RESEARCH PAPER

# Universal Vision Screening for School Children in Bangladesh: Evidence on Need, Feasibility, and Public Health Implications

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## 1. ABSTRACT

Uncorrected refractive error (URE), meaning an error in the eye that impacts how clearly an object appears, is the leading cause of visual disability among children around the world. URE disproportionately affects children living in low and middle-income countries, such as Bangladesh. While there is a large burden of URE and it can be treated easily, there are very few systematic school-based initiatives for screening children for vision problems.

This study investigated how much demand there is for school-based vision screening and the feasibility of implementing such screening programs in Bangladesh using secondary data from an NGO-led screening program. A retrospective cross-sectional study of 320 primary school students (640 eyes) who screened for vision using autorefractors under standard settings was completed in Dhaka, Barisal, and Chandpur during 2015.

Refractive errors were found in at least 91.6% to 94.8% of screened eyes. Myopia accounted for at least 30% to 42% of the detected refractive errors. The child-level prevalence of refractive error was estimated at 93.5% (95% CI: 90.8%-96.2%). The reported incidence of refractive error in this study, while much higher than the population-based prevalence, is likely due to selection bias (screening was conducted among people with current symptoms) rather than reflecting true national prevalence. However, the data support that there is a large burden of previously undiagnosed visual impairment in this population and support the idea that school-based vision screening should serve as an effective tool for the early identification of visual impairment and for the timely provision of treatment.

Without the rapid implementation of systematic nationwide screening programs, a large proportion of preventable blindness and visual impairment in Bangladeshi children would stay undiscovered and would have a severe impact on their scholastic performance and the development of human capital in the long run.

**KEYWORDS:** Uncorrected refractive error, school-based vision screening, myopia, visual impairment, child eye health, Bangladesh, early detection, public health.

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## 2. INTRODUCTION

Their eyes will have a big effect on how well children do at school, how intelligent they are and how happy they are generally. Despite the progress in eye care systems in other areas of the world, VI is a serious public health problem. VI is predicted to affect 2.2 billion people

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(WHO, 2019). Approximately 50% are preventable or treatable. The major cause of vision loss is uncorrected refractive error (URE), and global estimates continue to show a substantial unresolved burden (Hashemi et al., 2017; Resnikoff et al., 2008). It is a sickness of any age, although its effects are more severe in the young. It is a matter of optical and neurological aspects. Children who show early signs of VI are more likely to have learning difficulties, to be unmotivated at school, to have a bad quality of life and to have delayed development. Their education and income may be damaged in the long run as well (Toledo et al., 2010). "An estimated 12.8 million children aged 5–15 years have uncorrected refractive error (WHO 2019). The main challenges are in nations where access to eye care services is restricted, awareness is low, and there are no organised screening programs (Holden et al., 2016). "Many children with refractive error are not diagnosed until they experience a vision impairment that affects their grades, and they complain about it. This has already led to a major delay in progress. "Refractive error is a substantial problem in Bangladesh, but most people don't know about it," he said. The National Eye Care (NEC) has improved access to eye care services, and school-level eye testing has also been promoted in Bangladesh (Ferdausi & Mostafa, 2021). If refractive defects are not detected and treated in childhood, they can cause major visual problems (i.e., amblyopia) (Toledo et al., 2010).

Poor visual ability has been associated with poor cognitive development, limited classroom involvement and poor social development (WHO, 2019). Therefore, the reduction in productivity and increased health costs magnify the effect of refractive error on public health expenditure. School vision screening for early diagnosis of refractive error is well known across the world. Studies in different countries (e.g., Taiwan, India, and China) (Murthy et al., 2018; Wu et al., 2020) have demonstrated that systematic vision examinations and follow-up management are related to better visual outcomes and less need for services for children with visual impairment. Bangladesh has multiple vision screening programs, but there is no empirical data on their utility or potential for scale-up. Hence, country and culture-specific statistics are vital to inform the establishment of the national-level policy and program for vision screening. This study aims to fill this gap by describing the magnitude of the problem of refractive error using data from a pilot vision screening conducted by an NGO in the districts of Dhaka, Barisal and Chandpur and by evaluating the feasibility of introducing universal vision screenings on a school-wide basis in Bangladesh. The research will look at current data on screening programs in the field and is intended to provide evidence to enhance the argument for supporting a more extensive vision screening in the overall national health strategy for schools. However, in Bangladesh, data to inform national-level implementation are still few, available mostly in the form of poor programmatic reports and carefully studied statistics.

## 3. METHODS

### 3.1 Study Design

This study employed a retrospective cross-sectional design using secondary data obtained from a community-based vision screening programme conducted in 2015. Retrospective cross-sectional studies are widely used in public health research to assess disease burden and evaluate screening outcomes in resource-limited settings (Setia, 2016).

### 3.2 Study Setting and Population

The screening programme was carried out in selected primary schools in three locations of Bangladesh, namely Dhaka (urban setting), Barisal (rural setting), and Chandpur (semi-urban setting). The study comprised 320 elementary school children (about 6–12 years of age) in total. Both eyes were investigated (n = 640).

**Criteria for inclusion:** 6–12 years old, Primary schools participating, enrolled, Present on the day of screening

**Exclusion Criteria:** Known eye disease (e.g., congenital abnormalities, current infection), History of eye surgery, Inadequate or unavailable screening data

### 3.3 Technique of Sampling

The study employed a non-probability convenience sample method where all children deemed eligible in the selected classrooms were screened during the program period. This approach is useful in the context of rapid field research, but it can result in sample bias (e.g., more high-risk individuals in this study than in the broader high-risk community) and makes the results less generalisable to other groups (Acharya et al., 2013). Things to consider while choosing a sample size: The sample size was dictated by the capacity of the NGO-led screening programme and hence should not be viewed statistically. The results should be viewed as exploratory, not representative of the entire country.

### 3.4 Criteria for diagnosis and method of screening

Vision screening was done through collaboration of the NGO, private optometrist centre, and eye hospital. All measurements were made by competent optometrists under standardised settings. Evaluation Tools: Autorefractor (objective refraction), Standard protocols for the testing of visual acuity. Autorefraction is a valid approach for finding refractive defects in paediatric populations, especially in large-scale screening programs (Choong et al., 2006; Guo et al., 2022).

Standardised criteria for the definition of Refractive Error: The classification of refractive errors was based on the following cut-offs: Myopia: Spherical equivalent ≤ −0.50 dioptres (D), Hyperopia: spherical equivalent ≥ +2.00 D, Cylindrical error ≥ 0.75 D (Astigmatism), Emmetropia (normal vision): values within the above threshold. These criteria were similarly applied to all participants. Important Methodological Note: Cycloplegic refraction was not conducted, which could lead to an overestimation of myopia and an underestimation of hyperopia in paediatric populations.

The exploratory nature of the dataset and restrictions of the sample design precluded the use of inferential statistical testing.

**3.5 Intervention**

NGOs assisted children diagnosed with a substantial refractive error, especially those from disadvantaged socio-economic situations, by providing them with free prescription spectacles. The distribution of spectacles is a proven, cost-effective solution to improve visual outcomes and reduce the burden of uncorrected refractive error (Smith et al., 2009; Ma et al., 2014).

**3.6 Data Collection and Handling**

Data were collected from the NGO's screening records and anonymised before research. The dataset contained: Screened children, Refractive error of the eye, Kind of Refractive Error To increase the analytical validity, both child-based and eye-based studies were performed: Per eye analysis: gives a thorough distribution of refractive error, Child-specific analysis: produces clinically relevant prevalence estimates

**3.7 Statistical Analysis**

Descriptive statistical analysis was done using frequencies and percentages. The prevalence of refractive error was defined as: Prevalence (%) = (Number of cases / Total population) x 100. Results were provided in tables and in graphical summaries (bar charts, pie charts). As the study was exploratory, no inferential statistical tests were carried out.

**3.8 Ethical Aspects**

The study used secondary data that was anonymised and had no personal identities. School officials gave authorisation to undertake screening activities, and parental approval was sought through the school administration. The study was performed according to the ethical guidelines of the Declaration of Helsinki for research involving human subjects (World Medical Association, 2013).

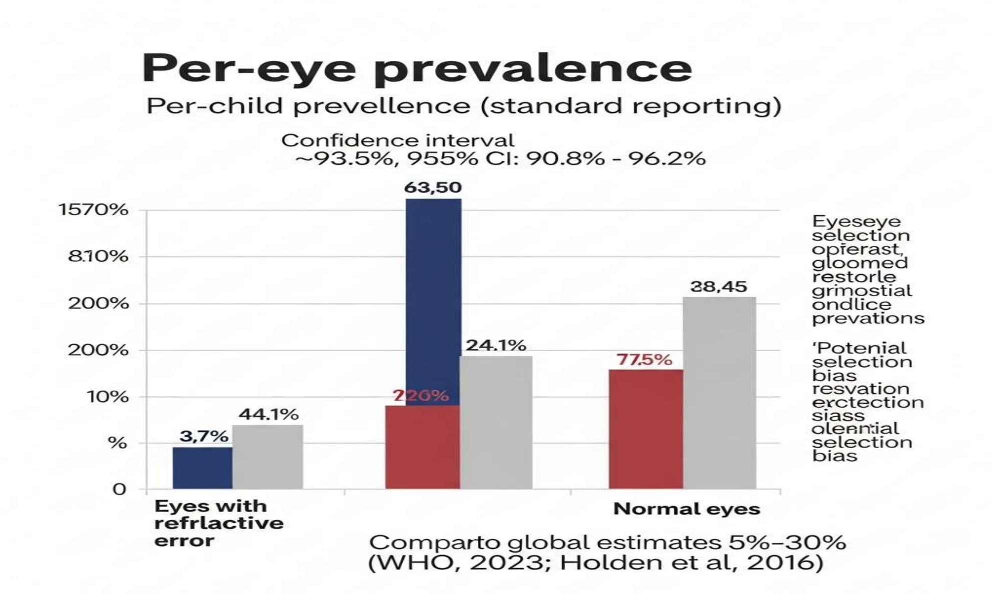
**4. RESULTS**

**4.1 Overall Prevalence of Refractive Error**

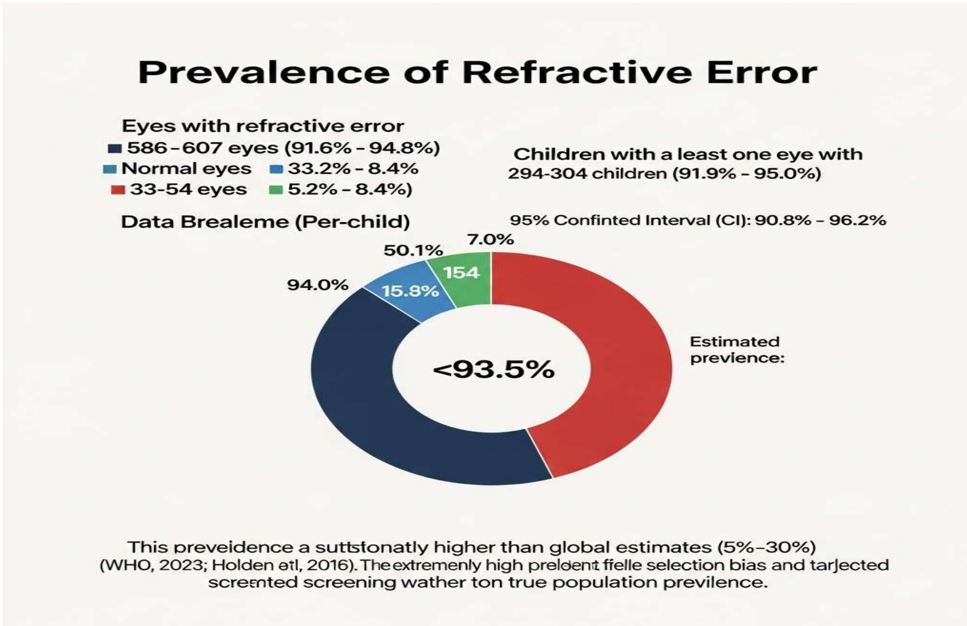
A total of 320 primary school children (640 eyes) were screened across selected schools in Dhaka, Barisal, and Chandpur districts, Bangladesh (2015).

Per-eye prevalence: Out of 640 eyes examined: Eyes with refractive error: 586–607 eyes (91.6%–94.8%), Normal eyes: 33–54 eyes (5.2%–8.4%)

Per-child prevalence: At the individual level, an estimated 294–304 children (91.9%–95.0%) had at least one eye with refractive error. Estimated prevalence: 93.5%, 95% Confidence Interval (CI): 90.8% – 96.2%




This prevalence is substantially higher than global estimates (5%–30%) (WHO, 2019; Holden et al., 2016). The extremely high prevalence likely reflects selection bias and targeted screening rather than true population prevalence.




### 4.2 School-wise and Regional Distribution

**Table 1. School-wise Distribution of Refractive Error (Per-eye Analysis, n = 640 eyes)**

| School Location | Total Eyes (n) | Normal Eyes (%) | Abnormal Eyes (%) |
|---|---|---|---|
| Dhaka (Urban 1) | 106 | 6.1% | 93.9% |
| Dhaka (Urban 2) | 106 | 9.3% | 90.7% |
| Barisal (Rural 1) | 106 | 5.2% | 94.8% |
| Barisal (Rural 2) | 106 | 10.2% | 89.8% |
| Chandpur (Semi-urban 1) | 106 | 8.5% | 91.5% |
| Chandpur (Semi-urban 2) | 106 | 7.7% | 92.3% |
| Total | 640 | 5.2%–10.2% | 89.8%–94.8% |

Urban vs Rural Comparison: Urban (Dhaka): 90.7%–93.9%, Rural (Barisal): 89.8%–94.8%, Semi-urban (Chandpur): 91.5%–92.3%
Although prevalence was consistently high across all regions, slightly higher values were observed in rural settings, suggesting potential disparities in access to prior eye care services.

### 4.3 Pattern of Refractive Error

**Table 2. Distribution of Refractive Error Types (Per-eye Analysis)**

| Refractive Status | Right Eye (%) | Left Eye (%) | Overall Pattern |
|---|---|---|---|
| Myopia | 30%–42% | 28%–35% | Most prevalent |
| Hyperopia | 12%–18% | 13%–19% | Moderate |
| Normal | 5%–10% | 5%–10% | Lowest |

Key Findings: Myopia was the dominant refractive error (30%–42%), and hyperopia was less common but clinically relevant. A similar distribution between right and left eyes indicates internal consistency

### 4.4 Comparative Epidemiological Insight

**Table 3. Comparison with Regional and Global Estimates**

| Region | Reported RE Prevalence |
|---|---|
| Bangladesh (Current Study) | 91.6%–94.8% |
| India | 10%–25% (Murthy et al., 2018) |
| China | 20%–40% (Wu et al., 2020) |
| Global Average | 5%–30% (WHO, 2023) |

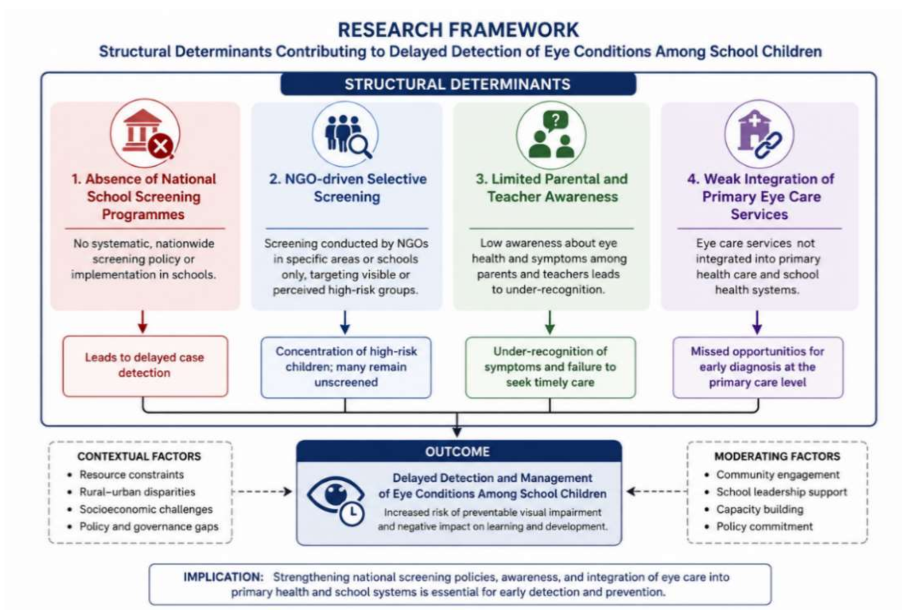
This study showed a higher prevalence than in past studies conducted in Kenya, meaning that there was some bias in the study; either because of a lack of previous systematic screening programs, or due to the number of previously undiagnosed cases that have now been identified (the backlog effect).

### 4.5 Impact of Intervention (Spectacle Provision)

All children with significant refractive error received free glasses through assistance from an NGO. Clinical significance includes immediate improvement in vision, prevention of amblyopia (lazy eye), academic underachievement, and psychosocial problems. Therefore, while the prevalence was very high, it should be considered in the context of targeted screening and potential bias in selection, and should not be interpreted as a true prevalence of the whole community.

## 5. DISCUSSION

The number of children who have refractive errors is very high. In Bangladesh, the percentage of primary school students with this problem was found to be between 91.6%-94.8%. The average amount of students with refractive errors in other countries is estimated to be between 5% to 30%, and so there is a significant difference between the amount found in Bangladesh and those countries that have been studied. This suggests that there is a large burden of disease from refractive error, and the increasing number of referrals for these problems suggests that the rate of disease is not increasing but rather that there are now more opportunities to diagnose (Morgan et al., 2012). Refractive error was found to be highly prevalent (91.6% - 94.8%) among primary school This elevated detection compared to the rate at which certain types of illnesses would otherwise have been discovered is consistent with detection bias. When estimating the prevalence of a certain type of disease with opportunistic screening programmes, it is a well-known fact that the estimates of the prevalence of the disease in a population would be strongly influenced by the risk profile of the group that was tested. The usual form of health care delivery has shown that screening NGOs targeted with autorefractors have a significant pool of previously undetected cases of refractive error. These findings suggest the need to transition from independent, NGO-led programs to health system-wide, long-term, and comprehensive School Eye Health Programmes that will integrate the health system viewpoint of the countries in which they are implemented (Burton et al., 2021). A critical explanatory ("WHY") framework highlights multiple structural determinants:




These data should therefore be used to demonstrate the existence of a large latent burden of disease and unaddressed need and not to estimate a true prevalence of refractive error in the population, as in most cases, opportunistic diagnosis of refractive error is not made without the presence of national referral systems to identify and link children with refractive error to appropriate intervention. The prevalence of myopia documented looks higher than in other poor or middle-income nations and prevalence reported in India (10% – 25%) (Murthy et al., 2018), and Africa (5% – 15%) (Naidoo et al., 2016). Variations between these estimates are therefore more likely to represent methodological differences than true differences in prevalence between populations. Screening-based methods tend to exaggerate prevalence rates because they use non-cycloplegic assessments and other assessment types. However, in general, a representative population-based sample would be selected via random sampling using cycloplegic refraction. The causes for these inequalities include poor integration of services for eye health of children in schools, low coverage of screening programmes, and extensive usage of non-governmental groups to supply these services (Tan et al., 2023; Burton

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et al., 2021). Therefore, uncorrected myopia would keep accumulating in people until the time of a screening programme for myopia and related risk factors. Myopia rates are ballooning around the world, particularly in Asia, and appear to be strongly associated with environmental and behavioural risk factors, including increased time spent on close work and electronic devices, less time spent engaging in outdoor physical activity, and increased urban development (Fricke et al., 2021). Bangladesh should also launch awareness programs on myopia and lifestyle modification to lower risk factors. From a system's point of view, we rely on NGOs & private sector solutions because we don't have coordinated, scalable & equitable national service delivery, and these programs are being conducted locally but don't have the capacity to meet the demands of the public. The findings are consistent with the WHO "School Health Services" model, which recommends that early detection and treatment of visual impairments should be included in a child's health care plan and that vision screening under national school health programs is a low-cost/high-impact option (World Health Organisation, 2021; Ross et al., 2021). Unaddressed Refractive Errors cause huge hurdles for the progress of an economy & education system. Children with impaired eyesight may underperform in academics, miss school, and ultimately have poor productivity throughout their lives (Toledo et al., 2010). It is important to treat this as an investment in human capital rather than just a health concern.

## 6. LIMITATIONS

There are methodological constraints; one of these is the possibly biased sample population (i.e., convenience sample). The second methodological concern is the lack of cycloplegia during visual acuity examinations, which is especially important for children because accommodating would give a false picture of how common myopia and hyperopia are. The third drawback is that the investigation is centred on one eye, which is not an independent observation. Moreover, since the study population was small and limited geographically, extrapolating the results to the larger population will likely be inaccurate. Without longitudinal follow-up, we cannot assess adherence, compliance, and long-term results on visual function. In addition, there were inconsistencies with regard to both the screening process and the methods of referring individuals to diagnostic testing. As a result of the above methodological limitations, we urge extreme caution in interpreting the results. Because the sample size was based on ease of recruitment rather than on specific population characteristics, the true prevalence of disease may be understated because of other confounding factors. Also, there were no statistical analyses performed to establish any relationship between or the cause of the results.

## 7. CONCLUSION

This article presents evidence for a major but unrecognised burden of refractive error in primary school children in Bangladesh, primarily resulting from systemic deficiencies in early identification and access to ophthalmic care. The high prevalence rates noted, while partly attributable to increased identification through focused screening efforts, illustrate the large and undocumented cohort of children who have NOT been identified and treated within the paediatric cohort for uncorrected refractive error. Additionally, the high incidence of myopia illustrates the effect of new environmental and behavioural risk factors.

The ultimate conclusion from this research is that there is an urgent need for a well-coordinated and nationwide school-based vision screening program, consistent with the WHO school health strategies (World Health Organisation, 2021; Ross et al., 2021). An integration of this program into existing education and primary health care systems with teacher training and availability of spectacles in an affordable manner provides a scalable and sustainable solution.

Should these programs be developed, they will improve the incidence of avoidable visual impairment and the equity of educational opportunities, while supporting the long-term development of human capital in Bangladesh.

**Author Contributions**

All authors contributed substantially to the conception and design of the study. Data collection, data analysis, interpretation of results, and manuscript preparation were carried out collaboratively by the authors. All authors reviewed, revised, and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

**Conflict of Interest Statement**

The authors declare no competing interests, financial or otherwise, that could have influenced the work reported in this study.

**Data Availability Statement**

All relevant data supporting the findings of this study are included within the manuscript. Additional information related to the dataset may be made available by the corresponding author upon reasonable request.

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