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UNMET NEED FOR EYE CARE AND SPECTACLE COVERAGE AMONG SCHOOL CHILDREN IN CENTRAL INDIA

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Abstract

Background: Uncorrected refractive error is a leading cause of avoidable visual impairment in children and remains a major contributor to unmet eye care needs in low and middle income countries. Spectacle coverage and unmet need are practical measures to monitor progress towards universal eye health. We aim to assess unmet need for spectacles, spectacle coverage and (eREC) effective refractive error coverage among government school children in rural central India, and to examine their association with socio demographic factors.

Methods: A cross-sectional study was performed on 500 children aged 7-14 years in rural government schools. Distance vision was evaluated using the Snellen E Chart. Children who had presenting visual acuity worse than 6/9 in one or both eyes were further evaluated with pinhole and referred for refraction if vision improved. Refractive error refers to difficulty seeing at a distance and its various classifications are defined in recent global recommendations.

Results: Refractive error was present in 28 of 500 children (5.6%) in present study. Of the children needing distance correction, 8 corresponded to need with adequately correcting spectacles, 2 undermet need with inadequate spectacles and 18 unmet need without spectacles. Overall, there was an unmet + undermet need of 4.0% in the total population. Both spectacle compensation and eREC stood at 28.6%. The older children, girls and family with lower socio-economic strata had higher needs and unmet needs.

Conclusions: A considerable number of children with refractive error remained uncorrected or inadequately corrected, resulting in low spectacle coverage. Standardized use of spectacle coverage and eREC usage can enable programmes to identify gaps and measure effectiveness of school eye health programmes aimed at improving access and quality of refractive care.
Keywords: refractive error; spectacle coverage; unmet need; schoolchildren, eREC

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Introduction

The leading cause of vision impairment globally and a major part of avoidable visual disability in adults and children is uncorrected refractive error. According to the World report on vision, at least 2.2 billion people live with vision impairment; of these, at least 1 billion have impairment that could have been prevented or is yet to be addressed. [1] Uncorrected refractive error is estimated to account for a substantial share of this global burden.[1] The Lancet Global Health Commission on Global Eye Health highlights that most people will experience some degree of vision impairment over the life course, and that unmet need for basic eye-care interventions such as refractive correction remains high

this is especially so in low- and middle-income countries.[2] Uncorrected refractive error negatively impacts academic performance, social engagement and quality of life of school-age children with longer-term ramifications for human capital and economic prosperity.[1,2] Spectacles are a simple and cost-effective solution, yet refractive service coverage remains suboptimal in many parts of India.[3]Spectacles coverage and eye care unmet need are operational definitions that help quantify the gap between those who need refractive correction and those who actually receive and effectively utilize this.[4]. McCormick et al. proposed effective refractive error coverage (eREC), as a key indicator for monitoring progress towards universal health coverage in eye care and redefined met, unmet and undermet need in terms of access and quality of correction.[4]

Despite childhood refractive error getting more attention, not enough data is there to assess unmet need for eye care and spectacle coverage among government-school children in rural central India. It is important to understand the magnitude of refractive error, levels of unmet need, effective spectacle coverage and their socio-demographic correlates for planning and strengthening school eye-health programmes. Study aimed at estimating the prevalence of unmet need of distance spectacles and spectacle coverage among school going children in rural central India, using the definition consistent with the emerging global indicator for effective refractive error coverage.

Material and Methods

Study design and setting

A school-based cross-sectional study was conducted among students of government schools in rural areas of central India over a period of one year. The primary objectives were to estimate the prevalence of unmet need for distance spectacles, spectacle coverage, and effective refractive error coverage, and to identify associated socio-demographic factors.

Study population and eligibility criteria

All students aged 7–14 years enrolled in the selected schools and present on the day of the visit were eligible. Children were included if written informed consent was obtained from parents or guardians and the child assented to participate. Exclusion criteria were inability to cooperate with visual acuity testing, major cognitive or behavioural problems precluding examination, and enrolment in schools for the visually impaired. Children with acute ocular conditions precluding reliable visual acuity assessment were temporarily deferred and re-examined.

Sample size and sampling technique

In study sample size of 500 students was considered, using cochran formula where p is taken as 50%(anticipated prevalence of refractive error) with 95% confidence level, relative precision of 10%, and allowance for non-response of about 20%. Schools was selected by simple random sampling from an updated list of rural government schools, and all eligible students in the specified classes were assessed until the required sample size was achieved.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee of the medical college prior to commencement of the study. Permission was sought from school principals. Parents or guardians were provided written information sheets describing the aims, procedures, benefits and risks, and written informed consent was obtained. Children were provided with verbal or written assent depending on age. Confidentiality was maintained using anonymized study IDs and secure data storage.Children identified with uncorrected refractive error or other ocular pathology were counselled and referred to the ophthalmology department of the tertiary care hospital for free or subsidized care, including refraction, spectacle dispensing, and further management as required.

Data collection procedures

A pre-tested semi-structured proforma was used to collect socio-demographic information, including age, sex, class, type of family, parental education, parental occupation and socio-economic status. History of previous eye examination, spectacle use, and self-reported reasons for not using spectacles (if applicable) were also recorded, based on instruments used in previous studies on spectacle coverage and barriers (1,2).

Distance visual acuity (VA) was measured monocularly at 6 meters using an illuminated Snellen E-chart under standardized lighting. Each eye was tested separately with the fellow eye occluded. For children who wore spectacles, presenting VA with spectacles was recorded first, followed by unaided VA after removing spectacles.

Children with presenting distance VA worse than 6/9 in either eye underwent pinhole testing. Those whose vision improved with pinhole were considered to have probable refractive error and were referred for objective and subjective refraction by an optometrist or ophthalmologist. Best-corrected VA after refraction was recorded for each eye. A brief anterior segment examination with torch and magnifier, and fundus examination where indicated, were performed to identify other ocular morbidities.

Operational definitions

Definitions were aligned with the proposed global indicator of effective refractive error coverage (eREC) .

- Refractive error: Uncorrected visual acuity (UCVA) worse than 6/9 in at least one eye that improved to 6/9 or better with refraction or pinhole.
- Need for distance refractive correction: UCVA worse than or equal to 6/12 in at least one eye improving with refraction or pinhole.
- Met need: Children with need who were already wearing distance spectacles at presentation and whose presenting VA with spectacles was 6/12 or better in the better eye.
- Unmet need: Children with need who were not wearing distance spectacles at presentation and whose VA improved to 6/12 or better in the better eye with refraction or pinhole.
- Undermet need: Children wearing spectacles at presentation whose VA remained worse than 6/12 in the better eye but improved to 6/12 or better after refraction, indicating suboptimal correction.
- Spectacle coverage was defined as:

$$\text{Spectacle coverage } (\backslash\,\%) = \frac{\text{Met need}}{\text{Met need} + \text{Unmet need}} \times 100$$

Undermet need was considered as part of unmet need for the purposes of this calculation, consistent with approaches used in prior work (4). Effective refractive error coverage (eREC) was defined as met need divided by met + unmet + undermet need, multiplied by 100.

Data management and analysis

Data were entered into a spreadsheet with built-in range and consistency checks and analysed using standard statistical software. Descriptive statistics (frequencies, percentages, means and standard deviations) were used to summarize socio-demographic characteristics and key eye-health indicators. Prevalence of unmet need, spectacle coverage and eREC were calculated.

Associations between categorical variables (e.g. presence of unmet need vs age group, sex, socio-economic status) were explored using chi-square tests, with $p < 0.05$ considered statistically significant.

Results

A total of 500 students aged 7–14 years were examined. The mean age was 10.4 ± 2.3 years; 278 (55.6%) were boys and 222 (44.4%) were girls. Most students belonged to middle or lower-middle socio-economic strata. Table 1 summarizes the key socio-demographic characteristics.

Table 1. Socio-demographic profile of the study population (N = 500)

Characteristic	Category	Number (%)
Age group (years)	7–8	130 (26.0)
	9–10	120 (24.0)
	11–12	120 (24.0)
	13–14	130 (26.0)
Sex	Boys	278 (55.6)
	Girls	222 (44.4)
Socio-economic status	Upper / upper-middle	110 (22.0)
	Middle	190 (38.0)
	Lower-middle / lower	200 (40.0)
Fathers' education	≤ Primary	210 (42.0)
	Secondary / higher secondary	200 (40.0)
	Graduate or above	90 (18.0)

Among the 500 children, Refractive error, as defined above, was identified in 28 children, giving a prevalence of 5.6% in the study population. Of these 28 children with need for distance correction, 8 were wearing adequately correcting spectacles at presentation (met need), 2 were wearing spectacles that did not provide adequate correction (undermet need), and 18 were not using spectacles (unmet need).

Thus, the overall prevalence of unmet need for distance spectacles in the total population was 20/500 (4.0%) if undermet and unmet are combined, and 18/500 (3.6%) if only those without spectacles are considered. Spectacle coverage, calculated as met+ undermet need divided by met + undermet+ unmet (10/28), was 35.71%. Effective refractive error coverage (eREC), using only adequately corrected individuals in the numerator and all with need (met + unmet + undermet) in the denominator (8 / 28), was also 28.6%.

Table 2. Refractive error, unmet need and spectacle coverage (N = 500)

Indicator	Number	Percent (%)
Children with refractive error (need for correction)	28	5.6
Met need (adequately corrected with spectacles)	8	1.6
Undermet need (spectacles but inadequate correction)	2	0.4
Unmet need (no spectacles despite need)	18	3.6
Total need (met + undermet + unmet)	28	5.6
Unmet + undermet need in population	20	4.0
Spectacle coverage*	–	28.6
Effective refractive error coverage (eREC)\†	–	28.6

*Spectacle coverage = Met + Undermet / (Met need + Unmet + Undermet).
\†eREC = Met need / (Met + Unmet + Undermet), following McCormick et al.

Table 3. Refractive error, unmet need and spectacle coverage by age and socio-economic status

Variable	Category	Need for spectacles n/N (%)	Unmet + undermet need n/N (%)	Spectacle coverage (%)
Age group (years)	7–10	8 / 250 (3.2)	5 / 250 (2.0)	37.5
	11–14	20 / 250 (8.0)	15 / 250 (6.0)	25.0
Sex	Boys	14 / 278 (5.0)	9 / 278 (3.2)	35.7
	Girls	14 / 222 (6.3)	11 / 222 (5.0)	21.4
Socio-economic status	Upper / upper-mid	4 / 110 (3.6)	2 / 110 (1.8)	50.0
	Middle	10 / 190 (5.3)	7 / 190 (3.7)	30.0
	Lower-mid / lower	14 / 200 (7.0)	11 / 200 (5.5)	21.4

Table 4: Association of Socio-demographic Characteristics with Need for Spectacles among Schoolchildren (N = 500)

Variable	Category	Need for Spectacles Present n (%)	Need for Spectacles Absent n (%)	Total (N)	χ^2	p-value
Age group (years)	7–10	8 (3.2)	242 (96.8)	250	5.45	0.020*
	11–14	20 (8.0)	230 (92.0)	250		
Sex	Boys	14 (5.0)	264 (95.0)	278	0.38	0.539
	Girls	14 (6.3)	208 (93.7)	222		
Socio-economic status	Upper/Upper-middle	4 (3.6)	106 (96.4)	110	1.58	0.453
	Middle	10 (5.3)	180 (94.7)	190		
	Lower-middle/Lower	14 (7.0)	186 (93.0)	200		

Out of 500 schoolchildren, 28 (5.6%) required spectacles. The need for spectacles was significantly higher among children aged 11–14 years (8.0%) compared to those aged 7–10 years (3.2%) ($\chi^2 = 5.45$, $p = 0.020$). Although girls (6.3%) and children from lower socio-economic groups (7.0%) had a higher prevalence of need for spectacles than their counterparts, these differences were not statistically significant ($p > 0.05$).

Table 5: Association of Socio-demographic Characteristics with Unmet + Undermet Need among Schoolchildren (N = 500)

Variable	Category	Unmet + Undermet Need Present n (%)	Unmet + Undermet Need Absent n (%)	Total (N)	χ^2	p-value
Age group (years)	7–10	5 (2.0)	245 (98.0)	250	5.21	0.022*
	11–14	15 (6.0)	235 (94.0)	250		
Sex	Boys	9 (3.2)	269 (96.8)	278	0.95	0.330
	Girls	11 (5.0)	211 (95.0)	222		
Socio-economic status	Upper/Upper-middle	2 (1.8)	108 (98.2)	110	2.58	0.275
	Middle	7 (3.7)	183 (96.3)	190		
	Lower-middle/Lower	11 (5.5)	189 (94.5)	200		

A total of 20 (4.0%) children had unmet or undermet need for spectacle correction. The prevalence was significantly higher among children aged 11–14 years (6.0%) than those aged 7–10 years (2.0%) ($\chi^2 = 5.21$, $p = 0.022$). Higher proportions of unmet/undermet need were observed among girls (5.0%) and children from lower socio-economic groups (5.5%); however, these associations were not statistically significant ($p > 0.05$).

Discussion

This school-based cross-sectional study illustrates key patterns in unmet need for eye care and spectacle coverage among rural government-school children in central India. The prevalence of refractive error (5.6%) lies within the 3–10% range reported in Indian school surveys, although estimates vary with age distribution, urban–rural setting and methodology. [5,6] More importantly, the spectacle coverage(35.71%) and eREC values below 30% indicate that more than two-thirds of children requiring spectacles either lack them or are inadequately corrected, mirroring the global concern that basic refractive services are underutilized despite their cost-effectiveness. [1,2] The low spectacle coverage in this study is consistent with empirical data from India. In a rural adult population in North India, Malhotra et al.[3] reported spectacle coverage of 33.3% among those needing distance correction, with unmet need of 10.8% and prominent barriers including lack of perceived need, cost and accessibility. Although that study focused on adults, it demonstrates systemic gaps in refractive service delivery that likely affect families and children. Among urban schoolchildren in Delhi, Gupta et al.[5] observed that baseline spectacle coverage was 29.3%; after a rose to 65.9% at one year, showing that targeted school-based interventions can substantially improve coverage. The baseline figures in that study are very similar to the 28.6% coverage presented here. The concept of eREC underscores that quality of correction matters as much as access.[4] Children who own spectacles but see poorly due to incorrect prescriptions or poor lens quality remain functionally uncorrected. School-based and population-based studies have highlighted that a proportion of spectacle wearers continue to have visual impairment, pointing to inadequate refraction or dispensing errors.[3,4] By distinguishing met, undermet and unmet need, eREC provides a more sensitive indicator of service performance and aligns with calls from the World report on vision and the Lancet Commission to track effective coverage of essential eye-care interventions.

Age-related patterns, with higher prevalence of refractive error and unmet need in older children, are consistent with evidence that myopia tends to manifest and progress in late childhood and early adolescence.[6] Increased near work and academic demands may exacerbate visual symptoms, yet older students may also face greater stigma around spectacles, leading to non-use. Gender differences, with slightly higher prevalence and lower coverage among girls in this example, echo some Indian and South Asian data, although findings are not uniform across studies.[3,5] Where present, such disparities highlight the need for gender-sensitive approaches in school eye-health programmes. Socio-economic inequalities are a recurring theme in refractive error and spectacle coverage research. In the present study, children from lower-middle and lower socio-economic strata have higher need and lower coverage than their better-off peers. This is consistent with Malhotra et al.,[3] who reported associations between lower education, lower socio-economic status and higher unmet need in adults, and with studies showing that parental education, especially maternal education, positively influences spectacle uptake in children. Interventions must therefore address not only clinical supply but also financial and informational barriers.

Compliance with spectacle wear is another critical element of effective coverage. In our study, Among the 28 children requiring spectacle correction, 12 (42.9%) were compliant with regular spectacle wear, while 16 (57.1%) were non-compliant. The most common reasons for non-compliance were lost spectacles (25.0%), broken spectacles (18.8%), and forgetting to wear spectacles (18.8%). Other reasons included dislike of appearance (12.5%), teasing by friends (6.3%), headache/discomfort (6.3%), blurred vision with spectacles (6.3%), and using spectacles only when needed (6.3%). Early work from rural Pune found that many children did not wear their prescribed spectacles, with main reasons including teasing, dislike of appearance and discomfort.[7] Later studies from Rohtak and elsewhere have reported compliance rates around 39–60%, with similar barriers such as teasing, aesthetic concerns and loss or breakage of spectacles.[8,9] These findings emphasise that even when spectacles are provided free or at subsidised cost, social and behavioural factors can limit effective use. Teachers and parents play a key role in reinforcing positive attitudes towards spectacle wear and addressing stigma. From a programme perspective, integrated school eye-health services that combine routine vision screening, on-site refraction, timely dispensing of good-quality spectacles and structured counselling for children and parents are likely to have the greatest impact.[5,9] The Delhi subsidized spectacle scheme demonstrates the effectiveness of such models in urban settings, and similar approaches can be adapted for rural contexts using mobile eye-care teams and linkages to nearby eye hospitals.[5] In line

with WHO's recommendation for integrated, people-centred eye care,[1] school eye-health activities should be embedded within broader primary care and child health programmes.[8]. Limitation of the study were that this study was the cross-sectional study which limits causal inference, and the findings may not be generalizable beyond rural government school children. Additionally, reliance on visual acuity screening without comprehensive cycloplegic refraction for all participants may have resulted in underestimation of certain refractive errors.

Conclusion

The findings indicate that in a routine rural government school situation in central India, not only a sizeable number of children have refractive error, but a large number of these for whom spectacles are needed are also uncorrected or under-corrected. It is essential to scale up integrated school eye health programmes providing regular screening, high-quality refraction, free or subsidised spectacles and systematic counselling for children, parents and teachers to reduce this unmet need. Employed consecutively, e-REC will assist programmes to monitor access and quality to contribute to national efforts to meet the goals of the World report on vision; global eye-health goals.

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