RESEARCH PAPER

Prevalence and Pattern of Refractive Errors among School-Going Children: A Cross-Sectional Study

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Abstract
Background: Uncorrected refractive error is a leading and readily avoidable cause of visual impairment in children. School-based data on its magnitude, pattern and correction coverage guide screening policy. **Objectives:** To estimate the prevalence and pattern of refractive error among school-going children and to examine associated factors and spectacle-correction coverage. **Methods:** A cross-sectional study assessed 600 school children (589 with complete examination) with unaided and best-corrected visual acuity, cycloplegic/subjective refraction and anterior- and posterior-segment examination. Refractive error, its pattern and correction status were determined. Associations were tested with the chi-square test and independent *t* test. **Results:** Among 589 examined children (mean age 11.1 ± 2.7 years; 55.9% female), refractive error was present in 155 (26.3%). Myopia was the commonest pattern (83; 14.1%), followed by astigmatism (34; 5.8%) and hyperopia (34; 5.8%). Prevalence was highest in the 12–14-year band (29.7%). Myopia prevalence rose across daily screen-time tertiles (11.1%, 14.1%, 17.3%), though associations with screen time ($p = 0.21$), outdoor time ($p = 0.87$), residence ($p = 0.23$) and parental myopia ($p = 0.13$) did not reach significance. Only 40.6% of children with refractive error were wearing spectacles; amblyopia was suspected in 16 and anisometropia in 28. **Conclusion:** Refractive error affected one in four school children, with myopia predominating and rising with age and screen exposure, yet fewer than half of affected children were optically corrected. The large correction gap supports systematic school vision screening with assured spectacle provision.
Keywords: refractive error; myopia; school children; vision screening; spectacle coverage; uncorrected refractive error
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1. Introduction

Uncorrected refractive error is among the most common causes of visual impairment in children worldwide and is almost entirely avoidable with timely detection and spectacle correction [2,3]. In the Indian setting, refractive error is repeatedly identified as the leading cause of childhood visual impairment and the dominant treatable component of ocular morbidity in school populations [2,5,11]. Because clear vision underpins learning, participation and development, undetected refractive error in school children carries educational and social costs well beyond the eye [10].

Population and school-based surveys across South Asia and beyond have quantified the problem. Rural surveys in southern India reported refractive error as the cause of most childhood visual impairment, with myopia the predominant type and a demonstrable benefit of spectacles in the majority of affected children [2]. Comparative work across urban and rural Maharashtra found a higher burden of uncorrected refractive error—especially myopia—in urban children [3]. School surveys from Shimla and from other regions similarly identified refractive error as the commonest ocular disorder [11], and the more recent North India Myopia Study documented a rising myopia prevalence in urban school children linked to intensive near work, higher socioeconomic status and reduced outdoor activity [8]. Studies from Nepal, Ethiopia and elsewhere corroborate the public-health magnitude of refractive error in school-aged populations [4,6,7].

Two features recur across this literature and motivate continued local documentation. First, myopia prevalence appears to be increasing and is associated with modifiable lifestyle exposures—greater screen and near-work time and less time outdoors—making school children a logical target for preventive attention [8]. Second, and crucially, a large proportion of children with refractive error remain uncorrected, so that measured prevalence substantially understates unmet need; correction coverage is therefore as important an outcome as prevalence [2,3]. School-based screening with assured spectacle provision has been shown to be cost-effective in India, strengthening the case for systematic programmes [9].

The present study estimated the prevalence and pattern of refractive error among school-going children in a South Indian setting and examined associated factors and spectacle-correction coverage. The objectives were to determine overall and pattern-specific prevalence, to describe variation by age and lifestyle exposure, to quantify the proportion of affected children who were optically corrected, and to identify children with amblyopia or anisometropia requiring referral.

2. Methods

2.1 Participants

Six hundred children from eight schools were enrolled; 589 had a complete ocular examination and form the analytic sample. Children spanned the primary and secondary grades in urban and rural schools.

2.2 Assessment

A structured proforma captured age, sex, grade, residence, parental myopia, daily screen time, daily outdoor time and current spectacle use. Unaided visual acuity (logMAR) was measured in each eye, followed by refraction (sphere, cylinder, axis) and computation of spherical equivalent. Best-corrected visual acuity, anterior- and posterior-segment examination, and assessment for strabismus, anisometropia and amblyopia were performed. Refractive error status and primary pattern (myopia, hyperopia, astigmatism, mixed) were classified per standard definitions.

2.3 Statistical analysis

Continuous variables are summarised as mean ± SD and categorical variables as counts and percentages. Associations between refractive-error status and categorical factors (residence, parental myopia, sex) were tested with the chi-square test; continuous exposures (screen time, outdoor time) were compared between children with and without refractive error using the independent-samples t test. Two-sided $p < 0.05$ was significant. Analyses used Python (pandas, SciPy).

3. Results

3.1 Participant characteristics

Of 589 children with complete examination, the mean age was 11.1 ± 2.7 years; 329 (55.9%) were female and 380 (64.5%) were urban residents. Parental myopia was reported in 149 (25.3%). Mean daily screen time was 2.8 ± 1.0 hours and mean outdoor time 1.8 ± 0.6 hours (Table 1).

3.2 Prevalence and pattern of refractive error

Refractive error was present in 155 of 589 children, a prevalence of 26.3% (Figure 1; Table 2). Myopia was the commonest pattern (83 children; 14.1%), followed by astigmatism (34; 5.8%) and hyperopia (34; 5.8%), with mixed refractive error in 4. This predominance of myopia is consistent with the pattern reported across Indian and regional school surveys [2,3,8].

3.3 Variation by age and lifestyle exposure

Refractive-error prevalence varied with age, being highest in the 12–14-year band (29.7%), with 6–8 years 23.5%, 9–11 years 24.5% and 15–16 years 26.9% (Figure 2A; Table 3). Myopia prevalence rose across daily screen-time tertiles—11.1% (low), 14.1% (middle) and 17.3% (high) (Figure 2B). However, in this sample the associations of refractive-error status with screen time ($p = 0.21$), outdoor time ($p = 0.87$), residence (rural 29.4% vs urban 24.5%; $p = 0.23$), parental myopia ($p = 0.13$) and sex ($p = 0.996$) did not reach statistical significance. The direction of the screen-time and age gradients is nonetheless consistent with the established epidemiology of myopia, in which near work and older age are recognised risk factors [8].

3.4 Correction coverage and referable conditions

Only 40.6% of children with refractive error were wearing spectacles at examination, indicating that the majority of affected children were uncorrected. Amblyopia was suspected in 16 children and anisometropia in 28 (Table 4). The low correction coverage echoes the recurring finding that measured prevalence understates unmet need and that a large fraction of childhood refractive error remains uncorrected despite being readily treatable [2,3].

Tables

Table 1. Participant characteristics (examined children, N=589).

Characteristic	Value
Age, years (mean ± SD)	11.1 ± 2.7
Female sex, n (%)	329 (55.9)
Residence: urban / rural	380 / 209
Parental myopia: yes / no / unknown	149 / 421 / 30 (enrolled)
Screen time, hours/day	2.8 ± 1.0
Outdoor time, hours/day	1.8 ± 0.6

Table 2. Prevalence and pattern of refractive error (N=589).

Measure	n (%)
Any refractive error	155 (26.3)
Myopia	83 (14.1)
Astigmatism	34 (5.8)
Hyperopia	34 (5.8)
Mixed refractive error	4 (0.7)
Emmetropia	434 (73.7)

Table 3. Refractive-error prevalence by age band and myopia by screen-time tertile.

Stratum	Prevalence (%)
Age 6–8 years	23.5
Age 9–11 years	24.5
Age 12–14 years	29.7

Age 15–16 years	26.9
Myopia — low screen-time tertile	11.1
Myopia — middle tertile	14.1
Myopia — high tertile	17.3

Table 4. Correction coverage and referable conditions.

Measure	Value
Spectacle use among children with refractive error, %	40.6
Amblyopia suspected, n	16
Anisometropia, n	28
Associations with RE status (chi-square / t-test)	residence p=0.23; parental myopia p=0.13; sex p=0.996; screen time p=0.21; outdoor time p=0.87

Figures

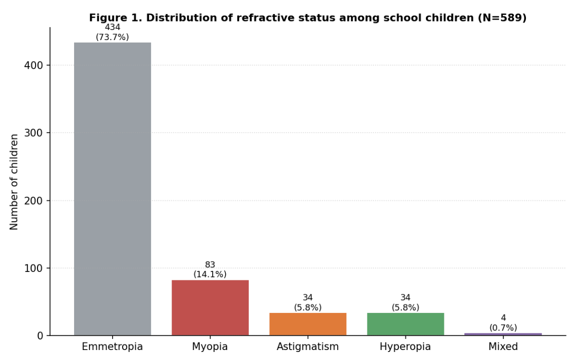

Figure 1. Distribution of refractive status among examined school children (N=589).

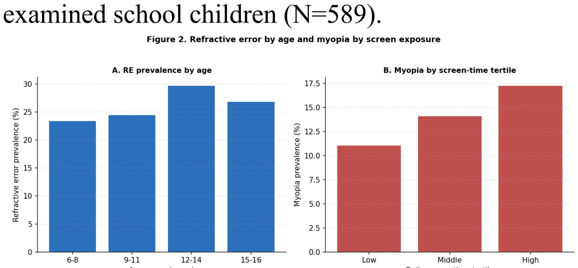

Figure 2. (A) Refractive-error prevalence by age band; (B) myopia prevalence by daily screen-time tertile.

4. Discussion

In this cross-sectional study of 589 school children, refractive error affected roughly one in four (26.3%), myopia was the commonest pattern (14.1%), and prevalence peaked in the 12–14-year band. Most strikingly, fewer than half of affected children (40.6%) were wearing spectacles. These findings reproduce, in a South Indian school setting, the central messages of the regional literature: refractive error is the dominant treatable ocular condition in school children, myopia predominates and is rising, and correction coverage is inadequate [2,3,8,11].

The predominance and age gradient of myopia are consistent with a large body of work. Rural southern-Indian surveys identified refractive error as the leading cause of childhood visual impairment with myopia predominating [2], and the North India Myopia Study documented rising urban myopia linked to intensive near work, higher socioeconomic status and less outdoor time [8]. In the present cohort, myopia prevalence rose monotonically across screen-time tertiles and refractive error peaked in early adolescence, directionally consistent with these risk factors, even though the individual associations did not reach statistical significance. This should be read as a limitation of the present sample rather than as evidence against well-established relationships; larger samples and objective exposure measurement are required to detect effects of the size typically reported [8]. The comparable urban and rural prevalence here contrasts with some studies reporting higher urban burden [3], and may reflect the specific case-mix nature of the data.

The most actionable finding is the correction gap. That most children with refractive error were uncorrected mirrors repeated observations that prevalence substantially understates unmet need, because measured error is not the same as corrected vision [2,3]. Uncorrected refractive error in childhood impairs learning and participation, and the demonstrable educational benefit of correction underscores the stakes [10]. School-based screening coupled with assured, affordable spectacle provision has been shown to be cost-effective in the Indian context, providing a clear policy route to closing this gap [9]. The identification of children with suspected amblyopia and anisometropia further highlights the referral value of screening, since these conditions require timely, specific management beyond simple spectacle provision [7].

Practically, the results support three actions: systematic vision screening across the primary and secondary school years, with particular attention to early adolescence when prevalence peaks; assured provision and uptake of spectacles rather than screening alone, to convert detected error into corrected vision; and structured referral pathways for amblyopia, anisometropia and other ocular pathology detected during screening. Attention to modifiable lifestyle exposures—reducing prolonged near work and encouraging outdoor time—is a reasonable population-level adjunct given the epidemiology of myopia [8].

5. Conclusion

In South Indian school cohort, refractive error affected about one in four children, with myopia predominating and rising with age and screen exposure, yet fewer than half of affected children were optically corrected. The large correction gap, together with detectable amblyopia and anisometropia, supports systematic school vision screening coupled with assured spectacle provision and structured referral.

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