Original Article

A Study of Asthenopia among Medical Students in Digital Era

Virinchi Chirravuri[1], Iqra Mushtaq[2], Shreeya Singh[3]

Abstract

Background : The COVID-19 pandemic catalyzed a rapid shift from traditional classroom teaching to online learning, significantly impacting the education sector. This transition, particularly challenging for medical students reliant on practical training and patient interaction, also presented an opportunity to explore the potential of digital learning. With the widespread adoption of online teaching platforms in over 107 countries, digital learning emerged as a viable solution, connecting students and educators globally. This research investigates the prevalence of asthenopia, a condition associated with eye strain, among medical students during the COVID-19 era.

Materials and Methods : A cross-sectional observational study was conducted, involving 270 medical students using smartphones, laptops and computers. The study aimed to identify factors contributing to asthenopia, compare findings with pre-pandemic data, and provide guidelines for mitigating ocular health issues. Key findings revealed that digital device overuse was a significant factor contributing to asthenopia. The majority of students spent over four hours daily on screens with eyewear usage primarily attributed to excessive device use. Various preventive measures were employed, such as regular breaks and anti-glare glasses, though they did not consistently alleviate symptoms.

Results : Statistical analysis demonstrated that demographic factors, including gender and digital screen time, had limited influence on asthenopia prevalence. However, asthenopia was more common among students spending longer hours on digital devices. Comparing these findings with pre-pandemic studies underscores the increased prevalence of asthenopia among medical students in the COVID-19 era.

Conclusion : The rising prevalence of asthenopia among medical students highlights the need for proactive measures to protect ocular health. Strategies encompassing adequate sleep, dietary choices and improved mental well-being are essential. Public awareness campaigns, ergonomic practices and regular eye checkups should be encouraged to mitigate the adverse effects of digital device usage. This research contributes to our understanding of the post-COVID-19 impact on asthenopia and provides insights for targeted screening and awareness initiatives in the education sector.

Key words : COVID-19, Asthenopia, e-learning.

The COVID-19 pandemic severely impacted the education sector, forcing a sudden shift from physical teaching to blended online learning. This transition particularly affected medical students who heavily rely on practical training and patient interaction for their professional courses. However, amidst the challenges, the pandemic also presented an opportunity for digital learning to emerge as a solution. It accelerated the acceptance and adoption of online teaching, allowing students and teachers to connect virtually and explore various online educational platforms. These platforms offered courses from global institutions and industry players, bringing the world closer to students and promoting their growth as global citizens.

Editor's Comment :

- Asthenopia is highly prevalent among medical students due to excessive digital device use.
- Despite preventive measures, symptoms persist, highlighting the need for better awareness and ergonomic practices.

More than 107 countries had implemented a nationwide e-learning system by March, 2020[1]. Nevertheless, e-learning in higher education has progressively increased over the past two decades[2]. Digital learning can be described as a tool that can make the teaching and learning process more student centred, innovative, and flexible. However, the major aspects of e-learning that have been consistently explored are its usefulness and the learner's satisfaction. Several studies have shown that e-learning is mostly as good as traditional methods[3].

Department of Ophthalmology, Dr D Y Patil Medical College, Hospital & Research Centre, Maharashtra 411018
[1]MBBS, Intern and Corresponding Author
[2]MS (Opthalmology), Associate Professor
[3]MBBS, Undergraduate Student
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Hence, being a boon to students, it helps them learn at their own pace even when they've been sequestered from their respective institutions, providing them a medium to learn and understand concepts. But, until recently little information is available regarding asthenopia with risk factors among the college students. Most of them have been experiencing the processing of functional maturation of the visual system in this time frame, which makes ocular tissue of college students more sensitive to the environmental change compared with other populations[4].

Asthenopia can manifest itself through a variety of perceptive symptoms such as off vision, dryness, redness, watering, itching in eyes, gritty sensation, impaired reading, light sensitivity, diplopia, headache[5]. These symptoms are frequently associated while they are doing near work for reading and writing whereby eye accommodative and vergence processes are more intense[6]. The prevalence of asthenopia is 46.3%[7,8]. The objectives of this study are to assess the occurrence of asthenopia among medical students, identify factors that contribute to its development, compare findings with pre-COVID-19 projects and provide necessary guidelines and precautions to mitigate ocular health issues.

Materials and Methods

A cross-sectional observational study was conducted amongst medical students who are using smartphones, laptops and computers to determine the relationship between asthenopia and related risk factors amongst the medical students in the study period. The study was conducted at a tertiary referral hospital after taking the proper ethical committee clearance from the respective Institutional Ethical Committee.

Data is based on (1) demographics, (2) current major, (3) usage of digital device and time spent using it, (4) use of glasses or contact lenses, (5) symptoms of asthenopia and (6) preventive measures, will be collected by questionnaire. Our primary outcome of asthenopia is binary and its prevalence will be calculated. A bivariate analysis will be performed to correlate asthenopia with the different variables. A multivariate analysis will be conducted to determine the extent of the contribution of the different variables to asthenopia after controlling for confounding variables.

All the medical students willing to participate in the study and who are using a smartphone, laptop or computer and students not suffering from any ocular disease were included in this study. Students with amblyopia, conjunctivitis, eye inflammation/ infection, pre-existing medical conditions (arthritis, osteoporosis, thyroid disease, diabetes, hypertension, chronic migraine and chronic headache), strabismus, high myopia (more than -6.0 diopters), glaucoma or cataract, retinal nerve damage any eye disease, or history of eye surgery were excluded from the study. A convenient sampling was done while assuming a 95% confidence level with a 6% margin of error; the sample size came out to be 267 and was rounded off to 300.

The data was compiled and entered into an Excel sheet and analyzed by using an appropriate statistical test. Statistical analysis was done using SPSS Version 20.

A bivariate analysis will be used to assess the association between asthenopia and the following variables: demographics, digital device use and preventive methods. Age, being a continuous variable, was analysed using an independent t-test. Multiple logistic regression was performed to analyse the ones that contribute the most to asthenopia and control for the effect of confounding variables.

Results

A total of 270 medical students participated in this study. Descriptive analysis indicated that almost 65% of the participants were females, while about 36% of them were males. Equal number of students were studying in 1st year (n=83; 30.74%) and 3rd year (n=83; 30.74%) of their course. Twenty-five percent of them were studying in the second year of graduation and 12.96% were studying in their fourth year. In 55% of them used eyewear only, while 12% used both glasses and contact lenses. However, about 35% were free of both glasses and contact lenses, indicating that majority of the students used eyewear as a result of the overuse of digital devices.

The possible risk factors of Asthenopia were examined as shown in Table 2. Majority of the students spent four to six hours on their devices per day. One-third of them spent more than 6 hours per day, about 20% of them spent two to four hours a day and very few spent less than two hours a day on their

devices. On an average, students spent more than four hours a day on digital devices.

Several preventive measures were taken by medical students to minimise the ill-effects of overuse of digital devices as shown in Table 1. More than 20% of them preferred to take regular breaks from screen time, 10% of them used anti glare glasses as well as took regular breaks, 10% used eye drops and frequent breaks from using devices and less than ten percent of the students used adjustable screens and also took frequent breaks. Other preventive measures used by students were adjustable screens, anti glare glasses, eye drop, regular break alone or a combination of these measures.

Multiple linear regression analysis was used to analyse the impact of different demographic factors on the frequency of Asthenopia presents the descriptive analysis of the various demographic factors (Table 2). Results showed that digital screen hours (Mean=3.07±0.81) had neutral influence on frequency of Asthenopia, eyewear (Mean=1.80±0.92), and dark room (Mean=1.46±0.71) had no influence on frequency of Asthenopia. A R2 value of 0.035 indicates that the demographic factors included were responsible for only 3.5% variation in the frequency of Asthenopia, suggesting that these factors did not contribute major changes to it (Table 3). The constant takes the value 2.36 and the predicted value of frequency of Asthenopia when the various demographic factors take the value zero. None of the factors including eyewear, digital screen time and dark room were found to be significant factors affecting the frequency of Asthenopia. Hence, they had no influence over it (Table 4).

Chi-square test was conducted to examine the association between different eyewear used by students and various demographic factors. The number of students who wore glasses compared to ones who use both glasses and contact lenses alternatively were drastically higher in regards to time spent in the dark room (Table 5). Moreover, there was a slight difference between the number of students who used glasses than those who didn't in terms of duration spent in the dark room. Despite these differences among the groups who use or do not use eyewear, the association between eyewear and duration of time spent in a dark room was found to be insignificant (Chi-square=7.736; p>0.05). The type of eyewear used and the duration of screen time were not significantly associated (Chi-square=10.699; p>0.05). Majority of them wore glasses compared to ones who used glasses as well as contact lenses and the ones who did not use any type of eyewear. However, these differences in the use of eyewear were found to be insignificant in terms of duration of digital devices used (Table 6).

Table 1 — *Frequency distribution of preventive measures adopted*

Preventive measures adopted	Frequency (%)
Adjustable Screen	10 (3.7%)
Antiglare glasses	10 (3.7%)
Eye drop	16 (5.93%)
Regular Break	62 (22.96%)

Table 2 — *Descriptive statistics*

	Mean	STD Deviation
Gender	1.64	0.48
Eyewear	1.80	0.92
Digital Screen hours	3.07	0.81
Dark room	1.46	0.71
Length of years on screen	3.19	1.29

Table 3 — *Model summary for impact of gender, eyewear, digital screen hours, hours spent in dark room with digital device and length of years on screen on Frequency of Asthenopia*

R	R Square	Adjusted R Square	STD. Error of the Estimate
0.186	0.035	0.016	0.370

Table 4 — *Impact of gender, eyewear, digital screen hours, hours spent in dark room with digital device and Length of years on screen on Frequency of Asthenopia*

	Unstandardized Coefficients		Standardized Coefficients	't'	P value	95.0% Confidence Interval for B	
	B	STD Error	Beta			Lower Bound	Upper Bound
(Constant)	2.361	0.141		16.688	0.000	2.083	2.640
Gender	0.023	0.048	0.030	0.485	0.628	-0.071	0.117
Eyewear	0.029	0.025	0.072	1.191	0.235	-0.019	0.078
Digital Screen hours	-0.045	0.029	-0.097	-1.530	0.127	-0.102	0.013
Dark room	-0.041	0.034	-0.078	-1.208	0.228	-0.107	0.026
Length of years on screen	-0.019	0.018	-0.065	-1.052	0.294	-0.054	0.016

Table 5 — *Association between eyewear and dark room*

Dark room	Eyewear			Total
	Glasses	Glasses, Contact Lenses	None	
< 2 Hours	89	20	64	173
	60.5%	64.5%	69.6%	64.1%
2-4 Hours	47	10	19	76
	32.0%	32.3%	20.7%	28.1%
4-6 Hours	9	0	5	14
	6.1%	0.0%	5.4%	5.2%
> 6 Hours	2	1	4	7
	1.4%	3.2%	4.3%	2.6%

Chi-square = 7.736; p-value = 0.288

Table 6 — *Association between eyewear and digital screen*

Digital screen	Eyewear			Total
	Glasses	Glasses, Contact Lenses	None	
< 2 Hours	6	0	2	8
	4.1%	0.0%	2.2%	3.0%
2-4 Hours	30	1	25	56
	20.4%	3.2%	27.2%	20.7%
4-6 Hours	60	18	37	115
	40.8%	58.1%	40.2%	42.6%
> 6 Hours	51	12	28	91
	34.7%	38.7%	30.4%	33.7%

Chi-square = 10.699; p-value = 0.098

Discussion

In the investigation conducted by Cheng-Cheng Han, Rong Liu,Ru-Ru Liu, Zhong-Hai Zhu, Rong-Bin Yu, and Le Ma on 500 students from five different universities in Xi'an, Shaanxi Province, China. They discovered a significant prevalence of asthenopia among college students in Xi'an, with a rate of approximately 57.0%. These findings suggest that college students are experiencing a decline in their eye health. Consequently, it is imperative to promptly identify the risk factors contributing to this condition and develop effective strategies to safeguard against asthenopia, ultimately enhancing visual function among college students[9]. Thus, asthenopia is a predominant problem among students, especially medical students. Therefore, the present study chose medical students suffering from eye-strain or asthenopia as the target audience.

Descriptive analysis indicated that almost 65% of the participants were females and about 36% of them were males. Almost 55% of them used eyewear only, 12% used both glasses and contact lenses and about 35% were free of both glasses and contact lenses, indicating that the majority of the students used eyewear as a result of the overuse of digital devices. In this study, students used either only one or a combination of these devices.

The possible risk factors of asthenopia were examined as shown in Table 2. A majority of the students spent 4 to 6 hours on their devices per day. One-third of them spent more than 6 hours per day and 20% of them spent two to four hours a day. Very few spent less than two hours a day on their devices. On average, students spent more than four hours a day on digital devices.

Several preventive measures were taken by medical students to minimise the ill-effects of overuse of digital devices as shown in Table 3. More than 20% of them took regular breaks from screen time. About 10% of them used anti glare glasses and took regular breaks, 10% used eye drops and frequent breaks from using devices. Less than 10% of the students used adjustable screens and took frequent breaks. Other preventive measures adopted by students included using an adjustable screen, anti glare glasses, eye drop, regular break singularly or a combination of these measures. Although in the present study, students reported taking different preventive measures, they complained of having different symptoms of asthenopia, suggesting that these preventive measures failed to reduce eye-strain among them.

None of the factors including eyewear, digital screen time and dark room were found to be significant factors affecting the frequency of asthenopia. However, it has been reported that longer duration of using devices on a daily basis increases the prevalence of asthenopia[10]. In addition, Ips, et al reported that the probability of children with eyestrain in using eyewear was higher compared to children who had no eye strain[11]. On the other hand, eye strain was significantly associated with the duration of digital device usage among school students. Additionaly, a difference between prevalence and frequency of asthenopia in terms of duration of time spent in front of digital screens has been reported[12].

Chi-square test was conducted to examine the association between different eyewear used by students and various demographic factors. The association between gender and the type of eyewear used was found to be significant. The association between eyewear and the duration of time spent in a dark room was found to be insignificant. The type of

eyewear used and the duration of screen time were not significantly associated. To the extent of our knowledge, this study is the first of its kind to report the relationship between eyewear used and demographic factors included in this study.

Conclusion

Increasing prevalence of asthenopia among medical students and in general students owing to digital device abuse is of great concern to the society as it causes ocular complications, leading to poor attention and poor academic performances. Some of the factors that help in preventing asthenopia include adequate sleep, regular intake of vegetables, and a good mental frame play a crucial role in preventing asthenopia. Therefore, the prevalence of asthenopia is expected to be high among medical students because of their time-constrained lifestyle, responsibilities which require multitasking resulting in lack of rest and sleep and irregular intake of food[13,14]. This study examines the link between digital device usage and asthenopia prevalence among students. It aims to identify risk factors and fill the research gap regarding post-COVID 19 impact, providing insights for awareness campaigns and targeted screening efforts.Therefore, it is crucial to develop effective strategies to prevent asthenopia among students and improve their ocular health. Practices like inappropriate distance from digital screen, high brightness levels and their use before going to sleep. The public, especially students, should be made aware of the ill-effects of digital devices. Thus, decision-makers and stakeholders should ensure that the public are aware of necessary preventive measures; and should take efforts to implement better ergonomic practices and also encourage and conduct annual eye check-ups to ensure good health of the public.

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