Eyes Over Exposed: Ocular Health of Students in Higher Education

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Abstract

Purpose: The study aimed to explore the virtual academic routine of students pursuing higher education, map their screen time, and ascertain their visual hygiene challenges. **Methods:** The online survey comprised of 600 students (389 undergraduates and 211 postgraduates). Chi-square test of Independence was applied to study the association between level of education and screen time; use of spectacles and consumption of eye medicines; and the increase in eye power. A value of $P \leq 0.05$ was considered significant. A three-point rating scale was developed to capture information on categorical variables. **Results:** While 1 out of 7 undergraduate students had a screen time of at least 8 hours/day, 1 out of 6 postgraduate students had a screen time of at least 9 hours/day. More than 90% of students reported facing at least one symptom of digital eye strain. Despite having eye-related problems, 78% of respondents did not consult an ophthalmologist. Due to the eye strain, 1/4th of the respondents self-medicated themselves. Close to 14% of respondents reported an increase in their eye power.

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Conclusion: The study confirms that overuse of digital technology has unintended consequences on students' ocular health. Gadgets and Apps provide students with the necessary convenience, but learning to use them responsibly is crucial. Going ahead, the digitized world calls for in-depth studies and significant empirical research to mitigate the impending challenges of ocular health and the physical and mental health of students.

Keywords

Higher Education; Screen Time; Digital Eye Strain; Ocular Health

Introduction

The COVID-19 pandemic has disrupted the educational systems globally. Worldwide the sudden closure of educational institutions has affected nearly 1.6 billion learners [1-3]. The disruption has had substantial effects beyond education along with endangering health, economic and societal consequences [4]. The crisis has stimulated digital solutions for the continuity of education. In India, UGC directed educational institutions to switch to "e-learning." Besides having physical and mental health impacts, digital devices' prolonged usage has led to 'Digital Eye Strain. According to Bhattacharya, et al., "Digital eye strain is an emerging public health threat" [5].

The panic created in the world due to COVID-19 is the first of its kind. Studies conducted by Srivastava, et al., Tsetim, Tanveer, et al., Wu, et al., Sylvia, et al., and others describe the implications of COVID-19 on various aspects of human life [6-10]. The fear of COVID-19 infection confined people at home. Like other sectors, higher education too became a victim of this virus, forcing students to spend increased time on virtual platforms which resulted in over usage of digital gadgets. According to the All India Survey on Higher Education by the Ministry of Education there are 993 Universities and 39,931 colleges Pan-India [11]. Due to educational institutions' closure, more than 320 million learners in India (nearly 25% of global statistics) were affected. Educational institutions forced teachers and students to transit and adopt virtual learning culture [12,13]. In the recent past e-learning has witnessed an uptick due to advances in technology and convenience factors. But the increased exposure to digital screens has been accompanied with a rise in the prevalence of ocular complaints and can lead to the risk of the onset of myopia [14,15]. Coles-Brennan, et al., highlights that 90% of digital device users experience symptoms of Digital Eye Strain [16]. According to the American Optometric Association less than two hours of continuous digital device usage per day can trigger an array of eye and vision-related problems and is referred to as Digital Eye Strain (DES) [17]. Studies indicate that excessive use of digital gadgets without breaks can lead to DES due to short, high-energy waves penetrating the eyes and eventually damaging the retinal cells [18,19].

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As cited in Hitavadi, Dr. Gopal Arora opines “The time spent by people on social media rose from 150 minutes per day to 280 minutes per day during the lockdown” [20]. In India, public health experts have suggested that glaring effects of blue light from screens include dry eye, blurred vision, headaches, and eye fatigue, commonly known as DES or Computer Vision Syndrome (CVS) [21]. “With the increased usage of digital devices, there are predictions of a rise in myopic refractive error in about 50% of the world's population by 2050” [22]. A Mumbai-based ophthalmologist shared that ‘multiple factors cause eye strain, one of them being dry eyes and if this has occurred even a few times, it is a good indicator to show the presence of eye strain in the patient. The rise in usage of digital devices’ will increasingly trigger symptoms of DES. Those using spectacles or contact lenses can tip the scales for various symptoms [23]. Bahkir and Grandee's study on the impact of the COVID-19 lockdown on the digital device related to ocular health with a sample size of 402 respondents reveal a significant correlation between an increase in screen time and the number of eye strain associated symptoms [24]. Das and Narayan's study concludes that ocular infections and ocular trauma were the most common emergency ailments caused due to the extended use of screen time during the nationwide lockdown [25].

In the new normal students pursuing higher education in India were mandated to attend virtual classes and follow the e-learning routine by their academic institutions. Coupled with this online socialization and entertainment increased their screen time. This new phenomenon of increased exposure to screen time by students and its impact needs systematic assessment. In this context the current study aimed to explore the online academic routine of students pursuing higher education, map their screen time, and ascertain their visual hygiene challenges.

Methods

A cross-sectional descriptive research design with a convenience sample of 600 students between 18 to 30 years of age enrolled in higher education was used for the study. An online survey tool was developed by the authors, which comprised four sections: demographic information like age and level of education along with their academic routine, total screen time (2 items), visual hygiene challenges (6 items) faced by the students while attending virtual classes and the student's preferences in terms of mode of learning. The online electronic survey form was validated by experienced ophthalmologists and subsequently circulated through Google link among social media groups of students and was open to responses among students pursuing undergraduate and postgraduate studies in India. Informed consent of the respondents was taken for the study. The tool evaluated the level of eye strain (never, sometimes, often) about related symptoms such as headaches, back pain, blurred eyes, itching, burning, teary sensation, and sensitivity to brightness.

Data were analyzed using Excel and relevant online statistical software. Descriptive and inferential analysis as per applicability was used to analyze the data. Chi-square test of

Independence was applied for categorical variables to study the association between them. A value of $P \leq 0.05$ was considered statistically significant.

Demographic Profile of Sample

Level of Education	No. of Respondents	Percentage
Undergraduate	389	65
Postgraduate	211	35
Total	600	100

Table 1: Respondents' level of education.

Nearly two-thirds of the sample comprised undergraduate students.

Age	No. of Respondents	Percentage
Less than 20 years	219	36.5
20-25 years	336	56
25-30 years	31	5
Above 30 years	14	2.5
Total	600	100

Table 2: Age of students.

Results

Academic Routine

No. of days	No. of respondents	Percentage
1 day	5	17.5
2 days	11	
3 days	50	
4 days	39	

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5 days	106	82.5
6 days	343	
7 days	46	
Total	600	100

Table 3: Frequency of attending virtual college classes.

As soon as the lockdown began in March 2020, only 12% (n=74) of the students' reported that their virtual classes had commenced. However, for a majority of the students (n=526), the academic year began a little late than usual.

It is observed from Table 3 that the students attended their virtual classes ranging from one to seven days per week. Based on availability of technical infrastructure, educational institutions across India transited to the virtual mode at their own pace. Delay in shifting to the virtual mode resulted in conducting virtual classes for extended duration across the week. The data observes that 82.5 % of students attended virtual classes 5 to 7 days per week.

Screen Time Spent

Device	No. of Respondents	Percentage
Laptop/Desktop/Computer	292	48.67
Mobile Phone	100	16.67
Multiple Devices	208	34.66
Total	600	100

Table 4: Devices where respondents viewed classes.

It can be inferred from Table 4 that 48% of the students used their laptops/computers to attend virtual classes, and nearly 35% of the students used a combination of both. A small screen was used by nearly 17 % of students. This can have detrimental effect on their vision if screen time is extended.

No. of Hours (hrs)	< than 2 hrs	2-4 hrs	4-6 hrs	> than 6 hrs	Total	Percentage
< than 2 hours	3	5	11	5	24	6
2-4 hrs	21	29	15	14	79	20
4-6 hrs	38	55	31	11	135	35
6-8 hrs	32	42	20	9	103	26.5
> than 8 hrs	18	25	2	3	48	12.5
Total					389	100

Table 5: Undergraduate students' total screen time-classes (columns) + social media and entertainment (Rows).

No. of hours (hrs)	< than 2 hrs	2-4 hrs	4-6 hrs	> than 6 hrs	Total	Percentage
< than 2 hours	3	2	0	1	6	3
2-4 hrs	12	24	6	3	45	21.5
4-6 hrs	19	26	9	11	65	30.5
6-8 hrs	13	18	4	3	38	18
> than 8 hrs	33	19	4	1	57	27
Total					211	100

Table 6: Postgraduate students' total screen time- classes (columns) + social media & entertainment (rows).

It is observed from Table 5 that 14.14% of undergraduate students spent 4 - 6 hours on classes per day and 2 - 4 hours on social media/entertainment. Table 6 shows that 15.64% of postgraduate students spent more than 8 hours attending virtual classes and less than 2 hours on social media/entertainment. At the undergraduate level, 159 out of 389 students (41%) used more than 10 hours of screen time per day; and at the postgraduate level, it was 103 out of 211 students (49%). This is alarming, and it gets worse if they use small screens and that too with inadequate lighting and ventilation.

Hypothesis 1: There is a significant association between level of education and screen time while attending virtual classes.

Degree/ Screen Time - College	< than 2 hrs	2-4 hrs	4-6 hrs	6-8 hrs	> than 8 hrs	Total
UG students	24	79	135	103	48	389
PG students	6	45	65	38	57	211
Total						600

Table 7: Education v/s Screen Time on classes.

The chi-square value for the data in Table 7 is 24.7282, and the p-value is 0.000057. The result was significant at the 0.05 level. As the p-value is less than 0.05, the hypothesis was retained. It was concluded that there is a significant association between the level of education and screen time spent by students while attending virtual classes. 34.70% of undergraduate students had a screen time of 4-6 hours per day against 30.81% of postgraduate students. However, 27.01% of postgraduate students had screen time of more than 8 hours as against 12.34 % of undergraduate students.

Hypothesis 2: There is a significant association between level of education and screen time spent on social media and entertainment.

Degree/ Screen time - SM/ENT	< than 2 hrs	2-4 hrs	4-6 hrs	> than 6 hours	Total
UG students	112	156	79	42	389
PG students	80	89	23	19	211
Total					600

Table 8: Education v/s Screen Time on social media and entertainment.

‘Visual hygiene’ challenges due to virtual classes

Options	No. of Respondents
Yes, 24 × 7 for viewing a screen	255
No	269
Yes, but not for screen	76
Total	600

Table 9: Respondents wearing Spectacles.

Options	No. of Respondents
Yes had to	151
No was not required	449
Total	600

Table 10: Usage of eye drops/medicines.

Options	No. of Respondents
Yes had to	104
No was not required	496
Total	600

Table 11: Consulting eye doctor.

Surrounding	No. of Respondents
Fan	285
AC	29
Both	268
None	18
TOTAL	600

Table 12: Surroundings.

Table 9 shows that 55% of the students wore spectacles, out of which only 42% wore while viewing a screen. Table 10 depicts that 1 in 4 students used eye drops or medicines due to continuous exposure to screen. Table 11 reveals that 1 in every 6 students consulted an eye

doctor due to continuous exposure to screen. It is observed from Table 12 that while attending classes, 47% of the students switched on the fans while 45% of the students switched on both AC and fan.

Symptoms Faced

Symptom	Headache			
Surrounding / Occurrence	Never	Sometimes	Frequently	Total
Fan	60	172	53	285
A/C	8	14	7	29
Both	42	155	71	268
None	7	6	5	18
Total				600

Table 13: Headache due to surroundings.

Symptom	Burn/Itchy/Redness			
Surrounding / Occurrence	Never	Sometimes	Frequently	Total
Fan	93	134	58	285
A/C	14	11	4	29
Both	75	129	64	268
None	7	4	7	18
Total				600

Table 14: Different sensations due to surroundings.

As per data displayed in Table 13, 80.5% of students sometimes experienced 'headaches'. From these, 46.80% students attending virtual classes from their air-conditioned rooms or with full fan speed for longer duration reported of 'burning/itching sensation' too.

Hypothesis 3: There is a significant association between the Use of Spectacles while attending virtual classes and consumption of eye medicines.

Spectacles	Eye Medicine	
	Yes	No
Wear specs		
Yes, 24×7 for viewing screen	81	174
Yes, but not for screen	15	61
No specs at all	55	214

Table 15: Association between usage of spectacles and consuming medicines.

The chi-square value for the data in Table 15 is 10.2672, and the p-value is 0.005895. The result was significant at the 0.05 level. As the p-value is less than 0.05, the null hypothesis was rejected, and the alternate hypothesis was retained. It was concluded that there is a significant association between the Use of Spectacles while attending virtual classes and consumption of eye medicines.

Hypothesis 4: There is a significant association between the Use of Spectacles while attending virtual classes and an increase in eye power.

Wear specs/ Increase in power	Yes	No	Not checked	Total
Yes, 24×7 for viewing screen	68	66	121	255
Yes, but not for screen	10	19	47	76
No specs at all	8	209	52	269
Total				600

Table 16: Association between usage of spectacles and increase in eye power.

The chi-square value for the data in Table 16 is 176.5742, and the p-value is < 0.00001. The result was significant at the 0.05 level. As the p-value is less than 0.05, the null hypothesis was rejected, and the alternate hypothesis was retained. It was concluded that there is a significant association between the Use of Spectacles while attending virtual classes and an increase in eye power.

Figure 1: Highlights that 80% of students had headaches and back pain. Additionally, 48.83% shared they were sensitive to bright light, 46.33% sometimes faced a burning or itchy sensation, and 40.17% reported experiencing a blurred screen. The data indicates that one in every two students faces visual hygiene challenges.

Student's Preferences

Of all respondents, 76.83% (n=461) were unhappy with virtual classes and were eagerly waiting for physical classes to commence. Most of them believed that actual learning took place in a physical setup and not in virtual mode. Given a choice, 33% (n=198) of the respondents felt that they would prefer a hybrid classes, i.e., 50% virtual and 50% physical classes.

Discussion

Virtual education has been on edge for a long time, and due to the COVID-19 pandemic, it acquired a center stage. This study explored students' online academic routine pursuing higher education, mapped their screen time, and ascertained their visual hygiene' challenges due to their increased screen timings.

The findings of the study suggest that the COVID-19 pandemic severely disrupted students' learning routine and forced them to adapt to 'e-learning.' Virtual classes, zoom meetings, video conferencing all took a front seat. Based on the state governments' approval, educational institutions commenced and formulated academic schedules with varying timings between two hours to six hours a day. The data observes that 10.80% of undergraduate students spent greater time on social media/entertainment in comparison to postgraduate students who had greater lecture screen time. This observation seems quite logical, considering the workload and level of education.

The new normal of "Stay Home-Stay Safe" became an indispensable part of students' lives as the government directives restricted outdoor physical activity and movement. Consequentially they were forced to abide by attending virtual classes, having virtual socialization, and getting glued to virtual entertainment by playing games on the mobile or watching television/movies/TV shows on available streaming platforms. The study finds a strong association of screen hours with the level of education and time spent on social media and entertainment. Thus it can be inferred from the analysis that students are becoming increasingly tech-savvy as they are now accustomed to pursuing their curricular and co-curricular activities virtually. As a general observation, the millennial generation is device multitasker. For instance, they binge-watch their favorite shows on television, work on their laptop, and scroll through social media through their mobile phones - at times all at the same time! Ophir, et al., study indicates that device multitaskers receiving multiple information streams cannot concentrate and recall information. They cannot shift smoothly from one project to another compared to those who complete one task at a time [26].

Increased usage of various types of digital devices increases greater degrees of eye strain and has other health impacts. It can disrupt sleep patterns by alerting brain activity [27]. According to ophthalmologists who were consulted shared that, 'when students view any screen for more than 2 hours in an air-conditioned environment with (out) the fan, the eyes become dry. This gives rise to symptoms related to eye strain. The strain also increases due to inadequate equipment, bad lighting, and poor ergonomics at home. So, virtual education may just not be as comfortable as it appears to be. It has cascading impacts on physical and mental health, as cited by Pandya, et al. Excessive screen time is reported to be associated with a range of adverse mental health outcomes like depression and anxiety. Such consequences often result in compulsive, unregulated, or addictive digital use. Studies have found an association between excessive screen time and poor mental health. Although digital technology boomed during the pandemic, digital health and well-being demanded greater attention due to increased screen time [28].

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The hasty nature of the virtual transition in the current study highlights that 80% of students suffered headaches and back pain due to constant access to digital technology. In all, 48.83% of students reported being sensitive to bright light, 46.33% of students faced a burning or itchy sensation, and 40.17% of students often experienced blurred screen. This shows that one in every two students faced visual hygiene challenges. This happens because Indian homes do not necessarily have study stations that are "eye-gonomical" and hence are likely to contribute to the strain on users' necks and backs. Consequently, there is a need for promoting advanced eyewear and lens technology that can protect them from the side effects of disproportionate use of technology. Vision problems associated with digital eyestrain can be alleviated through simple measures like controlling lighting and glare on the device screen, taking intermittent breaks, maintaining appropriate posture and distance while using digital devices.

Minor vision problems faced by students should be addressed immediately by consulting ophthalmologists and discussing with them the extent of digital device usage. Failing this can have cascading health, academic, and other detrimental impacts on their future economic life.

Limitations

The study was based on a self-reported survey and was delimited to students pursuing higher education in India. However, the results could be similar all across. Industry experts predict that the trend is likely to stay in the context of an exponential rise in virtual education and online work. This implies a need to conduct in-depth studies on ocular health for different age groups to mitigate the upcoming challenges caused due to increased screen time.

Conclusion

Despite the potential effects of screen time on visual, physical, and mental health, it is impossible to abstain from screen time in modern times. While it is crucial to resort to critical measures to cease the spread of COVID-19, it can be surmised from the above discussion that the COVID-19 pandemic has accelerated the pace of digitalization among students. Their eyes are subject to a constant barrage of digital input from tablets, smartphones, computers, and televisions. The study highlights that students' phenomenal increase in screen time is attributed to the sudden shift to a virtual mode of education and online socializing activities. Consequentially, more than 90% of students faced at least one symptom of digital eye strain. Headaches, back pain, and burning/itchiness in the eyes were some of the significant challenges. Educational institutions going ahead with the virtual mode/hybrid mode of education need to note the deterioration of ocular health over and above mental health and take appropriate steps to educate students on the responsible use of technology. In this direction, proper measures should be taken to formulate virtual academic schedules for a shorter duration, and the same should be offered at staggered intervals. Eyes are windows to our world, and hence there is a need to protect and keep them healthy. Therefore, measures to promote

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awareness about strategies to prevent digital eye strain and reduce the adverse effects have to be taken on a war footing with eye care providers' support.

Going ahead, our vision health in a technology-driven world raises the question: how will our vision adapt to our relatively newfound habits? In this context, ocular health is a highly topical area, having great scope for future research. There is a need to undertake systematic and large-scale empirical studies on the effects of virtual learning and work on various demographic populations' visual functions. The scientific implications arising from these studies will give directions to mitigating long-term vision issues.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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