community sensitization. Participants recommended stronger collaboration between education and health sectors and establishment of structured referral feedback systems.

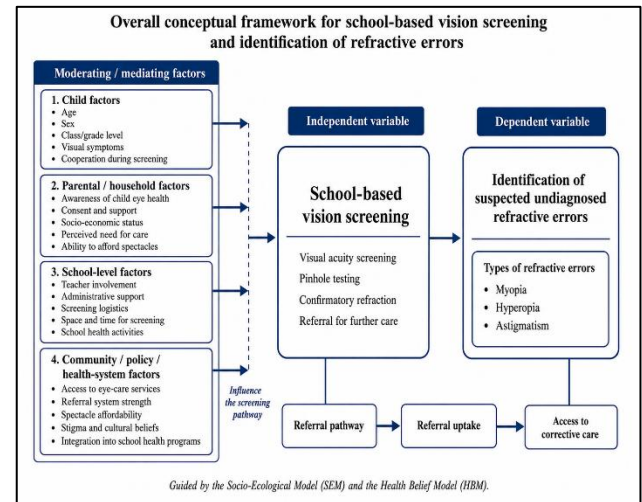


Figure 3: Overall conceptual framework for school-based vision screening and identification of refractive errors.

DISCUSSION

This study found that school-based vision screening identified a substantial burden of previously undiagnosed refractive errors among children in Mathare and Kibera. The overall proportion of 19.1% is higher than many estimates reported for sub-Saharan African school-aged children, which have varied by setting and methodology.^{4,7} The finding highlights a large unmet need for routine child eye-health services in informal urban settlements.

Myopia was the predominant refractive error, accounting for more than four-fifths of affected children. This aligns with global evidence indicating increasing myopia among school-aged children, especially in urban settings where educational demands, near-work activities and reduced outdoor exposure may contribute to risk.¹ The predominance of myopia has programmatic implications because school-based screening should be supported by timely refraction and affordable spectacle provision.

The significant differences observed across schools suggest that institutional and contextual factors may influence detection and burden of refractive errors. Differences in school type, classroom conditions, learning demands, awareness and previous access to screening may partly explain this variation. Although public school attendance was associated with lower odds of refractive error after adjustment, the finding should be interpreted

cautiously because the study was cross-sectional and not designed to establish causality.

The qualitative findings demonstrate that screening alone is insufficient if referral and treatment pathways are weak. Cost of spectacles, transport, long hospital queues, competing household needs and low parental awareness limited referral completion. Stigma associated with spectacle wear also discouraged uptake. These barriers are consistent with literature from low-resource settings where the effectiveness of screening programs is limited by poor linkage to care.^{4,7,10}

Teachers and school health coordinators were important facilitators because they could identify classroom signs such as squinting, difficulty reading the blackboard, poor concentration and headaches. However, teachers required additional training and institutional support. Integrating eye health into school health policies and providing structured referral feedback systems could strengthen continuity of care and improve the sustainability of screening programs.

The study has limitations. It was conducted in selected schools in two informal settlements and may not be generalizable to all Kenyan schoolchildren or rural settings. The cross-sectional design limits causal inference. Referral uptake was also difficult to verify fully because of household mobility and weak follow-up systems. Despite these limitations, the study provides context-specific evidence on school-based vision screening in underserved urban communities.

CONCLUSION

School-based vision screening was feasible and effective in identifying previously undiagnosed refractive errors among children in Mathare and Kibera. Myopia was the dominant refractive error. However, the public health impact of screening depends on strengthened referral systems, teacher sensitization, parental awareness, affordable spectacles and integration of eye health into routine school health services. Sustainable collaboration between the Ministry of Health, Ministry of Education, schools, county health services and eye-care partners is needed to reduce avoidable childhood visual impairment in informal settlements.

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