ISSN: 2455 – 9938
PubMed- National Library of Medicine - ID: 101731611

EIJO: Journal of Science, Technology and Innovative Research (EIJO–JSTIR)
Einstein International Journal Organization (EIJO)
Available Online at:www.eijo.in
Volume – 11, Issue – 2, March – April – 2026, Page No. : 23 – 33

Prevalence and Risk Factors of Asthenopia Among Medical Students

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Asthenopia (visual fatigue) has emerged as a common ocular complaint in the era of digital learning. Medical students constitute a high-risk group due to prolonged academic screen exposure and intensive near-work demands.

Objective: To determine the prevalence of asthenopia among undergraduate medical students and to identify associated demographic and behavioural risk factors.

Methods: A descriptive cross-sectional study was conducted among 200 undergraduate medical students at RKDF Medical College Hospital & Research Centre, Bhopal. Data were collected using a pre-tested, semi-structured questionnaire assessing socio-demographic characteristics, digital device usage patterns, and symptoms of asthenopia. Asthenopia was defined as the presence of one or more symptoms of visual fatigue following prolonged near work or screen exposure. Data were analyzed using SPSS. Descriptive statistics were calculated, and associations were assessed using the Chi-square test. Logistic regression analysis was performed to identify independent predictors. A p-value <0.05 was considered statistically significant.

Results: The overall prevalence of asthenopia was 62%. A significant association was observed between daily screen time and asthenopia ($\chi^2 = 22.59$, $p < 0.001$). Students with more than six hours of daily screen exposure demonstrated significantly higher odds of developing asthenopia (OR = 6.5; 95% CI: 2.87–14.73). Logistic regression analysis confirmed prolonged screen time (>6 hours) as an independent predictor (Adjusted OR = 6.36, $p < 0.001$). Female gender was also significantly associated with asthenopia (Adjusted OR = 1.86, $p = 0.027$).

Conclusion: Asthenopia is highly prevalent among medical students and is strongly associated with prolonged digital screen exposure. Implementation of preventive strategies, including ergonomic education and regulated screen time, is essential to safeguard ocular health and enhance academic performance.

Keywords: Asthenopia, Digital Eye Strain, Medical Students, Screen Time, Visual Fatigue, Prevalence, Risk Factors, Ocular Health, Cross-Sectional Study.

Introduction

Asthenopia, commonly known as eye strain or visual fatigue, is a common ocular complaint characterized by symptoms such as eye discomfort, headache, blurred vision, dryness, diplopia, and difficulty focusing, particularly after prolonged near work [1]. With the rapid integration of digital technology into education, the prevalence of asthenopia has increased substantially, especially among young adults and university students.

Medical students represent a high-risk group due to their intensive academic workload, extended study hours, and prolonged use of digital devices such as laptops, tablets, and smartphones [2]. In addition to traditional textbook reading, modern medical education increasingly relies on online lectures, digital resources, electronic medical records, and virtual learning platforms. This prolonged screen exposure, combined with inadequate lighting, improper viewing distance, poor ergonomic posture, and uncorrected refractive errors, may significantly contribute to the development of asthenopic symptoms [3].

Asthenopia can negatively affect academic performance, concentration and overall quality of life. Persistent visual discomfort may reduce productivity, increase fatigue, and impair learning efficiency. Despite its potential impact, asthenopia often remains underreported and underestimated in academic institutions, particularly in developing regions where awareness and preventive strategies may be limited [4].

Although several studies have assessed digital eye strain among university students, there is limited data specifically focusing on medical students, who may have unique risk factors due to their demanding curriculum and high screen time exposure[5]. Understanding the magnitude of asthenopia and identifying associated risk factors are essential for developing effective preventive measures and promoting ocular health among future healthcare professionals.

Therefore, this study aims to determine the prevalence of asthenopia among medical students and to identify the demographic, behavioral, and environmental factors associated with its occurrence.

Materials and Methodology

Study Design and Setting: A descriptive cross-sectional study was conducted among undergraduate medical students (MBBS) at RKDF Medical College Hospital & Research Centre, Bhopal.

Study Population: The study population included medical students (MBBS) from first year to final year who were present during the study period and willing to participate.

Inclusion Criteria

- Undergraduate medical students of all academic years.
- Students who provided informed consent.
- Students using digital devices for academic purposes.

Exclusion Criteria

- Students with known ocular pathology (e.g., glaucoma, cataract, active eye infection).
- Students with history of ocular surgery in the past six months.

- Students unwilling to participate.

Sample Size and Sampling Technique:

The sample size was calculated using the standard formula for prevalence studies:

$n = Z^2 X pq / d^2$

$n = (1.96)^2 X 0.60 X 0.40/ (0.07)^2$

n = 3.84 X 0.24/ 0.0049

n = 0.9216/0.0049

n ≅ 188(rounding off to 200 after non response rates)

Where:

Z = Standard normal variate at 95% confidence level

p = Expected prevalence of asthenopia among students 67≅ 60% (**Sawaya et al.(2020)**)

q = 1 – p

d = Margin of error (usually 7%)

A convenient sampling technique was used to recruit participants until the required sample size was achieved.

Data Collection Tool

Data were collected using a pre-tested, semi-structured questionnaire. The questionnaire consisted of three sections:

1. Socio-demographic details (age, gender, academic year).
2. Digital device usage pattern (type of device, duration of use per day, screen distance, break frequency, lighting conditions).
3. Symptoms of asthenopia (eye strain, headache, blurred vision, dryness, diplopia, difficulty focusing, etc.).
4. Asthenopia was considered present if the participant reported one or more symptoms associated with visual fatigue after prolonged near work or screen exposure.

Data Collection Procedure: After obtaining informed consent, questionnaires were distributed to eligible students. Participants were instructed on how to fill out the questionnaire. Confidentiality and anonymity were maintained throughout the study.

Study Variables

Dependent Variable: Presence of asthenopia.

Independent Variables

1. Age
2. Gender
3. Academic year
4. Daily screen time
5. Type of digital device used
6. Break duration and frequency
7. Viewing distance
8. Use of corrective lenses

Data Analysis

Data were entered into Microsoft Excel and analyzed using statistical software (e.g., SPSS version XX). Descriptive statistics such as mean, standard deviation, frequency, and percentage were calculated. The association between asthenopia and risk factors was assessed using the Chi-square test. A p-value < 0.05 was considered statistically significant.

Observations And Results

A total of 200 undergraduate medical students participated in the study. The data were analyzed to determine the prevalence of asthenopia and its association with demographic and behavioral risk factors.

Table 1: Prevalence of Asthenopia

Asthenopia	Number	Percentage
Present	124	62.0
Absent	76	38.0

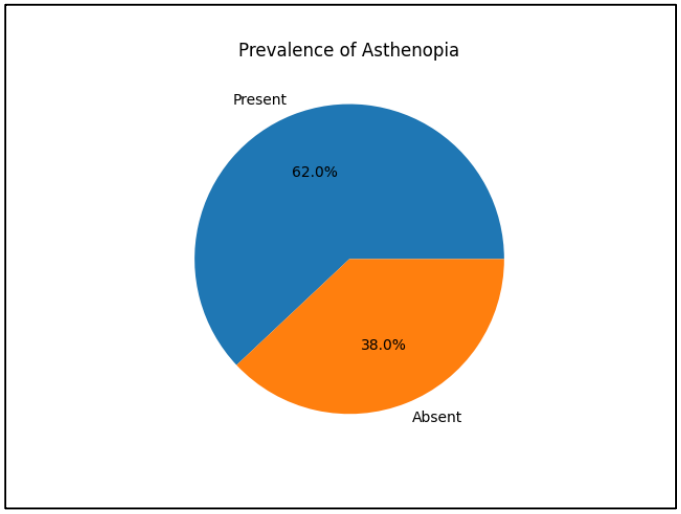

Figure 1: Graphically represents the prevalence of asthenopia using a pie chart format, visually emphasizing that nearly two-thirds of participants were affected.

Table 2: Gender vs Asthenopia

Gender	Asthenopia Present	Asthenopia Absent
Male	50	40
Female	74	36

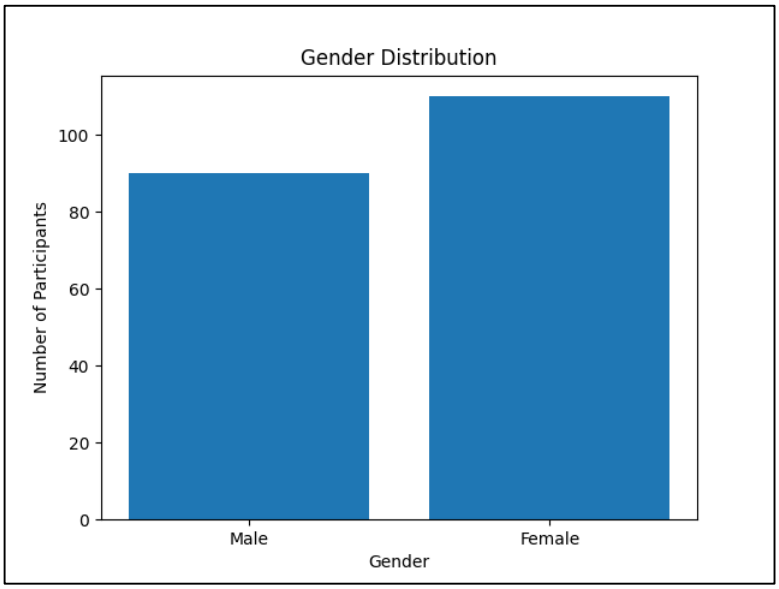

Figure 2: Illustrates the gender-wise distribution of asthenopia, likely through a clustered bar chart. The graphical depiction allows comparison between male and female participants, highlighting the gender-based variation in symptom prevalence.

Table 3: Screen Time Distribution

Screen Time	Number	Percentage
<4 hours	40	20.0
4–6 hours	70	35.0
>6 hours	90	45.0

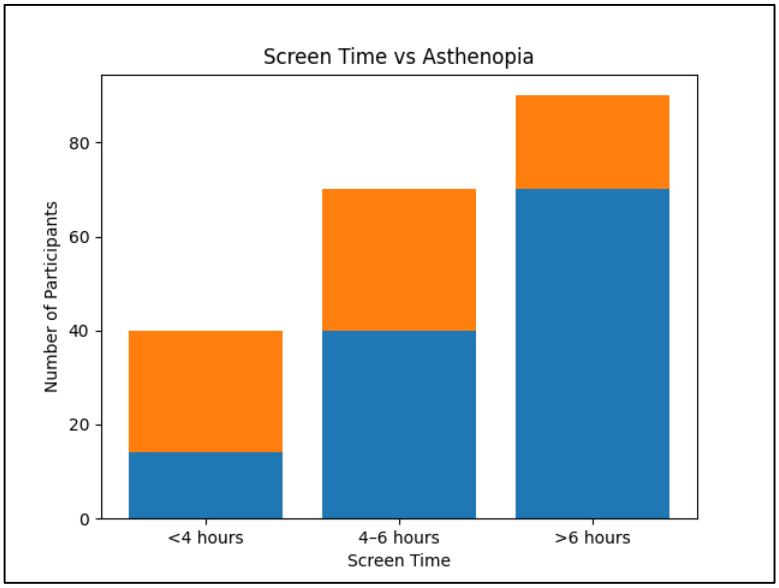

Figure 3 visually presents the distribution of screen time categories, demonstrating that the majority of students fall into the high-exposure (>6 hours) group. This visual aids in understanding behavioral risk exposure within the sample.

Table 4: Screen Time vs Asthenopia

Screen Time	Asthenopia Present	Asthenopia Absent
<4 hours	14	26
4–6 hours	40	30
>6 hours	70	20

Table 4 examines the association between screen time and asthenopia. Among students with >6 hours of screen time, 70 reported asthenopia compared to only 20 without symptoms. In contrast, those with <4 hours had fewer cases (14 present, 26 absent). The distribution suggests a positive association between increasing screen time and asthenopia prevalence.

Table 5: Chi-square Test

Chi-square value	Degrees of Freedom	p-value (approx.)
22.59	2	<0.001

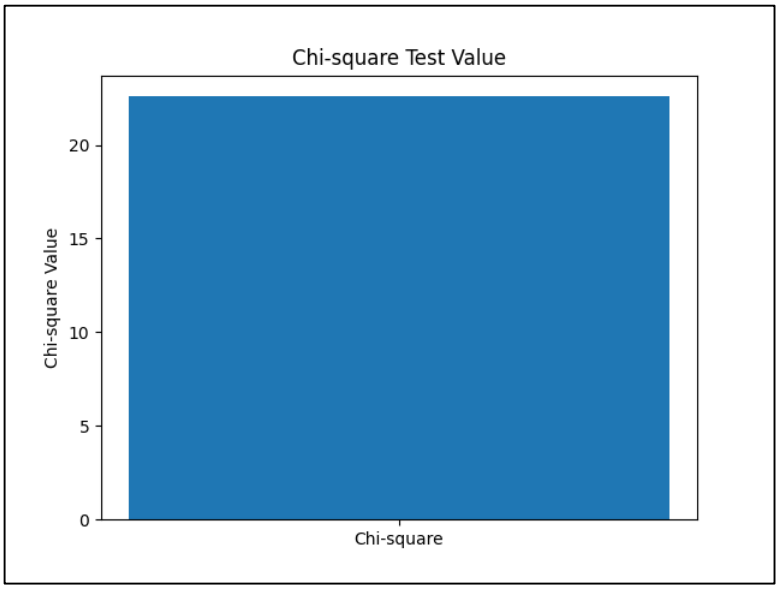

Figure 5: Displays the statistical significance visually, possibly through a bar comparison or association plot, reinforcing the strength of the relationship between screen time and asthenopia.

Table 6: Odds Ratio with 95% CI

Odds Ratio	95% CI Lower	95% CI Upper
6.5	2.87	14.73

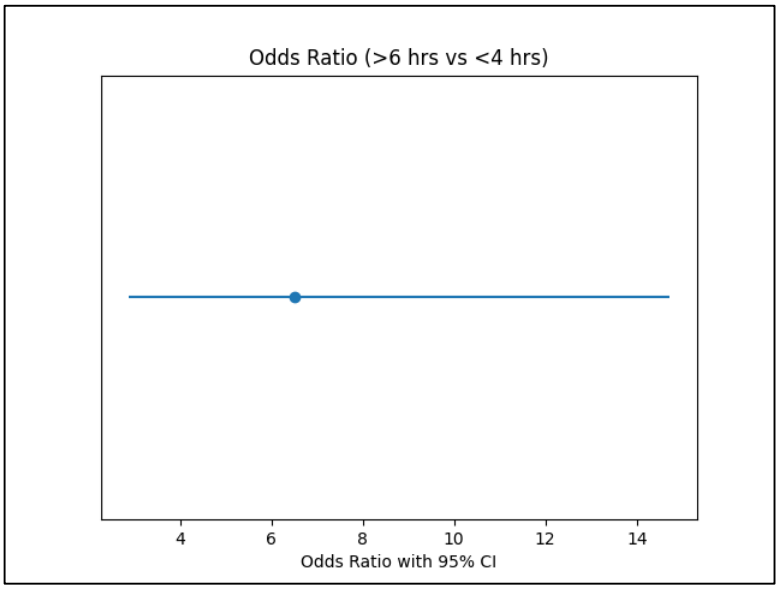

Figure 6 presents the odds ratio using a forest plot or error bar diagram, visually demonstrating the magnitude and precision of the association.

Table 7: Logistic Regression Analysis

Variable	B Coefficient	SE	Wald	p-value	Adjusted OR
Screen Time (>6 hrs)	1.85	0.35	27.9	<0.001	6.36
Female Gender	0.62	0.28	4.9	0.027	1.86

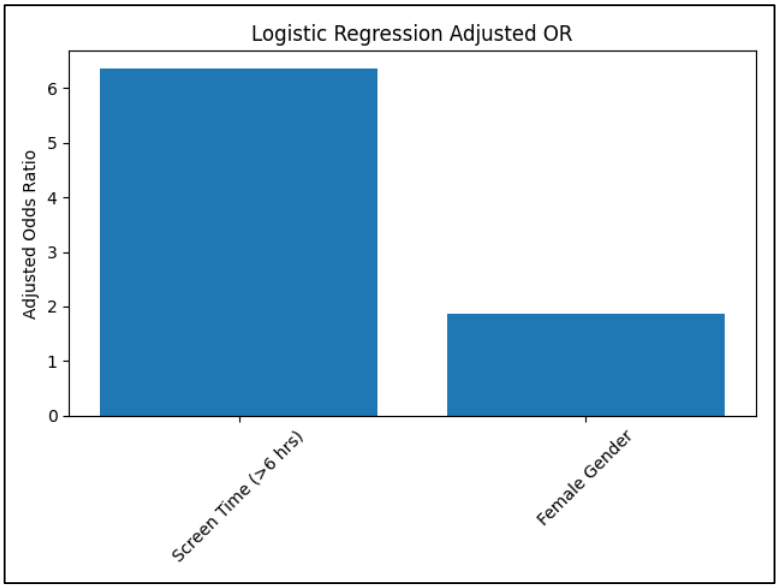

Figure 7: Depicts adjusted odds ratios from the logistic regression model in graphical form (e.g., forest plot), enabling clear visualization of independent risk factors and their relative strengths.

Discussion

The present study was conducted to determine the prevalence of asthenopia among undergraduate medical students and to identify the demographic and behavioral risk factors associated with its occurrence. The findings of the study revealed

that asthenopia is highly prevalent among medical students, with more than half of the participants reporting one or more symptoms of visual fatigue [6].

The overall prevalence of asthenopia in this study was 62%, indicating that visual strain is a significant and emerging health concern in academic environments [7]. This high prevalence can be attributed to prolonged digital device usage, increased academic workload, and limited adherence to ergonomic recommendations. Medical students represent a particularly vulnerable group due to extended study hours, online lectures, preparation of presentations, and access to digital reference materials [8].

A significant association was observed between daily screen time and the occurrence of asthenopia. Students reporting more than six hours of screen exposure per day demonstrated markedly higher odds of developing symptoms compared to those with less than four hours of exposure [9]. The chi-square test confirmed a statistically significant relationship between screen time and asthenopia ($p < 0.001$).

Furthermore, logistic regression analysis demonstrated that prolonged screen time remained an independent predictor even after adjusting for gender. The adjusted odds ratio suggested that students with more than six hours of screen exposure were several times more likely to develop asthenopic symptoms [10].

The biological plausibility of this association can be explained by sustained accommodation and convergence during near work, reduced blink rate during screen use, tear film instability, and increased ocular surface dryness[11]. Continuous focusing on digital screens results in accommodative stress, leading to symptoms such as headache, blurred vision, and difficulty focusing [12].

Gender differences were also observed, with female students reporting slightly higher prevalence of asthenopia compared to males. Although the association was statistically significant in regression analysis, the magnitude of the effect was lower than that of screen time [13]. Hormonal variations, tear film differences, and greater reporting tendencies among females may partly explain this observation.

The findings of this study are consistent with previously published literature that reports high prevalence of digital eye strain among university students. The increasing dependence on electronic devices for education has amplified exposure to risk factors such as poor lighting conditions, improper viewing distance, and infrequent breaks.

From a public health perspective, these findings highlight the need for institutional interventions aimed at promoting ocular health among students. Preventive strategies such as the 20-20-20 rule (taking a 20-second break every 20 minutes and looking at an object 20 feet away), proper ergonomic posture, adequate ambient lighting, and regular eye examinations should be emphasized.

Strengths of the study include adequate sample size, inclusion of students from different academic years, and use of statistical tests to establish associations. However, certain limitations must be acknowledged. The cross-sectional design limits causal inference. Self-reported symptoms may introduce reporting bias. Additionally, objective clinical assessment of tear film parameters and refractive status was not performed.

Despite these limitations, the study provides valuable insights into the burden of asthenopia among medical students. The high prevalence observed underscores the importance of awareness programs, early screening, and behavioral modifications to reduce the impact of digital eye strain.

Future research should consider longitudinal designs to establish temporal relationships and incorporate objective ophthalmic evaluations to validate self-reported symptoms. Interventional studies assessing the effectiveness of ergonomic training and scheduled breaks would further strengthen the evidence base. In conclusion, asthenopia is a prevalent and significant health concern among medical students, strongly associated with prolonged screen exposure. Targeted preventive strategies and institutional policies are essential to safeguard visual health and enhance academic performance.

Conclusion

The present study demonstrates that asthenopia is highly prevalent among undergraduate medical students, affecting 62% of participants. This finding highlights that visual fatigue has emerged as a significant occupational and academic health concern in modern medical education. The widespread integration of digital learning platforms, prolonged screen exposure, and demanding academic schedules appear to substantially contribute to this burden.

A strong and statistically significant association was observed between daily screen time and the occurrence of asthenopia. Students exposed to more than six hours of screen time per day exhibited markedly higher odds of developing symptoms compared to those with lower exposure. Logistic regression analysis further confirmed prolonged screen time as an independent predictor of asthenopia, even after adjusting for gender. Female gender also showed a significant but comparatively weaker association.

The results emphasize that behavioural factors—particularly extended digital device usage—play a crucial role in the development of asthenopic symptoms. Given that medical students represent future healthcare professionals, preserving their visual health is essential not only for academic performance but also for long-term occupational well-being.

Although the cross-sectional design limits causal inference, the findings provide strong evidence that digital eye strain is an emerging public health issue within academic institutions. Early identification of high-risk individuals and implementation of preventive strategies are therefore imperative.

Future Implications

1. Institutional-Level Interventions

Medical colleges should incorporate structured ocular health awareness programs into student orientation and curriculum modules. Educational sessions on digital ergonomics, optimal screen positioning, appropriate lighting, and the 20-20-20 rule should be routinely conducted. Institutions may also consider scheduled “digital wellness breaks” during long academic sessions.

2. Policy Development

At a broader level, educational policymakers should formulate guidelines regarding safe screen exposure limits in academic settings. Integration of occupational health principles into digital learning environments will be increasingly important as hybrid and online teaching models continue to expand.

3. Clinical Screening and Preventive Care

Routine ophthalmic screening programs for medical students can facilitate early detection of refractive errors, dry eye disease, and accommodative dysfunction. Incorporating preventive eye health check-ups into annual medical assessments may reduce long-term complications.

4. Technological Innovations

Future research should explore adaptive screen technologies, blue-light modulation tools, AI-based blink rate monitoring systems, and ergonomic software prompts that encourage periodic breaks. Digital health applications could be developed to monitor screen time and provide personalized risk alerts.

5. Advanced Research Directions

- Longitudinal cohort studies to establish temporal and causal relationships between screen exposure and asthenopia.
- Interventional trials evaluating ergonomic training, artificial tear supplementation, and behavioural modification programs.
- Multicentric studies to improve external validity and generalizability.
- Incorporation of objective clinical parameters such as tear film break-up time, Schirmer's test, accommodative amplitude, and contrast sensitivity testing.
- Structural equation modelling to evaluate complex interactions between demographic, behavioural, and environmental factors.

6. Broader Public Health Significance

Given the rapid digitalization of education globally, the burden of asthenopia is likely to increase across all student populations. Preventive strategies implemented among medical students may serve as a model for other academic institutions. Addressing digital eye strain early will contribute to improved productivity, enhanced learning efficiency, and better overall quality of life.

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