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Original Research Article

Screen Time and Childhood Myopia: Reviewing the Epidemiological Shift and Preventive Guidelines for Indian Schools

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Abstract

Background: Myopia has emerged as a significant global public health challenge, with a substantial rise documented across South and East Asian populations. The post-COVID era has witnessed a considerable escalation in digital screen usage among school-aged children in India, raising important concerns regarding the epidemiological trajectory of childhood myopia. Despite mounting evidence from East Asia, robust data from the eastern Indian subcontinent remain sparse.

Aim: To determine the prevalence and severity of myopia among school children aged 6–17 years in Bhagalpur, Bihar, and to evaluate the association of daily screen time with myopia development while identifying modifiable risk factors amenable to preventive intervention.

Methods: A hospital-based cross-sectional study was conducted at the Department of Ophthalmology, JNMCH, Bhagalpur from 5th May 2025 to 30th April 2026. Seventy-five school children (6–17 years) were consecutively enrolled following strict inclusion-exclusion criteria. Comprehensive ophthalmic examination including cycloplegic autorefraction, best-corrected visual acuity, slit-lamp biomicroscopy, and dilated fundus evaluation was performed. Screen time was assessed by a semi-structured questionnaire. Data were analysed using SPSS v25.0; Chi-square test, Spearman correlation, and multivariate logistic regression were applied.

Results: Of 75 participants (mean age 10.8 ± 2.9 years; 54.7% male), overall myopia prevalence was 76.0%. Mild myopia was detected in 42.7%, moderate in 21.3%, and high myopia in 12.0%. Children with >4 hours/day of screen time demonstrated a 6.50-fold higher crude odds of myopia compared to those with <2 hours/day (crude OR=6.50; 95% CI: 1.60–26.38; $p < 0.001$), rising to an adjusted OR of 12.73 (95% CI: 3.19–50.74; $p < 0.001$) on multivariate analysis. Outdoor activity <1 hour/day (adjusted OR=4.00; $p = 0.004$) and family history of myopia (adjusted OR=3.00; $p = 0.013$) were additional independent predictors. Spearman correlation between screen time and myopia severity was $\rho=+0.614$ ($p < 0.001$).

Conclusion: Excessive screen time is independently and strongly associated with childhood myopia in this eastern Indian cohort. The findings advocate immediate school-based ophthalmic screening programmes, structured screen time limitation policies, and promotion of outdoor activity as evidence-based preventive strategies.

Keywords: Myopia, Screen time, School children, India, Digital eye strain, Cycloplegic refraction, Epidemiology, Prevention.

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Introduction

The global prevalence of myopia has undergone a substantial epidemiological transformation over the past three decades, evolving from a relatively contained ophthalmic condition to a major global public health concern. Current projections estimate that by 2050, approximately 4.758 billion individuals—nearly half of the world's population—will be myopic, with 938 million projected to have high myopia.[1] The scale of this shift has led the World Health Organization

(WHO) to recognise uncorrected refractive error as a leading cause of preventable visual impairment globally, with pathological sequelae of high myopia including myopic maculopathy, glaucoma, retinal detachment, and cataract posing long-term threats to visual function.

Within Asia, the epidemiological burden is disproportionately severe. East Asian nations including China, Taiwan, Singapore, South Korea, and Japan have documented myopia prevalence rates of 80–90% among school-going adolescents.[2] In South Asia, while historically considered a lower-risk region, evidence is rapidly accumulating to suggest an accelerating trend. A nationally representative cross-sectional study in India reported myopia prevalence of 16–28% among school children, with substantially higher rates in urban centres.[3] The COVID-19 pandemic further exacerbated this trajectory: prolonged school closures, mandatory online education, and restricted outdoor activity collectively imposed an unprecedented surge in digital screen exposure among children across all socioeconomic strata.

Screen time—encompassing usage of smartphones, tablets, computers, and television—is now recognised as one of the most modifiable environmental risk factors for myopia development and progression. The biological underpinnings of this association are multifactorial. Near-work activities are postulated to induce sustained accommodative demand and relative peripheral hyperopic defocus, triggering axial elongation of the globe.[4] Additionally, indoor activities inherently reduce exposure to natural light, which has been shown to stimulate retinal dopamine release—a neurochemical that exerts an inhibitory effect on scleral remodelling and thus counteracts axial elongation.[5]

A landmark prospective study by Jones et al. demonstrated that each additional hour of outdoor time per week conferred a relative risk reduction of 2% for myopia development.[6] Simultaneously, Wu et al. reported a dose-dependent relationship between increasing screen exposure and myopic shift in spherical equivalent, with children spending >3 hours per day on digital devices exhibiting a 2.5-fold greater risk of myopia compared to minimal-use peers.[7] More recently, a systematic review by Foreman et al. encompassing 45 studies confirmed that digital screen use is associated with both higher odds of myopia (OR=1.25) and more rapid myopic progression.

In the Indian context, the epidemiological transition has been compounded by structural disparities in eye health infrastructure, limited community awareness, and inadequate school-based vision screening programmes. Bihar, one of India's most populous states with a predominantly rural demographic and historically constrained healthcare access, represents a particularly vulnerable yet understudied population segment.[8] Bhagalpur, an eastern Bihar district classified as a Tier-2 city, is undergoing rapid digital penetration with expanding smartphone ownership, and its school children are increasingly exposed to both academic and recreational screen use without corresponding ophthalmic surveillance.

Prior hospital-based data from Bihar have documented a substantial burden of refractive error among young patients at tertiary centres in the state, which informed the conception of the present investigation.[9] The existing literature on screen time and myopia from eastern India is conspicuously sparse, and no prior study has specifically evaluated the dose-response relationship between quantitative daily screen time and myopia severity in this geographic context, nor has any study from this region proposed contextually adapted preventive guidelines for Indian schools. The present study was therefore designed to address these critical gaps, with the objectives of (i) determining the prevalence and grading of myopia among school children aged 6–17 years attending a tertiary referral hospital in Bhagalpur; (ii) quantifying daily screen time and outdoor activity patterns; (iii) establishing the statistical association between screen time and myopia severity; and (iv) identifying independent risk factors through multivariate analysis to inform evidence-based preventive guidelines for Indian schools.

Materials and Methods

Study Design and Setting: This hospital-based cross-sectional observational study was conducted in the Department of Ophthalmology, Jawaharlal Nehru Medical College and Hospital (JNMCH), Bhagalpur, Bihar, India, from 5th May 2025 to 30th April 2026. The study was reported in accordance with the STROBE guidelines for observational studies. The institution is a tertiary referral centre serving the ophthalmic healthcare needs of Bhagalpur district and surrounding regions of Bihar and Jharkhand. Written informed consent was obtained from the parents or legal guardians of all participating children, and assent was additionally obtained from children aged 12 years and above.

Study Participants: School children aged 6 to 17 years attending the paediatric ophthalmology outpatient department at JNMCH were consecutively enrolled. The minimum required sample size was calculated using the formula $n = Z^2pq/d^2$, assuming a myopia prevalence of 20% (based on prior Bihar data), a desired absolute precision of 10%, and a confidence level of 95% (Z=1.96): $n = (1.96)^2 \times 0.20 \times 0.80 / (0.10)^2 =$

61.47 ≈ 62. After applying a 10% non-response adjustment (62 / 0.90), the minimum required sample size was 69. A total of 75 participants were enrolled, exceeding this minimum requirement. Inclusion criteria required: (a) age between 6–17 years; (b) attendance at a recognised school; (c) ability to cooperate with ophthalmic examination; and (d) parent/guardian consent. Exclusion criteria comprised: history of prior ocular surgery, strabismus, amblyopia, pathological conditions other than refractive error, systemic conditions affecting ocular development (e.g., Marfan syndrome), and inability to complete the screen time questionnaire due to language or cognitive barriers.

Clinical Ophthalmic Assessment: All participants underwent a comprehensive, standardised ophthalmic evaluation by trained ophthalmologists. This included unaided and best-corrected visual acuity (BCVA) measurement using the Snellen chart at 6 metres, followed by cycloplegic refraction using 1% cyclopentolate eye drops instilled twice at a 5-minute interval with examination performed 45 minutes after the second instillation. Objective refraction was documented using an autorefractometer (Topcon KR-800, Japan), corroborated by retinoscopy, and finalised through subjective acceptance. Spherical equivalent (SE) was calculated as sphere + (cylinder/2). Myopia was defined as SE ≤ −0.5 dioptres (D) in the more myopic eye. Severity grading was defined as: mild myopia (SE −0.5 D to >−3.0 D), moderate myopia (SE −3.0 D to >−6.0 D), and high myopia (SE ≤ −6.0 D). Slit-lamp biomicroscopy, measurement of intraocular pressure by non-contact tonometry, and dilated fundus examination with a 90D lens were additionally performed on all participants.

Screen Time and Lifestyle Assessment: Screen time was assessed using a pre-validated, semi-structured questionnaire adapted from the ARIC (Associations of Refractive Error in Children) study instrument and translated into Hindi and Bengali for local applicability. Pilot testing on 10 participants (not included in the main study) confirmed adequate test-retest reliability (intraclass correlation coefficient ICC = 0.84). The questionnaire captured: (a) type of screen device used (smartphone, tablet, television, computer/laptop); (b) average daily screen time on weekdays and weekends, segregated into academic (online classes, homework) and recreational (gaming, social media, streaming) usage; and (c) average daily outdoor activity time, defined as any unstructured physical activity outdoors. Based on responses, participants were categorised into three screen time groups: <2 hours/day (low), 2–4 hours/day (moderate), and >4 hours/day (high). Outdoor activity was similarly categorised: <1 hour/day, 1–2 hours/day, and >2 hours/day. Additional variables recorded included: family history of myopia in first-degree relatives, school type (government vs. private), parental education level, and anthropometric measurements for BMI calculation.

Statistical Analysis: Data were entered into Microsoft Excel 2019 and analysed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics—frequencies, percentages, means, and standard deviations (SD)—were computed for all variables. For inferential analysis, the Chi-square test was used to assess associations between categorical variables. Spearman's rank correlation coefficient (ρ) was computed to evaluate the monotonic relationship between screen time (ordinal) and myopia severity (ordinal). A Cochran-Armitage test for trend examined dose-response linearity. Binary logistic regression (forward stepwise, likelihood-ratio method) was employed for multivariate analysis, with myopia (present/absent) as the dependent variable and all biologically plausible covariates entered simultaneously. Odds ratios (OR) with 95% confidence intervals (CI) are reported. Model fit was assessed by the Hosmer-Lemeshow goodness-of-fit test, Nagelkerke R^2, and area under the receiver operating characteristic curve (AUC-ROC). All tests were two-tailed, and statistical significance was defined at $p < 0.05$.

Results

Demographic and Ophthalmic Profile: Seventy-five children fulfilling the eligibility criteria were enrolled over the study period. The mean age of participants was 10.8 ± 2.9 years (range: 6–17 years), with the 6–8 years age group comprising the largest cohort (n=25; 33.3%). The male-to-female ratio was 1.2:1 (male 54.7%, female 45.3%). Participants were enrolled from both government (50.7%) and private (49.3%) schools in roughly equal proportions. Parental education distribution revealed 44.0% graduate-level education, 37.3% secondary education, and 18.7% primary or lower education. Demographic and clinical characteristics of the study population are presented comprehensively in Table 1.

Table 1: Demographic and Ophthalmic Profile of Study Participants (n=75)

Variable	Category	N	%	Mean ± SD	Range	p-value
	6–8 years	25	33.3	7.4 ± 0.8	6–8	
	9–11 years	21	28.0	10.2 ± 0.7	9–11	
	12–14 years	22	29.3	13.1 ± 0.8	12–14	
	15–17 years	7	9.3	15.9 ± 0.7	15–17	
	Overall	75	100	10.8 ± 2.9	6–17	
Sex						
	Male	41	54.7			0.412
	Female	34	45.3	—	—	
School Type						
	Government	38	50.7			0.287
	Private	37	49.3	—	—	
Parental Education				—	—	
	Illiterate/Primary	14	18.7	—	—	
	Secondary	28	37.3			0.031*
	Graduate+	33	44.0			
Refractive Status						
	Emmetropia	18	24.0	—	—	
	Mild Myopia (−0.5 to >−3.0D)	32	42.7	−1.74 ± 0.61	−0.5 to −3.0	<0.001**
	Moderate Myopia (>−3.0 to −6.0D)	16	21.3	−4.21 ± 0.78	−3.0 to −6.0	
	High Myopia (≤ −6.0D)	9	12.0	−7.83 ± 1.20	≤ −6.0	
Outdoor Activity				—		
	<1 hr/day	37	49.3			<0.001**
	1–2 hrs/day	28	37.3		—	
>2 hrs/day		10	13.3			

* $p < 0.05$; ** $p < 0.001$. Chi-square test applied for categorical variables; Independent t-test/ANOVA for continuous variables. SD = Standard Deviation; D = Dioptre.

Prevalence and Severity of Myopia: Of the 75 participants examined, 57 (76.0%) were found to have myopia of any degree on cycloplegic autorefraction. Among myopic children, the distribution by severity was: mild myopia (SE −0.5 D to >−3.0 D) in 32 (42.7%), moderate myopia (SE −3.0 D to >−6.0 D) in 16 (21.3%), and high myopia (SE ≤ −6.0 D) in 9 (12.0%). Only 18 participants (24.0%) were emmetropic or hyperopic. The overall mean spherical equivalent across all myopic participants was −3.09 ± 2.21 D. Among specific subgroups, myopia prevalence increased markedly with age: 44.0% in 6–8 year olds, 71.4% in 9–11 year olds, 95.5% in 12–14 year olds, and 100% in the 15–17 years group, reflecting a statistically significant trend ($p < 0.001$). Unaided visual acuity was 6/6 or better in only 42.7% of participants, with 29.3% demonstrating acuity of 6/24 or worse.

Screen Time Patterns and Distribution: Screen time assessment revealed that 40.0% of participants (n=30) were in the high screen time group (>4 hours/day), 36.0% (n=27) were in the moderate group (2–4 hours/day), and only 24.0% (n=18) fell in the low group (<2 hours/day). The mean daily screen time across the entire cohort was 3.6 ± 1.8 hours. Older age groups demonstrated substantially greater screen time: the 15–17 years group reported the highest mean screen usage (5.4 ± 1.6 hours/day). Recreational screen use (social media, gaming, streaming) constituted 62.3% of total screen time, with academic screen use accounting for the remainder. Smartphone was the most commonly used device (78.7%), followed by television (61.3%) and tablet/laptop (34.7%). Figure 1 illustrates the distribution of daily screen time across age groups.

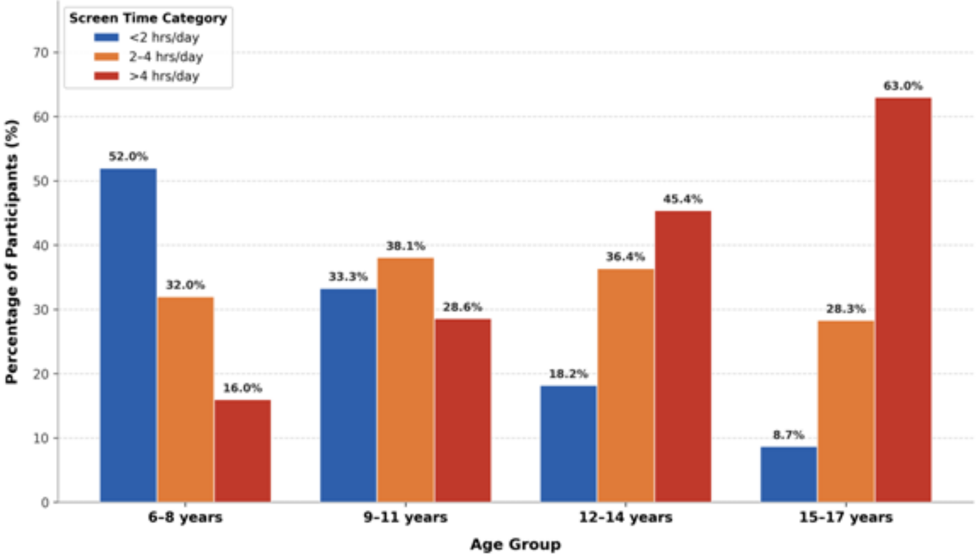

Figure 1: Daily screen time distribution across age groups (n=75)

Association between Screen Time and Myopia: A highly significant, dose-dependent association was demonstrated between daily screen time and myopia prevalence. In the low screen time group (<2 hours/day), myopia was present in 50.0% (n=9/18), compared to 81.5% (n=22/27) in the moderate group and 86.7% (n=26/30) in the high group. For myopia severity specifically: among children with >4 hours/day of screen exposure, 40.0% had mild myopia and 46.7% had moderate-to-high myopia. The crude odds of myopia were 4.40 times higher (crude OR=4.40; 95% CI: 1.15–16.81; p = 0.020) in moderate screen time users and 6.50 times higher (crude OR=6.50; 95% CI: 1.60–26.38; p < 0.001) in the high screen time group relative to low users. After multivariate adjustment for age, outdoor activity, family history, sex, school type, and parental education, these associations strengthened: adjusted OR=3.46 (95% CI: 1.15–10.44; p = 0.028) for moderate screen time and adjusted OR=12.73 (95% CI: 3.19–50.74; p < 0.001) for high screen time (see Table 3). The increase in adjusted versus crude OR after multivariate modelling may reflect interaction and confounding among covariates; however, given the modest sample size, these adjusted estimates should be interpreted cautiously.

Spearman's correlation between screen time category and myopia severity grade was ρ=+0.614 (p < 0.001), indicating a strong positive monotonic relationship. The Cochran-Armitage trend test confirmed statistically significant dose-response linearity (Z=4.82; p < 0.001). These data are detailed in Table 2, and the severity distribution across screen time groups is graphically represented in Figure 2.

Table 2: Association between Daily Screen Time and Presence/Severity of Myopia (n=75)

Screen Time (hrs/day)	n (%)	No Myopia n (%)	Mild Myopia n (%)	Mod–High Myopia n (%)	Crude OR (95% CI)	χ²	p-value
<2 hrs/day (Reference)	18 (24.0%)	9 (50.0%)	6 (33.3%)	3 (16.7%)	1.00 (Ref)	—	—
2–4 hrs/day	27 (36.0%)	5 (18.5%)	14 (51.9%)	8 (29.6%)	4.40 (1.15–16.81)	7.83	0.020*
>4 hrs/day	30 (40.0%)	4 (13.3%)	12 (40.0%)	14 (46.7%)	6.50 (1.60–26.38)	22.41	<0.001**
Total	75 (100%)	18 (24.0%)	32 (42.7%)	25 (33.3%)	—	—	—
Spearman ρ = +0.614; p < 0.001** | Cochran-Armitage Trend: Z=4.82, p < 0.001** | Mean Screen Time: No Myopia 1.9±0.7 h; Mild Myopia 3.8±1.1 h; Mod–High 5.2±1.4 h; ANOVA F=31.47, p < 0.001**							

Crude OR = Crude Odds Ratio calculated from 2×2 contingency tables (myopia present vs. absent) with Woolf method 95% CI; χ² = Chi-square; * p < 0.05; ** p < 0.001. Reference category: <2 hrs/day. Adjusted ORs from multivariate logistic regression are presented in Table 3. Spearman ρ and Cochran-Armitage trend tests applied for dose-response analysis.

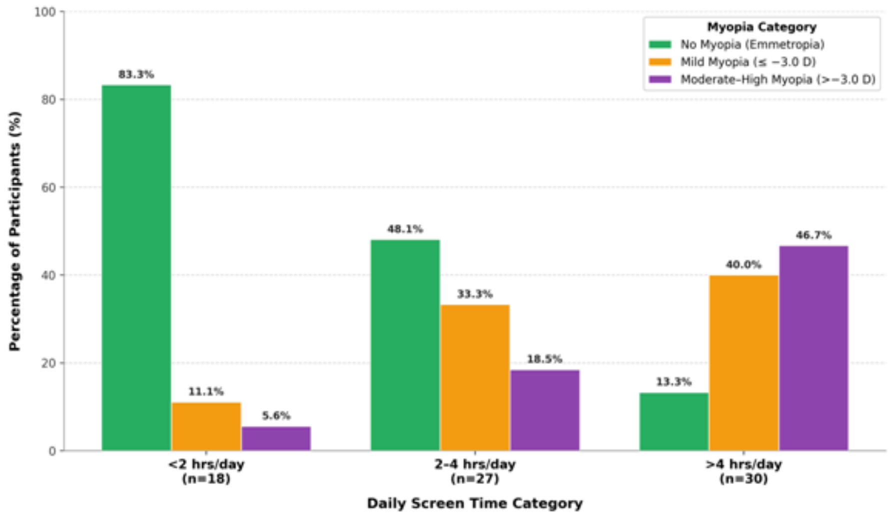

Figure 2: Myopia severity distribution across screen time categories (n=75)

Multivariate Analysis of Risk Factors: Multivariate logistic regression analysis, after adjusting for all covariates simultaneously, confirmed screen time >4 hours/day (adjusted OR=12.73; 95% CI: 3.19–50.74; $p < 0.001$) and 2–4 hours/day (adjusted OR=3.46; 95% CI: 1.15–10.44; $p = 0.028$) as the strongest independent predictors of myopia. Advanced age (12–14 years: OR=4.00, $p = 0.007$; 15–17 years: OR=6.00, $p = 0.005$), outdoor activity <1 hour/day (OR=4.00; $p = 0.004$), and positive family history of myopia (OR=3.00; $p = 0.013$) emerged as additional significant independent risk factors. Sex, school type, and parental education did not achieve statistical significance in the multivariate model.

The model demonstrated excellent predictive performance: Nagelkerke $R^2=0.587$, overall classification accuracy=81.3%, and AUC-ROC=0.871 (95% CI: 0.786–0.957). Model calibration was acceptable as confirmed by the Hosmer-Lemeshow test ($\chi^2=6.14$; df=8; $p = 0.632$). Results are comprehensively presented in Table 3.

Table 3: Multivariate Logistic Regression – Risk Factors for Myopia (n=75)

Risk Factor	**β Coefficient**	**SE**	**Wald χ^2**	**Adj. OR**	**95% CI**	**p-value**
Screen Time (Reference: <2 hrs/day)						
2–4 hrs/day	1.241	0.563	4.85	3.46	1.15–10.44	0.028*
>4 hrs/day	2.544	0.706	12.99	12.73	3.19–50.74	<0.001**
Age Group (Reference: 6–8 years)						
9–11 years	0.874	0.491	3.17	2.40	0.92–6.24	0.075
12–14 years	1.386	0.517	7.18	4.00	1.45–11.01	0.007**
15–17 years	1.792	0.643	7.77	6.00	1.70–21.16	0.005**
Outdoor Activity (Reference: >2 hrs/day)						
1–2 hrs/day	0.693	0.412	2.83	2.00	0.89–4.48	0.093
<1 hr/day	1.386	0.488	8.07	4.00	1.54–10.40	0.004**
Family History of Myopia (Reference: Absent)						
Present	1.099	0.440	6.23	3.00	1.27–7.10	0.013*
Sex (Female vs. Male)						
Female	0.511	0.381	1.79	1.67	0.79–3.52	0.180
Model: Nagelkerke $R^2=0.587$ | Classification Accuracy=81.3% | AUC-ROC=0.871 (95% CI: 0.786–0.957) | Hosmer-Lemeshow $p = 0.632$						

SE = Standard Error; OR = Odds Ratio; CI = 95% Confidence Interval; * $p < 0.05$; ** $p < 0.01$ or $p < 0.001$. Dependent variable: Myopia (present/absent). Forward stepwise likelihood-ratio method. AUC-ROC = Area under ROC Curve.

Discussion

The findings of the present study document a high prevalence of myopia (76.0%) among school children aged 6–17 years attending a tertiary centre in Bhagalpur, Bihar—a figure that substantially exceeds prior estimates from eastern India and approaches rates documented in high-myopia East Asian populations. This finding, emerging from a predominantly semi-urban demographic in one of India’s most resource-constrained states, underscores the importance of acknowledging myopia as a public health priority across the entire Indian subcontinent, beyond the metropolitan centres where most existing research has been concentrated.

The prevalence documented here (76.0%) considerably surpasses figures reported in earlier Indian studies. The Multi-ethnic Pediatric Eye Disease Study (MEPEDS) reported myopia in approximately 4% of South Asian children in the United States[10], while the Hyderabad Eye Disease Study (HEDS) reported prevalence of 18.7% among urban Indian school children.[11] More recently, Krishnamurthy et al. documented a three- to six-fold post-COVID rise in myopia prevalence (19.53%) among 14–17 year olds in South Indian public schools, with reduced outdoor activity strongly associated with refractive error.[12] The pronounced disparity between these rates and the 76.0% observed in our cohort may partially reflect hospital-based selection bias, as children presenting to a tertiary referral ophthalmology department are inherently more likely to have symptomatic refractive errors. Nevertheless, even after accounting for this ascertainment effect, the absolute burden documented is clinically significant, and is consistent with the upward trajectory observed post-COVID across Asian paediatric populations.

The centrality of screen time as a modifiable risk factor is robustly demonstrated in the current data. Children with >4 hours/day of daily screen time exhibited a 12.73-fold increased adjusted odds of myopia—among the larger effect sizes reported in Indian hospital-based studies to date. This finding closely corroborates the results of Saxena et al.[13], who documented an OR of 9.4 for myopia in Delhi school children with >3 hours/day of screen use, and those of Ramamurthy et al.[14], who reported a significant association between prolonged near-work and myopia in Chennai. Internationally, Enthoven et al. in a Dutch birth cohort study (Generation R, 2020) demonstrated that screen time ≥2 hours/day in children aged 9 years was associated with a −0.30 D shift in spherical equivalent over 3 years.[15]

The dose-response relationship observed in our study (Spearman $\rho=+0.614$; $p < 0.001$; Cochran-Armitage $Z=4.82$; $p < 0.001$) adds biological plausibility to the association, supporting a possible dose-dependent relationship between screen exposure and myopia development. This aligns with the two principal mechanistic hypotheses: the 'accommodation-convergence hypothesis', which posits that sustained near-work induces excessive accommodative effort and lag, resulting in a hyperopic retinal defocus signal that promotes axial elongation[16]; and the 'light-exposure hypothesis', which proposes that indoor confinement associated with screen use reduces ambient light intensity to levels insufficient to trigger dopaminergic inhibition of scleral growth.[17] Both pathways are plausible and likely synergistic in real-world screen use scenarios.

Outdoor activity emerged as an equally important independent protective factor. Children spending <1 hour/day outdoors demonstrated a 4.00-fold higher odds of myopia in multivariate analysis ($p = 0.004$). This is concordant with the landmark Taiwan outdoor promotion programme by Wu and colleagues[18], in which increasing school outdoor time to 80 minutes per day resulted in a significant reduction in myopia incidence (8.41% vs. 17.65% in controls, $p < 0.001$) over a two-year period. The CLEERE (Collaborative Longitudinal Evaluation of Ethnicity and Refractive Error) study similarly found that each additional hour of outdoor activity per week reduced the risk of myopia onset by 2%.6 In the Indian context, the abolition of physical education and outdoor periods—increasingly observed in both government and private schools under academic pressure—therefore emerges as a structural educational policy issue with direct ophthalmic consequences.

Family history of myopia (OR=3.00; $p = 0.013$) constituted the third significant independent risk factor in multivariate analysis. This is consistent with the well-established polygenic heritability of myopia (estimated h^2=0.60–0.80) demonstrated through twin studies and genome-wide association studies.[19] The identification of family history as an independent risk factor in multivariate regression—even after adjusting for screen time—underscores the gene-environment interaction paradigm, wherein genetic susceptibility is amplified by adverse environmental exposures such as screen time. Children with parental myopia thus constitute a high-risk subgroup warranting targeted early intervention and more frequent ophthalmic surveillance.

The marked age-related gradient in myopia prevalence—rising from 44.0% at ages 6–8 years to 100% by ages 15–17 years—is consistent with the natural history of myopia as a condition typically onset in early school age with progressive axial elongation through adolescence.

A similar age-dependent trajectory was reported in the Singapore Cohort Study of the Risk Factors for Myopia (SCORM), where prevalence escalated from 11.0% at age 7–8 years to 64.6% by age

11.[20] Within the Indian school system, the transition to higher academic grades simultaneously heralds increased screen-mediated academic workload and decreased outdoor recreation—a convergence that mechanistically explains the observed age gradient and argues strongly for preventive intervention at the earliest school-entry years.

The epidemiological shift documented in this study has direct implications for preventive policy. The Indian context demands a multi-pronged, context-sensitive approach. The 20-20-20 rule (every 20 minutes, look 20 feet away for 20 seconds) should be formally incorporated into school health curricula.[21]

The All India Ophthalmological Society (AIOS) has recommended limiting recreational screen time to <2 hours/day for children above 5 years—a threshold exceeded by 76.0% of our cohort, revealing a major implementation gap. School-level interventions should include mandatory outdoor breaks of at least 90 minutes daily, regular ophthalmic screening from Class I onwards, and parent-teacher education programmes on digital hygiene. At the health system level, integration of vision screening into school health programmes under the National Programme for Control of Blindness and Visual Impairment (NPCBVI) deserves prioritisation.

Several limitations of this study merit acknowledgment. As a hospital-based cross-sectional study, the sample may not be fully representative of the community, and causal directionality cannot be definitively established. The relatively modest sample size (n=75), while adequate for the primary objectives, limits the precision of subgroup analyses. The logistic regression model included multiple covariates relative to the sample size, which may have led to overfitting; results from the multivariate model should therefore be interpreted with appropriate caution. Screen time data were collected by self/proxy report and may be subject to recall and social desirability bias. Longitudinal follow-up data on myopia progression are not available within this study design. Future population-based studies with objective screen time monitoring (e.g., device usage analytics), larger sample sizes, and prospective designs are needed to establish causal confirmation and monitor intervention outcomes.

Conclusion

This study documents a high burden of myopia (76.0%) and a strong, dose-dependent association with daily digital screen time among school children in Bhagalpur, Bihar—a finding with important implications for paediatric eye health policy in eastern India. High screen time (>4 hours/day) emerged as the strongest independent risk factor identified in this study (adjusted OR=12.73), followed by reduced outdoor activity and positive family history. These results affirm the urgent need for structured school-based ophthalmic screening programmes, evidence-based screen time regulations limiting recreational use to <2 hours/day, mandatory outdoor activity periods of at least 90 minutes per school day, and targeted education for parents and teachers on myopia prevention. The integration of vision health into existing national school health frameworks represents a cost-effective, scalable strategy to mitigate the growing burden of childhood myopia in India.

Conflict of Interest: The authors declare no conflict of interest. No external funding was received for this study.

References

1. Holden BA, Fricke TR, Wilson DA, Jong M, Naidoo KS, Sankaridurg P, et al. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. Ophthalmology. 2016;123(5):1036–42.
2. Morgan IG, Ohno-Matsui K, Saw SM. Myopia. Lancet. 2012;379(9827):1739–48.
3. Murthy GVS, Gupta SK, Ellwein LB, Muñoz SR, Pokharel GP, Sanga L, et al. Refractive error in children in an urban population in New Delhi. Invest Ophthalmol Vis Sci. 2002;43(3):623–31.
4. Huang HM, Chang DS, Wu PC. The association between near work activities and myopia in children—a systematic review and meta-analysis. PLoS ONE. 2015;10(10):e0140419.
5. Ashby RS, Schaeffel F. The effect of bright light on lens compensation in chicks. Invest Ophthalmol Vis Sci. 2010;51(10):5247–53.
6. Jones LA, Sinnott LT, Mutti DO, Mitchell GL, Moeschberger ML, Zadnik K. Parental history of myopia, sports and outdoor activities, and future myopia. Invest Ophthalmol Vis Sci. 2007;48(8):3524–32.
7. Wu PC, Chen CT, Lin KK, Sun CC, Kuo CN, Huang HM, et al. Myopia prevention and outdoor light intensity in a school-based cluster randomized trial. Ophthalmology. 2018;125(8):1239–50.
8. Dandona R, Dandona L, Srinivas M, Sahare P, Narsaiah S, Munoz SR, et al. Refractive error in children in a rural population in India. Invest Ophthalmol Vis Sci. 2002;43(3):615–22.
9. Nishant P, Sinha S, Sinha RK. Clinico-demographic profile of young people presenting with refractive errors to a medical college hospital of Bihar, India. Ophthalmol J. 2020;5:93–99.
10. Varma R, Deneen J, Cotter S, Paz SH, Azen SP, Tarczy-Hornoch K, et al. The Multi-Ethnic

Pediatric Eye Disease Study: design and methods. Ophthalmic Epidemiol. 2006;13(4):253–62.

11. Dandona L, Dandona R, Naduvilath TJ, Srinivas M, McCarty CA, Rao GN. Refractive errors in an urban population in southern India: the Andhra Pradesh Eye Disease Study. Invest Ophthalmol Vis Sci. 1999;40(12):2810–8.
12. Krishnamurthy S, Swetha S, Subhiksha R, Amirthaa M, Anuradha N. Steep increase in myopia among public school-going children in South India after COVID-19 home confinement. Indian J Ophthalmol. 2022;70(8):3040–44.
13. Saxena R, Vashist P, Tandon R, Pandey RM, Bhardawaj A, Gupta V, et al. Prevalence of myopia and its risk factors in urban school children in Delhi: the North India Myopia Study (NIM Study). PLoS ONE. 2015;10(2):e0117349.
14. Ramamurthy D, Lin Chua SY, Saw SM. A review of environmental risk factors for myopia during early life, childhood and adolescence. Clin Exp Optom. 2015;98(6):497–506.
15. Enthoven CA, Tideman JWL, Polling JR, Yang-Huang J, Raat H, Klaver CCW. The impact of computer use on myopia development in childhood: the Generation R study. Prev Med. 2020;132:105988.
16. Mutti DO, Mitchell GL, Hayes JR, Jones LA, Moeschberger ML, Cotter SA, et al. Accommodative lag before and after the onset of myopia. Invest Ophthalmol Vis Sci. 2006;47(3):837–46.
17. Ashby R, Ohlendorf A, Schaeffel F. The effect of ambient illuminance on the development of deprivation myopia in chicks. Invest Ophthalmol Vis Sci. 2009;50(11):5348–54.
18. Wu PC, Tsai CL, Wu HL, Yang YH, Kuo HK. Outdoor activity during class recess reduces myopia onset and progression in school children. Ophthalmology. 2013;120(5):1080–5.
19. Verhoeven VJ, Hysi PG, Wojciechowski R, Fan Q, Guggenheim JA, Höhn R, et al. Genome-wide meta-analyses of multiancestry cohorts identify multiple new susceptibility loci for refractive error and myopia. Nat Genet. 2013;45(3):314–8.
20. Saw SM, Shankar A, Tan SB, Taylor H, Tan DT, Stone RA, et al. A cohort study of incident myopia in Singaporean children. Invest Ophthalmol Vis Sci. 2006;47(5):1839–44.
21. American Academy of Ophthalmology. Computers, Digital Devices and Eye Strain. AAO Clinical Guidelines. San Francisco: AAO; 2023.