Section: Community Medicine

Original Research Article

PREVALENCE OF REFRACTIVE ERROR AND ITS DETERMINANTS AMONG GOVERNMENT AND PRIVATE SCHOOL ADOLESCENTS OF BAREILLY DISTRICT, UTTAR PRADESH

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ABSTRACT

Background: Refractive errors are among the leading causes of visual impairment globally and significantly affect adolescents learning performance. Early detection and correction can prevent vision loss. The objective is to determine the prevalence and determinants of refractive errors among school-going adolescents in government and private schools in Bareilly, Uttar Pradesh.

Materials and Methods: A cross-sectional study was conducted among 300 adolescents aged 10–19 years, selected through stratified random sampling from government and private schools. Vision was assessed using Snellen's chart, and a structured questionnaire recorded sociodemographic, behavioural, and familial factors. Data were analyzed using Jamovi. Chi-square and logistic regression analyses were used to identify the predictors of refractive errors ($p<0.05$).

Results: Overall prevalence was 20% (60/300). Refractive errors were more prevalent in private schools (24%) than in government schools (16%). Significant predictors included screen time >2 hours/day (AOR=2.46, 95% CI: 1.30–4.65, p=0.005), positive family history (AOR=3.75, 95% CI: 1.98–7.09, $p<0.001$), and outdoor activity <1 hour/day (AOR=1.96, 95% CI: 1.03–3.74, p=0.038).

Conclusion: Refractive errors are common among adolescents and are strongly associated with modifiable risk factors, such as prolonged screen exposure and less outdoor activity. School-based eye screening and awareness programs are crucial for early prevention of amblyopia.

Keywords: Adolescents, Myopia, Refractive errors, Risk factors, Vision screening.

INTRODUCTION

Refractive errors (REs) are the leading cause of correctable visual impairment and the second most common cause of blindness globally.[1,2] They affect more than 2.6 billion people, including a significant proportion of adolescents and young adults. The WHO's World Report on Vision emphasizes early detection and correction as part of its Vision 2020: Right to Sight initiative.[1-8] In India, RE prevalence among children ranges between 13%–25%, depending on the study setting and population.[5-7] Myopia has been increasingly reported, attributed to increase near work, screen exposure, and reduced outdoor activities.[4,9,10] This study was conducted to determine the prevalence and determinants of refractive errors among school-going adolescents in Bareilly, Uttar Pradesh, comparing government and private schools.[11-16]

MATERIALS AND METHODS

A cross-sectional study was conducted in Bareilly, Uttar Pradesh, from January to March 2025, among

school-going adolescents aged 10-19 years. The sample size was calculated using the formula, n=(Z^2 pq)/d^2 , where Z = 1.96, the anticipated prevalence of 20 percent, q = 0.8, and a precision level of 0.05, yielding a minimum sample requirement of 246, which was increased to 300 to counter potential non-response.

Stratified random sampling ensured proportional representation, with 150 participants from each government and private school type. Data collection incorporated standardized distance visual acuity testing using the Snellen chart at six meters, along with a structured questionnaire documenting demographic characteristics, daily screen exposure, outdoor play duration, study hours, and family history of visual problems. Refractive error was defined as visual acuity below 6/9, which improved with pinhole testing. Screen time was categorized as more than two hours versus two hours or less per day, and outdoor activity was classified as less than one hour versus at least one hour per day. Statistical analysis was performed using Jamovi, applying the chi-square test to evaluate associations and binary logistic regression to identify independent predictors, with statistical significance set at p less than 0.05.

Ethical Clearance: Institutional Ethics Committee approval was obtained. Consent from parents and assent from students were obtained.

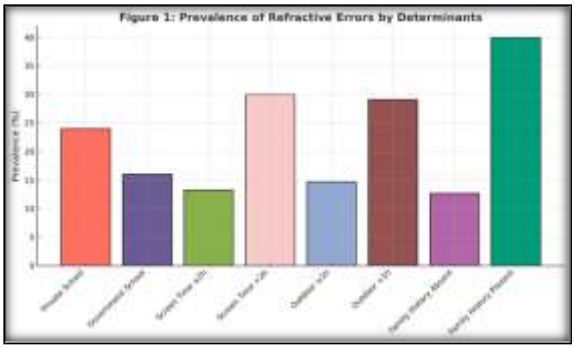
RESULTS

A total of 300 students were screened: 156 (52%) males and 144 (48%) females. Mean age: 14.2 ± 2.1 years. Overall prevalence: 20% (60/300). Private schools: 24%; Government schools: 16%.

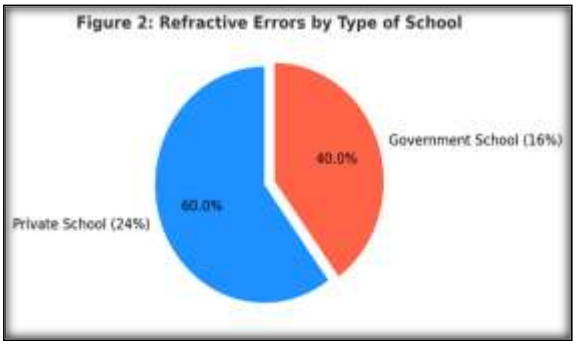
Table 1: Prevalence and Determinants of Refractive Errors

Variable	Category	Total (n=300)	Refractive Error	Prevalence (%)	P value
Type of School	Private	150	36	24.0	0.09
	Government	150	24	16.0	
Screen Time	≤ 2 hours/day	180	24	13.3	0.008
	> 2 hours/day	120	36	30.0	
Family History	Present	80	32	40.0	<0.001
	Absent	220	28	12.7	
Outdoor Activity	≥ 1 hour/day	190	28	14.7	0.02
	< 1 hour/day	110	32	29.1	

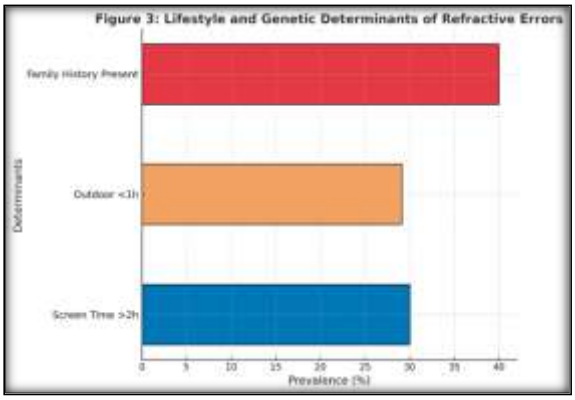
The overall prevalence was 20% (60 out of 300). Refractive errors were more frequent among private school students (24%) than among government school students (16%), although the difference was not statistically significant (p=0.09). A significant association was found between screen time and refractive error prevalence, which increased from 13.3%among those with ≤2 hours of screen time to 30% among those exceeding 2 hours daily (p=0.008). Family history of refractive errors showed a strong and highly significant relationship (p<0.001), with prevalence rising to 40% in students with affected parents or siblings, compared to 12.7% among those without. Similarly, outdoor activity <1 hour/day was significantly associated with a higher prevalence (29.1%) than that in those spending ≥1 hour/day outdoors (14.7%) (p=0.02). These findings indicate that both behavioral (screen use, outdoor time) and genetic (family history) factors contribute significantly to the occurrence of refractive errors among adolescents.



The prevalence of refractive errors was substantially higher among students with screen time exceeding two hours per day (30%) compared to those with screen exposure of two hours or less (13.3%). Similarly, students who reported less than one hour of outdoor activity per day had a higher prevalence (29.1%) than those who spent at least one hour outdoors (14.7%). The influence of family history was also evident, with a prevalence of 40% among adolescents with a positive family history versus 12.7% among those without.



Private school students accounted for a larger share (24%) of total refractive error cases than government school students (16%). This difference, although not statistically significant (p=0.09), indicates a trend toward a higher prevalence in private institutions. This pattern can be attributed to longer study hours, increased near work, and greater digital device exposure, which are common in private school settings.



Adolescents with a positive family history of refractive errors exhibited the highest prevalence (40%), reflecting a strong genetic predisposition toward myopia development.

Lifestyle behaviour also played a major role, with students with screen time >2 hours/day (30%) and those engaging in outdoor activity <1 hour/day (29.1%) showing elevated prevalence. This figure highlights the modifiable risk factors impacting adolescent eye health.

Table 2: Binary Logistic Regression Analysis of Determinants

Variable	AOR	95% CI	p value
Screen time >2 hours/day	2.46	1.30 – 4.65	0.005
Positive family history	3.75	1.98 – 7.09	<0.001
Outdoor activity <1 hour/day	1.96	1.03 – 3.74	0.038
Private school (vs. government)	1.62	0.88 – 2.96	0.112
Study duration >4 hours/day	1.27	0.70 – 2.33	0.418
Gender (female)	1.22	0.66 – 2.26	0.515

Binary logistic regression analysis was performed to identify the independent determinants of refractive errors in school-going adolescents. After adjusting for potential confounding factors, three variables remained significant. Students who reported screen time exceeding two hours per day were found to be 2.46 times more likely to have refractive errors compared to those with lower screen exposure (AOR=2.46; 95% CI: 1.30–4.65; p=0.005). Similarly, adolescents engaging in outdoor activity for less than one hour per day were at an almost two-fold higher risk of developing refractive errors (AOR=1.96; 95% CI: 1.03–3.74; p=0.038).

The most significant predictor was positive family history, which increased the likelihood of refractive errors by 3.75 times (AOR=3.75; 95% CI: 1.98–7.09; p<0.001), highlighting the strong influence of genetic predisposition. In contrast, variables such as type of school, gender, and study duration were not significantly associated after adjustment, suggesting that their influence was secondary to lifestyle and hereditary factors.

Overall, the model confirmed that screen time, outdoor activity, and family history were the primary independent predictors of refractive errors, reinforcing the importance of modifiable behavioral factors alongside hereditary risk in adolescent eye health.

DISCUSSION

The study found a 20% prevalence, aligning with prior Indian research from Haryana,[5] Lucknow,[13] and North India.[17] Private school students showed a higher burden, possibly linked to lifestyle and educational patterns.[9,10] Screen time >2 hours/day significantly increased the risk (AOR=2.46, p=0.005), matching the findings of Zhao et al., 2023.[9] Low outdoor activity (<1 hour/day) almost doubled the risk (AOR=1.96, p=0.038), consistent with Rose et al, 2008,[11] and Wu et al, 2013.[14] Family history (AOR=3.75, p<0.001) was the strongest determinant, confirming genetic predisposition.[18] These results emphasize the interplay between hereditary and modifiable environmental factors and support the role of school-based preventive strategies in reducing adolescent visual morbidity.

CONCLUSION

Refractive errors affect one in five adolescents in Bareilly, India. Significant determinants included excessive screen exposure, limited outdoor activity, and family history.

School-based vision screening, parental education, and regular eye checkups can mitigate vision loss.

Recommendations

Schools should conduct annual vision screenings for all students to identify refractive errors early. Daily screen time for adolescents should be restricted to a maximum of two hours to reduce digital eye strain and prevent the progression of refractive errors. Students should be encouraged to spend at least one hour outdoors each day, as adequate natural light exposure has protective effects on their eye health. Eye health education should be incorporated into routine school teaching so that children can understand healthy visual habits and preventive measures. Regular use of prescribed spectacles must be ensured, along with scheduled follow-up visits to monitor visual improvement and adjust prescriptions as needed.

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