# Prevalence of visual impairments and refractive errors in school-aged children in Mogadishu, Somalia

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## ABSTRACT

**Objective:** To determine the prevalence and causes of Visual Impairment (VI) and Refractive Errors (RE) among school-aged children in Mogadishu, Somalia.
**Study design:** Cross-sectional, school-based study.
**Methods:** Children aged 6–15 years were recruited from five schools using a modified Refractive Error Study in Children (RESC) protocol. Visual Acuity (VA) was measured with the Snellen Tumbling E-chart. Children with uncorrected VA ≤6/12 underwent pinhole testing, non-cycloplegic retinoscopy, and refraction. REs were defined as myopia (≥−0.5 diopters [D]), hypermetropia (≥+2.0 D), or astigmatism (≥0.75 D).
**Results:** Of 1,540 children, 1,516 participated (response rate 98.4%). Mean age was 7.44±1.58 years; 57.3% were female. VI in the better eye was detected in 19.4% (95% Confidence Interval (CI): 17.4–21.4%), yet only 19.7% used spectacles. VI was higher in females (21.9%) than males (16.0%) (P<0.001). REs accounted for 93.8% of VI, with an overall prevalence of 24.9% (myopia 10.5%, astigmatism 8.4%, hypermetropia 6.1%). RE prevalence was higher in females (29.1%) than males (19.2%) (P<0.001). Posterior segment abnormalities occurred in 1.8%.
**Conclusions:** Childhood VI in Mogadishu is common, largely driven by uncorrected REs. Low spectacle coverage underscores the need for school-based vision screening.

**Key words**: Visual impairment, Refractive errors, Myopia, Hypermetropia, Astigmatism, Schoolchildren, Somalia

## INTRODUCTION

Refractive errors disrupt light focusing on the retina, causing blurred vision. In children, uncorrected refractive errors impact visual development and academic performance. Conditions like myopia, hypermetropia, and astigmatism can impede a child's ability to read and participate in educational activities[1].

Refractive errors are the primary cause of Visual Impairment (VI), affecting 101.2 million people worldwide. Furthermore, when left uncorrected, these refractive errors rank as the second leading cause of blindness, affecting 6.8 million people worldwide[2]. Refractive errors represent a substantial global health issue, impacting populations worldwide with varying prevalence rates across regions. Globally, uncorrected refractive errors are the primary cause of visual impairment, affecting approximately 19 million children[3]. The prevalence of myopia has been increasing rapidly, with projections suggesting that nearly half of the world's population may be myopic by 2050. The prevalence of refractive errors varies by region. In Asia, particularly in East Asian countries, the prevalence is the highest[4]. In certain urban areas of China, South Korea, and Japan, the incidence of myopia among young adults can surpass 87.7%[5]. In contrast, Europe and North America reported a myopia incidence with adult prevalence rates of 7%. Although these rates are generally lower than those in other regions, there is a clear upward trend in their prevalence[4].

In East Africa, data on refractive error is scarce. Studies indicate lower prevalence than global averages, though increasing in urban areas. Myopia is most common, followed by astigmatism and hypermetropia. Studies from Ethiopia and Kenya show 5-10% myopia prevalence in school children[6]. In Somalia, the lack of comprehensive data on the prevalence of Refractive Errors (RE) is largely due to limited eye care infrastructure and ongoing socioeconomic challenges[7]. Population-based studies are needed to assess refractive errors in Somalia, with higher urban prevalence and limited rural eye care access. Research must examine socioeconomic, environmental and genetic causes. Improved screening and infrastructure should address this issue in underserved areas. Developed countries have seen an increase in myopia, particularly in East Asia, while hyperopia remains prevalent in Western populations[8]. However, data on refractive errors in children from many developing countries, including Somalia, are lacking. This gap limits our understanding of the global burden and hinders targeted interventions for affected populations.

## MATERIALS AND METHODS

*Study population and study site:* The study included children aged 6–15 years from Al Najah, Al Haramain, KPP Sheikh Ali Sufi, Ma'hadu Sunnah, and Moasser schools in Mogadishu, Somalia.

*Study design:* This cross-sectional study used the modified Refractive Error Study in Children (RESC) protocol to evaluate Visual Impairment (VI) and Refractive Errors (RE) in children. Non-cycloplegic refraction was used to determine RE prevalence, defined as (a) myopia of ≥ −0.5 diopters (D) in one or both eyes, (b) hypermetropia of ≥ 2.0 D, and (c) astigmatism of ≥ 0.75 D cylindrical refraction[3].

*Inclusion and exclusion criteria:* Children aged 6-15 years present at school on examination days with parental consent were included in the study. Children without parental consent were excluded.

*Study sample:* A two-stage sampling method was employed. First, five schools were randomly selected from the registry of primary schools in Mogadishu. Second, within these selected schools, eligible children present on the examination days were consecutively examined using convenience sampling. We assumed an RE prevalence of 15.7% based on childhood rates in Hargeisa, Somaliland, Somalia[7]. The sample size was calculated using a 97% CI and 3% sampling error. With a design effect of 2, the final sample size was 1540.

$n = (Z^2pq)/d^2 = (2.172 \times 0.157 \times 0.843)/ 0.032 = 692.48 \approx 693$

The initial sample size was 693 participants. To account for the design effect of 2, this was multiplied by 1386. With a 10% non-response rate, the final sample size was adjusted to 1540 schoolchildren. Five randomly selected schools were selected for this study.

*Clinical investigation:* Clinical assessments followed the modified RESC protocol. Distance Visual Acuity (VA) was assessed using the Snellen Tumbling E-chart at 6 m. Participants with VA ≤ 6/12 underwent a pinhole test; if vision improved, they had retinoscopy and subjective refraction. Children were examined for anterior segment abnormalities using a penlight and hand magnifier. A cover test detected heterophoria or heterotropia, measured through corneal light reflex and Prism Cover Test. Ocular motility testing evaluated eye muscle function. For children with pinhole-improved vision, subjective refraction determined optimal correction. Those with VA ≤ 6/12 and no pinhole improvement underwent fundus examination, with abnormalities recorded as potential VI causes.

*Data analysis:* A descriptive analysis of the participant data was conducted using Standard Deviation (SD) and percentages facilitated by the Statistical Package for the Social Sciences (SPSS) version 26. The relationships between variables were assessed using correlation, cross-tabulation and $\chi 2$ analysis. A significance level of P = 0.05 was applied to all the statistical tests.

*Ethical considerations:* Ethical approval for this study was obtained from the Jazeera University Research Ethics Review Committee (JU24/08). This study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants. To protect patient confidentiality, physical data collection sheets containing personal identifiers were securely shredded after data entry. The anonymized master database and copies of the signed consent forms are securely retained at Jazeera University in accordance with institutional ethics committee mandates.

## RESULTS

From a cohort of 1,540 children, 1,516 (98.4%) were enrolled in the study.

*Demographic characteristics of participants*: Table 1 shows the demographic characteristics of the participants. The study included 1,516 children aged 6-15 years (mean age 7.44 years, SD = 1.58). The cohort comprised 872 females (57.3%) and 644 males (42.5%) participants. Seven-year-olds constituted 42.8%, while 6-year-olds made up 25.1%. Ages 14-15 years had lowest representation (0.3-0.8%). A significant age difference existed between males and females (analysis of variance [ANOVA]: F = 7.197, P < 0.001).

**Table 1:** Sociodemographic characteristics

| Variable | Categories | Frequency | (%) |
|---|---|---|---|
| Age of children (years) | 6 | 380 | 25.1 |
| | 7 | 649 | 42.8 |
| | 8 | 279 | 18.4 |
| | 9 | 79 | 5.2 |
| | 10 | 46 | 3.0 |
| | 11 | 13 | 0.9 |
| | 12 | 29 | 1.9 |
| | 13 | 24 | 1.6 |
| | 14 | 12 | 0.8 |
| | 15 | 5 | 0.3 |
| | Total | 1516 | 100.0 |
| Gender | Female | 872 | 57.5 |
| | Male | 644 | 42.5 |
| | Total | 1516 | 100.0 |

*Distribution of signs and symptoms among school-aged children:* Among school-aged children surveyed, 1,138 (75.1%) reported no ocular symptoms, while 227 (15.0%) had blurred vision, 129 (8.5%) experienced itching and redness, and 22 (1.5%) had pain and photophobia.

*Visual acuity:* Table 2 shows the distribution of uncorrected visual acuity. Among the children, 1,172 (77.3%; 95% CI: 75.2–79.4) had normal uncorrected Visual Acuity (VA) of 6/6 in the right eye, while 1,166 (76.9%; 95% CI: 74.7–79.0) had normal VA in their left eye. For better eyes, 1,169 (77.1%; 95% CI: 75.0–79.2) had VA of 6/6. Visual impairment (VA ≤6/12) was identified in 283 children (18.7%; 95% CI: 16.7–20.6) in the right eye, 304 (20.1%; 95% CI: 18.0–22.1) in the left eye, and 294 (19.4%; 95% CI: 17.4–21.4) in their better eye. After best-corrected refraction, VA ≤6/12 decreased to 24 children (1.58%; 95% CI: 0.95–2.21).

**Table 2:** Distribution of uncorrected visual acuity for right – left and better eye by percentage

| UVA | Right Eye | | Left Eye | | Better Eye | | Best-Corrected VA | |
|---|---|---|---|---|---|---|---|---|
| | N | % (95% CI) | N | % (95% CI) | N | % (95% CI) | N | % (95% CI) |
| 6/6 | 1172 | 77.3% (75.2% - 79.4%) | 1166 | 76.9%(74.7% - 79.0%) | 1169 | 77.1% (75.0%-79.2%) | 1480 | 97.63% (96.7% - 98.4%) |
| 6/9 | 61 | 4.0% (3.0% - 5.0%) | 46 | 3.0%(2.1% - 3.9%) | 53 | 3.5% (2.6% -4.5%) | 12 | 0.79% (0.4% - 1.2%) |
| 6/12 | 108 | 7.1% (5.8% - 8.4%) | 109 | 7.2%(5.8% - 8.4%) | 109 | 7.2% (5.9% - 8.5%) | 6 | 0.40% (0.1% - 0.7%) |
| 6/18 | 91 | 6.0% (4.8% - 7.2%) | 95 | 6.3%(5.0% - 7.4%) | 93 | 6.1% (4.9% - 7.3%) | 5 | 0.33% (0.04% - 0.6%) |
| 6/24 | 29 | 1.9% (1.2% - 2.6%) | 46 | 3.0%(2.1% - 3.9%) | 37 | 2.5% (1.7% - 3.3%) | 3 | 0.20% (-0.03% - 0.4%) |
| 6/36 | 17 | 1.1% (0.5% - 1.6%) | 14 | 0.9%(0.4% - 1.4%) | 16 | 1.0% (0.5% - 1.5%) | 5 | 0.33% (0.04% - 0.6%) |
| 6/60 | 13 | 0.9% (0.3% - 1.3%) | 17 | 1.1%(0.5% - 1.6%) | 15 | 1.0% (0.5% - 1.5%) | 2 | 0.13% (-0.05% - 0.31%) |
| CF | 23 | 1.5% (0.9% - 2.1%) | 21 | 1.4%(0.80% - 1.9%) | 22 | 1.5% (0.9% - 2.1%) | 1 | 0.07% (-0.06% - 0.20%) |
| HM | 2 | 0.1% (-0.0% - 0.3%) | 2 | 0.2%(0.0% - 0.2%) | 2 | 0.1% (0.1% - 0.4%) | 2 | 0.13% (-0.05% - 0.31%) |
| Total | 1516 | 100.0% | 1516 | 100.0% | 1516 | 100.0% | 1516 | 100.0% |
| VA ≥ 6/12 | | | | | 294 | 19.4% (17.4% - 21.4%) | 24 | 1.58% (0.95% - 2.21%) |

CF = Count Fingers; CI = Confidence Interval; HM = Hand Movement; UVA = Uncorrected Visual Acuity; VA = Visual Acuity.

*Prevalence of visual impairment:* Table 3 analyzes Visual Impairment (VI) data from 1,516 school-aged children in the Mogadishu, Somalia. VI prevalence, measured by uncorrected visual acuity in the better eye, was 19.4% (294 cases; 95% CI: 17.4%-21.4%), with only 19.7% of VI cases wearing spectacles. VI prevalence showed significant association with age (P<0.001) and sex (P = .004), being higher in girls (21.9%; 95% CI, 19.1%–24.7%) than boys (16.0%; 95% CI, 13.0%-19.0%). Children aged 6-7 years showed lower VI prevalence (15.8%; 95% CI, 13.6%-18.1%), while the 10-11 age group had the highest (49.2%; 95% CI, 36.5%–62.0%).

**Table 3:** Prevalence of visual impairment among school-aged children by age groups and gender

| Variable | | Categories | Frequency | Percentage with 95% CI |
|---|---|---|---|---|
| Better eye VA | | 6/6 | 1169 | 77.1% (75.0-79.2%) |
| | | 6/9 | 53 | 3.5% (2.6 -4.5%) |
| | | 6/12 | 109 | 7.2% (5.9% - 8.5%) |
| | | 6/18 | 93 | 6.1% (4.9% - 7.3%) |
| | | 6/24 | 37 | 2.5% (1.7% - 3.3%) |
| | | 6/36 | 16 | 1.0% (0.5% - 1.5%) |
| | | 6/60 | 15 | 1.0% (0.5% - 1.5%) |
| | | CF | 22 | 1.5% (0.9% - 2.1%) |
| | | HM | 2 | 0.1% (0.1% - 0.4%) |
| | | Total | 1516 | 100.0% |
| Visual Impairment | | Children without visual impairment | 1222 | 80.6% |
| | | Children with visual impairment (VA ≤ 6/12 in Better Eye) | 294 | 19.4% |
| | | Total | 1516 | 100.0 |
| | | Children without visual impairment | Children with visual impairment | Total |
| Gender P=0.004 | Male | 541 | 103 | 644 |
| | Female | 681 | 191 | 872 |
| Total | | 1222 | 294 | 1516 |
| Age (years) P=0.000 | 6 | 336 | 44 | 380 |
| | 7 | 530 | 119 | 649 |
| | 8 | 229 | 50 | 279 |
| | 9 | 57 | 22 | 79 |
| | 10 | 21 | 25 | 46 |
| | 11 | 9 | 4 | 13 |
| | 12 | 18 | 11 | 29 |
| | 13 | 13 | 11 | 24 |
| | 14 | 6 | 6 | 12 |
| | 15 | 3 | 2 | 5 |
| Total | | 1222 | 294 | 1516 |

CI = Confidence Interval; VA = Visual Acuity

*Binocular anomalies:* In a study involving children, 28 participants (1.9% of the total) were diagnosed with tropia. Of these, 12 were identified as esotropia and 16 as exotropias.

*Anterior-segment examination:* In this study, 1,416 children (93.4%, 95% Confidence Interval (CI) (92.2%, 94.7%)) had no right eye abnormalities, while 1,417 children (93.5%, 95% CI (92.2%, 94.7%)) had no left eye abnormalities. Conjunctivitis, including bacterial, viral, and allergic types, was observed in 30 children (2.0%) in the right eye [95% CI, 1.3%–2.7%] and 30 children (2.0%) in the left eye [95% CI, 1.3%–2.7%]. Vernal Keratoconjunctivitis (VKC) affected 26 children (1.7%) in the right eye [95% Confidence Interval (CI), 1.1%–2.4%] and 26 children (1.7%) in the left eye [95% CI, 1.1%–2.4%]. Cataracts appeared in seven children (0.5%) in the right eye [95% CI, 0.1%–0.8%] and in three children (0.2%) in the left eye [95% CI, 0.0%–0.4%]. A corneal scar was observed in one child (0.1%) in the right eye [95% CI, 0.0%–0.2%] and in one child (0.1%) in the left eye [95% CI, 0.0%–0.2%].

*Prevalence of refractive error:* Table 4 shows the prevalence of refractive error. The prevalence of Refractive Errors (RE) among schoolchildren was 24.9% (95% CI, 22.8–27.1), with 75.1% being emmetropic. Myopia was the most common RE, affecting 10.5%, followed by astigmatism (8.4%) and hypermetropia (6.1%). RE prevalence was significantly linked to sex (P = 0.001) and age (P = 0.001), with higher rates in girls (29.1%) than boys (19.2%). Myopia was more prevalent in girls (12.4%) than boys (7.9%), hypermetropia in girls (7.5%) than boys (4.2%), and astigmatism in girls (9.3%) than boys (7.1%). RE prevalence rose with age, with myopia peaking at 58.6% among 12-year-olds. Hypermetropia was most common in 7-year-olds (6.8%) and absent in 13- and 15-year-olds. Astigmatism was highest in 7-year-olds (9.4%) and declined with age.

**Table 4:** The prevalence of refractive error in one or both eyes by age and gender

| Age (years) (P=0.001) | Emmetropia | | Myopia | | Hypermetropia | | Astigmatism | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | % (95% CI) | N | % (95% CI) | N | % (95% CI) | N | % (95% CI) | N | % (95% CI) |
| 6 | 323 | 85.0% 81.4%, 88.6%) | 23 | 6.1% (3.7%, 8.5%) | 19 | 5.0% (2.8%, 7.2%) | 15 | 3.9% (2.0%, 5.9%) | 380 | 25.1% (22.9% - 27.3%) |
| 7 | 489 | 75.3% (72.0%, 78.7%) | 55 | 8.5% (6.3%, 10.6%) | 44 | 6.8% (4.8%, 8.7%) | 61 | 9.4% (7.2%, 11.6%) | 649 | 42.8% (40.3% - 45.3%) |
| 8 | 206 | 73.8% (68.7%, 79.0%) | 24 | 8.6% (5.3%, 11.9%) | 18 | 6.5% (3.6%, 9.3%) | 31 | 11.1% (7.4%, 14.8%) | 279 | 18.4% (16.5% - 20.4%) |
| 9 | 64 | 81.0% (72.4%, 89.7%) | 7 | 8.9% (2.6%, 15.1%) | 2 | 2.5% (-0.9%, 6.0%) | 6 | 7.6% (1.8%, 13.4%) | 79 | 5.2% (4.2% - 6.4%) |
| 10 | 31 | 67.4% (53.8%, 80.9%) | 2 | 4.3% (-1.5%, 10.2%) | 6 | 13.0% (3.3%, 22.8%) | 7 | 15.2% (4.8%, 25.6%) | 46 | 3.0% (2.3% - 4.1%) |
| 11 | 4 | 30.8% (5.7%, 55.9%) | 7 | 53.8% (26.7%, 80.9%) | 1 | 7.7% (-6.8%, 22.2%) | 1 | 7.7% (-6.8%, 22.2%) | 13 | 0.9% (0.5% - 1.5%) |
| 12 | 9 | 31.0% (14.2%, 47.9%) | 17 | 58.6% (40.7%, 76.5%) | 1 | 3.4% (-3.2%, 10.1%) | 2 | 6.9% (-2.3%, 16.1%) | 29 | 1.9% (1.3% - 2.8%) |
| 13 | 8 | 33.3% (14.5%, 52.2%) | 15 | 62.5% (43.1%, 81.9%) | 0 | 0.0% (0.0%, 0.0%) | 1 | 4.2% (-3.8%, 12.2%) | 24 | 1.6% (1.1% - 2.4%) |
| 14 | 2 | 16.7% (-4.4%, 37.8%) | 8 | 66.7% (40.0%, 93.3%) | 1 | 8.3% (-7.3%, 24.0%) | 1 | 8.3% (-7.3%, 24.0%) | 12 | 0.8% (0.4% - 1.4%) |
| 15s | 2 | 40.0% (-2.9%, 82.9%) | 1 | 20.0% (-15.1%, 55.1%) | 0 | 0.0% (0.0%, 0.0%) | 2 | 40.0% (-2.9%, 82.9%) | 5 | 0.3% (0.1% - 0.8%) |
| Total | 1138 | 100.0% | 159 | 100.0% | 92 | 100.0% | 127 | 100.0% | 1516 | 100.0% |
| Gender (P=0.001) | N | % (95% CI) | N | % (95% CI) | N | % (95% CI) | N | % (95% CI) | N | % |
| Male | 520 | 80.7% (77.7%, 83.8%) | 51 | 7.9% (5.8%, 10.0%) | 27 | 4.2% (2.6%, 5.7%) | 46 | 7.1% (5.2%, 9.1%) | 644 | 42.5% (40.0% - 45.0%) |
| Female | 618 | 70.9% (67.9%, 73.9%) | 108 | 12.4% (10.2%, 14.6%) | 65 | 7.5% (5.7%, 9.2%) | 81 | 9.3% (7.4%, 11.2%) | 872 | 57.5% (55.0% - 60.0%) |
| Total | 1138 | 75.1% (72.8% - 77.2%) | 159 | 10.5% (9.0% - 12.1%) | 92 | 6.1% (5.0% - 7.4%) | 127 | 8.4% (7.1% - 9.9%) | 1516 | 100.0% |

CI = Confidence Interval

*Posterior-segment examination:* A comprehensive examination of the posterior segment revealed that 1,488 children (98.2% [95% CI, 97.4–98.8%]) had no abnormalities. In contrast, abnormalities in the posterior segment were detected in 28 children (1.8% [95% CI, 1.2–2.6%]). Among these cases, myopic degeneration was the most frequent, affecting 17 children (1.1% [95% CI, 0.6–1.7%]). Additional abnormalities included optic atrophy in three children (0.2% [95% CI, 0.04–0.6%]), macular dystrophy in three children (0.2% [95% CI, 0.04–0.6%]), glaucoma in two children (0.1% [95% CI, 0.01–0.4%]), diabetic retinopathy in two children (0.1% [95% CI, 0.01–0.4%]), and toxoplasmosis in one child (0.1% [95% CI, 0.002–0.3%]).

*The principal causes of visual impairment:* Table 5 shows the causes of Uncorrected Visual Acuity (UVA) of 6/12 or worse in at least one eye. Refractive Error (RE) was the main cause of Visual Impairment (VI) in 364 children (93.81%; 95% CI, 91.42%–96.21%), with a population prevalence of 24.01% (95% CI, 21.86%–26.16%). Cataract was observed in 10 children (2.58%; 95% CI, 1.00%–4.15%), with a population prevalence of 0.66% (95% CI, 0.25%–1.07%), and amblyopia in 9 children (2.32%; 95% CI, 0.82%–3.82%), with a population prevalence of 0.59% (95% CI, 0.21%–0.98%). Retinal disease affected three children (0.77%; 95% CI, 0.00% to 1.64%) and corneal opacity 2 children (0.52%; 95% CI, 0.00% to 1.23%), with population prevalence rates of 0.20% (95% CI, 0.00%–0.42%) and 0.13% (95% CI, 0.00%–0.31%), respectively.

**Table 5:** Causes of uncorrected visual acuity 6/12 or worse

| Causes | Children with VA 6/12 or worse in one or both eyes | | Prevalence in the population in one or both eyes, % (95% CI) |
|---|---|---|---|
| | N | % (95% CI) | |
| Amblyopia | 9 | 2.32% (0.82% - 3.82%) | 0.59% (0.21% - 0.98%) |
| Refractive error | 364 | 93.81% (91.42% - 96.21%) | 24.01% (21.86% - 26.16%) |
| Cataract | 10 | 2.58% (1.00% - 4.15%) | 0.66% (0.25% - 1.07%) |
| Corneal opacity | 2 | 0.52% (-0.20% - 1.23%) | 0.13% (0.00% - 0.31%) |
| Retinal disease | 3 | 0.77% (-0.10% - 1.64%) | 0.20% (0.00% - 0.42%) |
| Total | 388 | 100.0% | 100.0% |

CI = Confidence Interval

*Schoolchildren who received spectacles, eye drops or were referred:* Of the study cohort, 1,066 children (70.3%; 95% CI, 68.1–72.5%) had normal ocular findings. Three hundred and sixty four children (24.0%, 95% CI, 21.9–26.2%) received corrective lenses, while 62 children (4.1%; 95% CI, 3.1–5.1%) received ophthalmic medications. Twenty four children (1.6%; 95% CI, 1.0–2.3%) were referred to Al Ihsan Specialist Hospital for specialized management.

## DISCUSSION

Refractive errors show significant regional variations worldwide. Due to the lack of standardized assessment methods, the "Refractive Error Study in Children" protocol was developed and implemented across multiple countries[2]. Understanding the prevalence of refractive errors and visual impairment among school-aged children is crucial for planning eye care services. This study aimed to assess these conditions in Mogadishu for the first time.

In this study, non-cycloplegic refraction was used to assess Refractive Errors (REs), consistent with research conducted on school-aged children in USA[9] and Somaliland, Somalia[7]. Non-cycloplegic refraction was selected to prevent interference with the children's academic activities.

The prevalence of presenting VI (uncorrected VA ≤6/12 in the better eye) was 19.4%, with refractive error causing 93.81% of cases, highlighting the need for vision screening in school children.

Our study revealed that the prevalence of Visual Impairment (VI) surpassed the rates documented in similar studies conducted in Nigeria (3.4%)[10], Sudan (1.75%)[3], Ethiopia (5.8%)[11], Somalia (7.6%)[7], and China (7.70%)[12]. However, this remains below the prevalence reported in western Saudi Arabia (34.9%)[13]. These

findings highlight the need for interventions targeting VI in school-aged children. The primary contributors to VI prevalence in this demographic are inadequate primary eye care services and a lack of health education programs to increase community awareness of the implications of VI in childhood.

Our analysis revealed a significant correlation between the prevalence of Visual Impairment (VI) and sex, with a notably higher prevalence among girls (21.9%) than among boys (16.0%) (P=.004). This observation is consistent with the findings from studies in Somalia, which reported a slightly higher prevalence in girls (4.6% vs. 2.6%)[7], and Ethiopia (3.2% vs. 2.6%)[6]. However, this finding differs from those of studies that found no significant sex differences. This variation may be due to socioeconomic factors, which give boys better access to healthcare in certain cultures. Furthermore, we identified a statistically significant relationship between VI prevalence and age (P<0.001), with VI being less common in younger children (6-7 years) and peaking in the 10 -11 year age group (49.2%). This pattern likely reflects the progression of refractive errors, particularly myopia, as children age.

The overall prevalence of Refractive Errors (RE) in our study was 24.9%, surpassing the 15.7% reported in a previous study conducted in Somaliland, Somalia[7], South Africa (20.7%)[15], and South India (1.44%)[16] but lower than that in Sudan (27%)[3] and Ghana (25.6%)[14]. The variation in RE prevalence across studies may be attributed to the sampling method, population size, and geographic location. We identified a significant association between RE prevalence and sex (P=0.001) and age (P=0.001). Consistent with our findings on Visual Impairment (VI), RE was more prevalent among girls (29.1%) than among boys (19.2%).

Myopia was identified as the most prevalent Refractive Error (RE), affecting 10.5% of children. This prevalence is higher than that reported in a previous study conducted in Ethiopia (6.0%)[6] and South India (1.38%)[16] but lower than the rates observed in Ghana (14.1%)[17] and Vietnam (20.4%)[17]. The age-related increase in myopia prevalence, which peaked at 58.6% among 12-year-olds, was consistent with findings from similar studies conducted in China, where the prevalence was 73.12% among 15-year-olds[18], Vietnam[17] and Ghana[14]. These findings underscore the importance of outdoor activities in preventing myopia in school-aged children.

Hypermetropia accounted for 6.1% of cases, which is lower than the 26.4% reported in Ethiopia[6]. However, this rate is higher than that documented in Somaliland, Somalia (2.7%)[7], and China (5.2%)[19]. The trend of decreasing hypermetropia prevalence with age, with a peak of 6.8% in 7-year-olds and no cases in the 13-15 age group, is consistent with the natural emmetropization process, where the eye's refractive state shifts towards emmetropia as children grow. It is crucial to acknowledge that our use of non-cycloplegic refraction may have resulted in an underestimation of the prevalence of hypermetropia. Studies comparing cycloplegic and non-cycloplegic refraction in similar age groups suggest that hypermetropia prevalence may be underestimated by approximately 2% to 5% when cycloplegia is not used due to active accommodation. Therefore, the true burden of hypermetropia in our cohort might be slightly higher than reported. Astigmatism was detected in 8.4% of the children, a figure that surpasses the rates reported in Somaliland, Somalia (3.9%)[7] but was lower than the prevalence found in the Islamic Republic of Iran (11.5%)[8], Sudan (14%)[3] and China (18.3%)[20]. The prevalence of manifest strabismus (tropia) was 1.9%, with exotropia being more common than esotropia. This is higher than the rates reported in Tanzania (0.5%)[21] but comparable to that of Iranian children (1.2%)[8]

In our study, uncorrected refractive error emerged as the predominant cause of Visual Impairment (VI), accounting for 93.81% of the cases. This finding aligns with the results of other studies employing similar methodologies, such as those conducted in Ethiopia (77.3%)[6], and Western China (86.08%)[12]. Cataracts were the second most prevalent cause of VI (2.58%), followed by amblyopia (2.32%). Retinal diseases, corneal opacities, and other causes contribute minimally to the overall burden. A critical public health concern is the low rate of spectacle use, with only 19.7% of children with VI using spectacles. This underscores a significant barrier to effective vision correction, which can be attributed to factors such as insufficient parental awareness, the financial burden of spectacles, and social stigma or peer pressure.

## Limitations

Our study had limitations. The cross-sectional design limited causal inferences. Non-cycloplegic refraction may have underestimated hypermetropia. The exclusion of certain schools and non-enrolled children due to economic hardship affects generalizability. Using Snellen E-charts and basic examination tools instead of advanced equipment may have reduced diagnostic precision. Additionally, non-school-attending children, who may have higher rates of uncorrected visual impairment, were not included. Furthermore, the age distribution of our sample was markedly skewed towards younger children (6 -7 years), resulting in very small sample sizes for older age groups (11-15 years). Consequently, age-specific prevalence estimates and confidence intervals for older children are wide and should be interpreted with caution.

## CONCLUSIONS

The prevalence of Visual Impairment (VI) among school-aged children in Mogadishu, Somalia, is notably high, with uncorrected Refractive Errors (REs) being the most prevalent cause. This underscores the urgent need for a comprehensive childhood eye care strategy aimed at delivering essential eye care services to this age group. Such a strategy should be formulated through a collaborative effort involving government entities, the private sector, stakeholders, and non-governmental organizations dedicated to the prevention of avoidable childhood blindness and VI. Furthermore, these findings emphasize the importance of instituting regular vision screening programs to mitigate the preventable causes of vision impairment.

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## Declarations

*Consent for publication*: All participants provided consent for publication, and any personal information was anonymized to protect their identities.

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*Availability of data and materials:* The datasets utilized and analyzed in the current study are available from the authors upon reasonable request.

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