e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(1); 1632-1638

Original Research Article

Study of Amblyopia and its Risk Factors in School-Going Children of North Bihar

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Received: 28-10-2025 / Revised: 27-11-2025 / Accepted: 26-12-2025

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Conflict of interest: Nil

Abstract:

Background: Amblyopia is a developmental visual disorder characterized by reduced visual acuity that cannot be explained by structural abnormalities of the eye. It is one of the most common causes of preventable visual impairment in children and can have long-term consequences if not detected early.

Aim: To determine the prevalence of amblyopia and analyze its associated risk factors among school-going children in North Bihar.

Methods: A prospective observational study was conducted among 500 school-going children aged 5–16 years from schools located near Darbhanga Medical College and Hospital. Visual acuity screening using Snellen's chart was performed, followed by comprehensive ophthalmic examination for children with suspected visual defects. Data on amblyopia type, refractive errors, severity, laterality, and demographic characteristics were analyzed.

Results: Among 500 children screened, 28 were diagnosed with amblyopia, giving a prevalence of 5.6%. The most common type was anisometropic amblyopia (53.57%), followed by strabismic amblyopia. Most cases were unilateral (71.42%). Moderate amblyopia accounted for 42.86% of cases. Hypermetropia was the most frequent refractive error associated with amblyopia (35.71%). Statistical analysis showed significant association between refractive error and amblyopia occurrence ($p = 0.041$).

Conclusion: Amblyopia remains an important yet under-recognized cause of visual impairment among school children. Early screening programs in schools can significantly improve detection and management, thereby preventing long-term visual disability.

Keywords: Amblyopia, Refractive Error, School Screening, Visual Acuity, Pediatric Ophthalmology.

DOI: 10.25258/ijcpr.18.1.281

Introduction

Amblyopia, commonly known as "lazy eye," is a neurodevelopmental visual disorder characterized by reduced best-corrected visual acuity in one or both eyes in the absence of detectable structural abnormalities. [1] It results from abnormal visual development during early childhood, particularly during the critical period of visual maturation. [2]

The condition occurs when normal binocular interaction is disrupted due to factors such as strabismus, anisometropia, refractive errors, or visual deprivation. [3] If untreated during early childhood, amblyopia can lead to permanent visual impairment because the brain suppresses input from the affected eye. [4]

Amblyopia is considered one of the leading causes of preventable monocular vision loss among children and young adults worldwide. [5] Global prevalence estimates range between 1% and 5%, depending on the population studied and the diagnostic criteria used. [6]

Refractive errors such as hypermetropia, myopia, and astigmatism play a major role in the development of amblyopia. Uncorrected anisometropia leads to unequal retinal images, resulting in cortical suppression of the weaker eye. [7]

Strabismus is another important etiological factor, as misalignment of the eyes disrupts normal binocular vision and leads to suppression of the deviating eye. [8]

Several epidemiological studies have reported varying prevalence rates of amblyopia across different geographic regions. [9] Variations in prevalence may be influenced by factors such as

genetic predisposition, access to eye care services, and awareness among parents and teachers. [10]

Early detection of amblyopia is essential because visual development is most plastic during childhood. [11] Prompt treatment through refractive correction, occlusion therapy, or vision therapy can significantly improve outcomes. [12]

School-based screening programs have been recognized as effective strategies for early detection of amblyopia and other visual disorders among children. [13] These programs can identify visual defects at an early stage when treatment is most effective. [14]

However, limited data are available regarding the prevalence and risk factors of amblyopia among school-going children in North Bihar. Therefore, the present study was conducted to evaluate the prevalence of amblyopia and associated risk factors in this population.

Materials and Methods

Study Design: The present investigation was conducted as a prospective observational cross-sectional study aimed at determining the prevalence of amblyopia and identifying associated risk factors among school-going children in North Bihar. The study involved systematic visual screening followed by detailed ophthalmological evaluation of children suspected to have visual impairment.

Study Setting: The study was carried out in collaboration with the Department of Ophthalmology at Darbhanga Medical College and Hospital (DMCH), Darbhanga, Bihar, India, along with selected nearby schools.

Study Duration: The study was conducted over a six-month period from January 2024 to June 2024.

Study Population: The study population consisted of school-going children aged between 5- and 16-years attending government and private schools located within approximately 2 km radius of Darbhanga Medical College and Hospital.

Sampling Method: Schools located in the vicinity of the medical college were selected using convenience sampling. Permission was obtained from school authorities before conducting the screening program. Children present on the day of examination and fulfilling the inclusion criteria were enrolled consecutively until the target sample size of 500 participants was achieved.

Inclusion Criteria

Children were included in the study if they fulfilled the following criteria:

- School-going children aged 5–16 years
- Both male and female students
- Children who were present during the screening program
- Children whose parents or guardians provided consent for participation

Exclusion Criteria

Children were excluded from the study if they had:

- History of ocular trauma
- Previous ocular surgery
- Active ocular infection at the time of examination
- Known anterior or posterior segment pathology
- Any systemic or neurological disorder affecting visual assessment

Children found to have structural ocular abnormalities were excluded from the amblyopia analysis.

Screening Procedure: Vision screening was conducted in school premises by trained ophthalmology residents and optometrists under supervision of faculty from the Department of Ophthalmology.

The screening process was performed in two stages.

Primary Screening: Initial visual screening included:

1. Visual acuity assessment using Snellen's chart at a distance of 6 meters.
2. Torchlight examination to evaluate anterior segment abnormalities.
3. Ocular alignment assessment using Hirschberg test to detect strabismus.

Children with visual acuity worse than 6/9 in either eye or those suspected of having ocular abnormalities were referred to the ophthalmology department for further evaluation.

Comprehensive Ophthalmic Examination: Children referred after initial screening underwent detailed ophthalmological evaluation at the ophthalmology outpatient department. The examination included:

- Best corrected visual acuity (BCVA) measurement
- Cycloplegic refraction using cyclopentolate eye drops
- Retinoscopy and subjective refraction
- Assessment of ocular alignment using cover-uncover test
- Fundus examination using direct ophthalmoscopy
- Evaluation of binocular vision

Based on these examinations, children were diagnosed with amblyopia when reduced visual acuity could not be explained by any structural abnormality of the eye.

Diagnostic Criteria for Amblyopia: Amblyopia was diagnosed according to standard clinical criteria:

- Best corrected visual acuity worse than 6/9 in one or both eyes
- Difference of two or more lines on Snellen chart between the two eyes
- Absence of detectable organic ocular pathology

Classification of Amblyopia: Children diagnosed with amblyopia were categorized into the following types based on clinical findings:

- Anisometropic amblyopia
- Strabismic amblyopia
- Mixed amblyopia (combination of strabismus and refractive error)
- Stimulus deprivation amblyopia

Assessment of Laterality: Amblyopia cases were also classified according to involvement of eyes:

- Unilateral amblyopia
- Bilateral amblyopia

Assessment of Severity: The severity of amblyopia was classified according to best corrected visual acuity:

- Mild amblyopia: 6/9 – 6/12
- Moderate amblyopia: 6/18 – 6/36
- Severe amblyopia: worse than 6/36

Evaluation of Refractive Errors: Cycloplegic refraction was performed for all children diagnosed with amblyopia to identify associated refractive errors. Refractive errors were categorized as:

- Hypermetropia
- Myopia
- Astigmatism
- Anisometropia

Data Collection: All relevant demographic and clinical information was recorded using structured data collection forms. The following variables were documented:

- Age
- Gender
- Visual acuity
- Type of amblyopia
- Laterality of involvement
- Severity of amblyopia
- Associated refractive error

These variables were subsequently analyzed to determine patterns and risk factors associated with amblyopia.

Outcome Measures

The primary outcome measures of the study included:

- Prevalence of amblyopia among screened school children
- Distribution of different types of amblyopia
- Severity classification
- Laterality of involvement
- Association between refractive errors and amblyopia

Statistical Analysis: Data collected during the study were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0.

Statistical analysis included:

- Descriptive statistics
- Frequency and percentage distribution for categorical variables
- Mean and standard deviation for continuous variables

Association between refractive errors and amblyopia was evaluated using the Chi-square test.

A p-value less than 0.05 was considered statistically significant.

Ethical Considerations: The study was conducted in accordance with the ethical principles of biomedical research involving human participants.

- Permission was obtained from the school authorities before conducting the screening program.
- Informed consent was obtained from parents or guardians.
- Confidentiality of participants was strictly maintained.

The study protocol was approved by the Institutional Ethics Committee of Darbhanga Medical College and Hospital, Bihar prior to initiation of the study.

Results

A total of 500 school-going children aged 5–16 years were screened for visual impairment during the study period. Among them, 28 children were diagnosed with amblyopia, resulting in an overall prevalence of 5.6% in the study population.

Age Distribution: The age distribution of children diagnosed with amblyopia is presented in Table 1. The majority of cases were observed in the 8–10 years age group (35.71%), followed by the 5–7 years age group (25%). The mean age at presentation was 9.2 ± 2.8 years.

Table 1: Age Distribution of Children with Amblyopia (n = 28)

Age Group (years)	Number of Patients	Percentage (%)
5–7	7	25.00
8–10	10	35.71
11–13	6	21.43
14–16	5	17.86
Total	**28**	**100**

The data indicate that amblyopia was most frequently detected in children aged 8–10 years, suggesting that visual problems often become apparent during early school years.

Gender Distribution: The gender distribution among children with amblyopia is shown in Table 2. Among the 28 cases, 15 were males (53.57%) and 13 were females (46.43%), demonstrating a slight male predominance.

Table 2: Gender Distribution of Amblyopia Cases

Gender	Number	Percentage (%)
Male	15	53.57
Female	13	46.43
Total	**28**	**100**

Types of Amblyopia: The distribution of different types of amblyopia observed in the study is presented in Table 3 and illustrated in Figure 1.

Anisometropic amblyopia was the most common subtype, accounting for 53.57% of cases, followed by strabismic amblyopia (25%), mixed amblyopia (14.29%), and stimulus deprivation amblyopia (7.14%).

Table 3: Distribution of Types of Amblyopia

Type of Amblyopia	Number	Percentage (%)
Anisometropic	15	53.57
Strabismic	7	25.00
Mixed	4	14.29
Stimulus deprivation	2	7.14
Total	**28**	**100**

Figure 1. Distribution of Types of Amblyopia

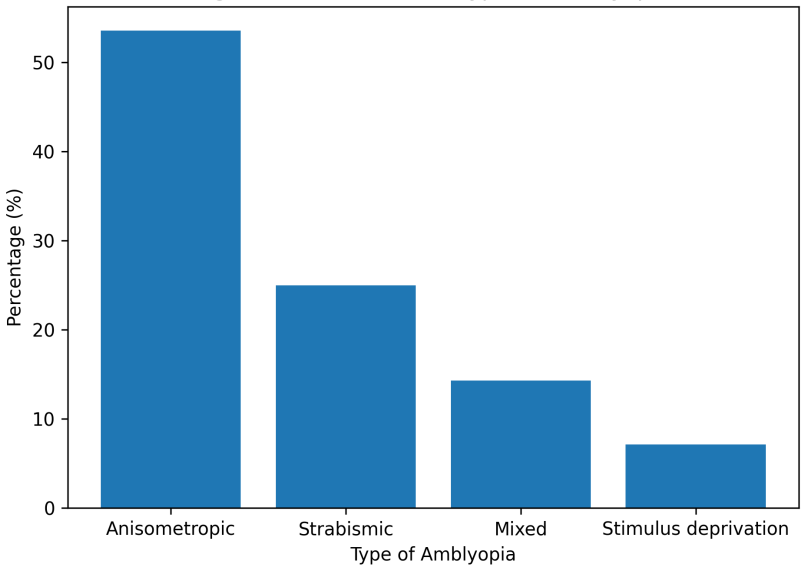

Figure 1: Distribution of Types of Amblyopia

Laterality of Amblyopia: The laterality of amblyopia cases is summarized in Table 4. Unilateral amblyopia was observed in 20 children (71.42%), whereas bilateral amblyopia was seen in 8 children (28.58%).

Table 4: Laterality of Amblyopia

Laterality	Number	Percentage (%)
Unilateral	20	71.42
Bilateral	8	28.58
Total	**28**	**100**

These findings indicate that unilateral amblyopia was considerably more common than bilateral amblyopia in the study population.

Severity of Amblyopia: The severity of amblyopia was classified based on visual acuity and is presented in Table 5 and Figure 2.

Table 5: Severity of Amblyopia

Severity	Number	Percentage (%)
Mild	7	25.00
Moderate	12	42.86
Severe	9	32.14
Total	**28**	**100**

Figure 2. Severity Distribution of Amblyopia

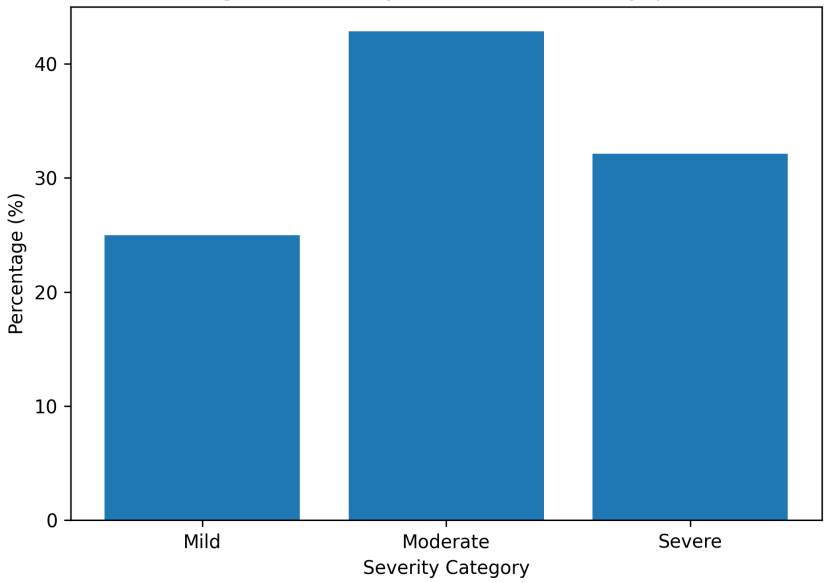

Figure 2. Severity Distribution of Amblyopia

Refractive Errors Associated with Amblyopia: The refractive errors associated with amblyopia are summarized in Table 6.

Table 6. Refractive Errors Associated with Amblyopia

Refractive Error	Number	Percentage (%)
Hypermetropia	10	35.71
Myopia	8	28.57
Astigmatism	6	21.43
Anisometropia	4	14.29
Total	**28**	**100**

Hypermetropia was the most common refractive error associated with amblyopia, accounting for 35.71% of cases, followed by myopia and astigmatism.

Statistical Analysis: A Chi-square test was performed to evaluate the association between refractive errors and amblyopia occurrence.

The analysis revealed a statistically significant association between refractive error and amblyopia ($\chi^2 = 6.41$, $p = 0.041$).

This finding indicates that uncorrected refractive errors play a significant role in the development of amblyopia among school-going children.

Discussion

The present study evaluated the prevalence and risk factors of amblyopia among school-going children in North Bihar.

The prevalence of amblyopia observed in this study was 5.6%, which is comparable to findings reported in several Indian epidemiological studies. [15]

Variations in prevalence across studies may be attributed to differences in study design, diagnostic criteria, and age groups examined. [16]

Our study found anisometropic amblyopia to be the most common subtype. Similar observations were reported by previous population-based studies in pediatric ophthalmology. [17]

Anisometropia results in unequal retinal image clarity between the two eyes, leading to suppression of visual input from the affected eye. [18]

The predominance of unilateral amblyopia observed in this study has also been documented in earlier studies, as unilateral visual impairment is often unnoticed by parents. [19]

Hypermetropia was identified as the most common refractive error associated with amblyopia in our study. Comparable findings have been reported in regional studies conducted in South Asia. [20]

The predominance of moderate amblyopia indicates that many cases could potentially be treated successfully if detected early. [21]

School screening programs have proven to be effective in detecting visual defects among children who may otherwise remain undiagnosed. [22]

The role of teachers and parents in recognizing early symptoms such as eye strain, squinting, and poor academic performance is critical for early referral. [23]

Untreated amblyopia can have long-term consequences including reduced quality of life, decreased educational opportunities, and limited career choices. [24]

Therefore, systematic vision screening programs should be incorporated into school health services to ensure early identification and timely management. [25]

Conclusion

Amblyopia remains a significant cause of visual impairment among school-going children. The prevalence observed in this study (5.6%) highlights the need for increased awareness and early detection. Most cases were unilateral and of moderate severity, indicating considerable potential for visual improvement with timely treatment. Implementation of school-based vision screening programs and community awareness initiatives is essential for early diagnosis and prevention of long-term visual disability.

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