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Digital Eye Strain and Sleep Related Complaints During Covid-19 E-Learning Among Undergraduate Medical Students in South Eastern Nigeria

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Abstract

During COVID-19 e-learning, medical students relied heavily on digital devices, often into the night, raising concerns about visual discomfort, sleep-related complaints and daytime functioning. This cross-sectional analytical survey described these symptoms and examined their association with the timing of device use among undergraduate medical students in Enugu, South-Eastern Nigeria, from August to October 2020. A context specific questionnaire, informed by student studies from Oman, Pakistan and Uganda and checked against the symptom coverage of the Computer Vision Syndrome Questionnaire, assessed device use and visual, sleep-related and daytime-function symptoms; the validated CVS-Q was neither administered nor scored. Blank symptom checklists were treated as missing. Frequencies, Fisher's exact test, Mann-Whitney U test and multivariable logistic regression were used. Among 247 students (mean age 24.8 ± 2.4 years), 226/239 (94.6%) reported night or combined day-and-night use. Of 214 valid visual responses, headache (79.9%) and eye strain (51.4%) were most frequent. Of 224 valid sleep-related/daytime-function responses, daytime sleepiness (71.4%) and difficulty concentrating (71.0%) predominated. Night-time users had a higher median sleep-related/daytime-function symptom count than day-only users (4 versus 2; $p<0.001$) and higher unadjusted odds of multiple visual symptoms (OR 4.23; $p=0.042$). Adjusted associations with multiple visual symptoms (aOR 3.35, 95% CI 0.81- 13.93) and perceived sleep wake disruption (aOR 1.54, 95% CI 0.43-5.51) were not statistically significant. Visual and sleep-related complaints were common, but the cross-sectional design and small day-only group preclude causal conclusions. Medical schools should promote practical eye-health, ergonomic and sleep-hygiene measures.

Keywords: *COVID-19; Digital eye strain; e-learning; Medical students; Sleep-related complaints*

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Background of the Study

Digital technology is central to medical education, but the COVID-19 pandemic abruptly transferred lectures, assessments, clinical resources and peer communication to screen-based platforms. Academic use occurred alongside recreational use and frequently extended into evening and night hours. This change created simultaneous concerns about digital eye strain and sleep-related or daytime-function complaints among students already managing demanding schedules.

Digital eye strain, also called computer vision syndrome, comprises ocular and visual symptoms that arise or worsen during screen viewing, including eye strain, headache, blur, diplopia, burning, tearing and dryness. Reduced or incomplete blinking, tear-film instability, sustained accommodative and vergence demand, glare, short viewing distance, uncorrected refractive error and prolonged uninterrupted near work are recognised contributors (Rosenfield, 2011; Sheppard & Wolffsohn, 2018; Wolffsohn et al., 2023). A systematic review estimated a pooled prevalence of 69.0%, increasing to 76.1% among university students, although estimates varied substantially by instrument and case definition (Ccami-Bernal et al., 2024). Pandemic studies similarly documented increased exposure and frequent symptoms among online learners (Bahkir & Grandee, 2020; Ganne et al., 2021; Bhatnagar et al., 2024).

Night-time exposure adds a sleep-health dimension. Evening display light can affect melanopsin-sensitive pathways, while engaging content may delay bedtime through time displacement and arousal. Controlled studies have reported delayed melatonin timing, longer sleep latency and reduced next-morning alertness after evening light-emitting device exposure (Chang et al., 2015; Schöllhorn et al., 2023). These effects depend on intensity, duration, viewing distance, content and existing sleep behaviour rather than blue light alone. Medical students have a high background prevalence of poor sleep and daytime sleepiness (Binjabr et al., 2023), and prolonged screen exposure during confinement was associated with poor sleep quality (Mishra et al., 2022)

Statement of the Problem

Evidence from sub-Saharan Africa is limited, and few studies have assessed device-use timing, visual symptoms, sleep-related complaints and daytime functioning in the same medical-student population. Existing studies are mainly cross-sectional, use heterogeneous symptom definitions and often emphasize total screen duration without separating night-time use. Consequently, institutions lack locally derived evidence for practical measures addressing late-night exposure, ambient lighting, refractive correction and visual breaks.

Justification and Literature Review

Medical students were an important population during compulsory e-learning because visual discomfort, inadequate sleep and daytime sleepiness may impair concentration, wellbeing and learning. Studies from India associated digital eye strain with longer exposure, close viewing, dark-room use, infrequent breaks, refractive error and pre-existing dry eye (Ganne et al., 2021; Bhatnagar et al., 2024). International research has also linked night-time screen behaviour with poor sleep quality (Liebig et al., 2026). A Nigerian post-pandemic study

indicates that digital eye symptoms remain relevant among tertiary students (Adepoju et al., 2025). Examining the two symptom domains together can therefore guide student-health education and future prospective research while establishing a pandemic-era Nigerian baseline.

Study Objective

The study aimed to describe digital eye strain symptoms and sleep-related and daytime-function complaints and to examine their relationship with the timing of digital-device use among undergraduate medical students during COVID-19 e-learning. Specifically, it sought to:

1. Describe device-use duration, timing and pandemic-related change;
2. Determine the frequency and pattern of visual, sleep-related and daytime-function symptoms;
3. Compare symptom burden between day-only users and students reporting night-time use; and
4. Evaluate whether night-time use independently predicted perceived sleep-wake disruption or multiple visual symptoms after adjustment for selected covariates.

Materials and Methods

Study Design and Setting

This cross-sectional analytical study was conducted among undergraduate medical students in the clinical years at the College of Medicine of a state-owned university in Enugu, South-Eastern Nigeria, between August and October 2021. Online teaching and digital learning were then the predominant modes of instruction.

Participants and Sampling

Eligible students used at least one digital device and consented to participate. A non-probability sample completed the self-administered survey. Rows without a participant number or any study data were excluded as formatting rows, leaving 247 participants for analysis.

Data Collection Instrument

The questionnaire was adapted to the study context from domains used in student studies from Oman and Pakistan (Jahan et al., 2018; Noreen et al., 2021) and an e-learning survey from Uganda (Olum et al., 2020). It captured device type and purpose, duration and day/night timing, low-light exposure, pandemic-related behavioural change, refractive history, protective practices, perceived sleep effects and visual, sleep-related and daytime-function symptoms. Its visual-symptom content was compared with the validated 16-item Computer Vision Syndrome Questionnaire (CVS-Q) to check domain coverage (Seguí et al., 2015), but the CVS-Q was not adopted, administered or scored. A single integrated questionnaire was scientifically appropriate because the study required exposure, environmental, refractive and sleep-related domains beyond the CVS-Q, while limiting respondent burden during remote

data collection. Accordingly, results are reported as individual symptoms and explicitly defined counts, not as CVS-Q prevalence or a validated diagnosis.

Variables and Operational Definitions

1. Night-time digital device use: reporting that most screen time occurred at night or across both day and night; day-only use was the reference category.
2. Perceived sleep-wake disruption: a yes response to whether device use affected night sleep or the sleep-wake cycle.
3. Sleep-related and daytime-function symptom burden: a count from 0 to 8 of difficulty falling asleep, fatigue, impaired judgement, difficulty controlling emotions, decreased alertness, difficulty concentrating, headache and daytime sleepiness. This was not a measure of circadian phase or a diagnosed sleep disorder.
4. Visual symptom burden: a count from 0 to 4 of blurred vision, double vision, eye strain and headache. Multiple visual symptoms meant two or more of these items and was not labelled a CVS-Q diagnosis.
5. Prolonged daily exposure: more than six hours of screen use per day, based on the category coded 5 in the study key.
6. Refractive error: a yes response to having refractive error or wearing spectacles; do not know was retained separately.

Blank, NA or unselected whole symptom checklists were treated as missing data and exclude from domain-specific prevalence estimates and analyses. Within a valid completed checklist, unselected symptoms were coded as absent. Invalid or undocumented single-response codes also remained missing.

Statistical Analysis

Categorical variables were summarised using frequencies and percentages with valid denominators; age was summarised using mean and standard deviation. Multiple-response percentages were not expected to sum to 100%. Fisher's exact test was used for binary comparisons because the day-only group was small, and Mann-Whitney U tests compared symptom counts. Two complete-case multivariable logistic regression models estimated adjusted odds ratios for perceived sleep-wake disruption and multiple visual symptoms. Covariates selected a priori were age, sex, daily exposure greater than six hours, working in a dark room and refractive error. Extreme-case sensitivity analyses classified all missing visual checklists first as fewer than two symptoms and then as two or more symptoms. Tests were two-sided with $p<0.05$; 95% confidence intervals are reported. Analyses were performed in Python 3.12 using NumPy- and SciPy-based routines.

Ethical Considerations

Participation was voluntary, informed consent was obtained and data were analysed without names. Ethical approval was obtained in July 2020 from the Health Research Ethics

Committee of the affiliated teaching hospital in Enugu [insert approval reference before submission].

Results

Participant Characteristics and Digital Exposure

The analysis included 247 students. Mean age was 24.8 ± 2.4 years (n=245), and 124 (50.2%) were male. More than half of respondents with valid duration data (128/246, 52.0%) reported more than six hours of daily screen use. Among 239 respondents with timing data, 226 (94.6%) reported night or combined day-and-night use and 13 (5.4%) reported day-only use. Digital-screen habits had changed since the pandemic for 166/220 (75.5%) respondents

Table 1: Participant characteristics and digital-device exposure

Characteristic	Category or statistic	n/N	%
Age, years	Mean ± SD	245	24.8 ± 2.4
Sex	Female	121/247	49.0
	Male	124/247	50.2
Residence	Urban	234/247	94.7
Year of study	Third year	68/247	27.5
	Fourth year	73/247	29.6
	Fifth year	43/247	17.4
	Final year	63/247	25.5
Daily screen exposure	>6 hours	128/246	52.0
Screen-use timing	Night or day-and-night	226/239	94.6
	Predominantly night	27/239	11.3
Day only	13/239	5.4	
Work in a dark room	Yes	127/242	52.5
Habits changed since pandemic	Yes	166/220	75.5
Refractive error or spectacles	Yes	82/238	34.5

Note. Valid denominators vary because missing or invalid single-response items were excluded. The night or day-and-night category includes predominantly night users and is not additive with that row.

Symptom Patterns

Perceived sleep-wake disruption was reported by 93/238 (39.1%) students. The sleep-related/daytime-function checklist was completed by 224 students; daytime sleepiness (71.4%), difficulty concentrating (71.0%), headache (68.8%) and fatigue (67.4%)

predominated. The visual checklist was completed by 214 students; 135 (63.1%) reported at least two of four visual symptoms, most commonly headache (79.9%) and eye strain (51.4%)

Table 2: Self-reported symptoms among respondents with valid checklists

Domain	Outcome	n/N	%
Sleep perception	Device use affected night sleep or sleep-wake cycle	93/238	39.1
Sleep-related or daytime function	Daytime sleepiness	160/224	71.4
	Difficulty concentrating	159/224	71.0
	Headache	154/224	68.8
	Fatigue	151/224	67.4
	Difficulty falling asleep	91/224	40.6
	Decreased alertness	60/224	26.8
	Difficulty controlling emotions	49/224	21.9
	Impaired judgement	19/224	8.5
Visual	Two or more visual symptoms	135/214	63.1
	Headache	171/214	79.9
	Eye strain	110/214	51.4
	Blurred vision	53/214	24.8
	Double vision	40/214	18.7

Note. Symptom items were multiple-response questions; percentages do not sum to 100%. Blank whole checklists were treated as missing. Denominators were 224 for sleep-related/daytime-function symptoms and 214 for visual symptoms.

Associations with Night-Time Use

Perceived sleep-wake disruption occurred in 86/219 (39.3%) night-time users and 4/12 (33.3%) day-only users (p=0.770). Night-time users had a higher median sleep-related/daytime-function symptom count than day-only users (4 versus 2; p<0.001). Their median visual symptom count was also higher (2 versus 1), but the difference was not statistically significant (p=0.063). Multiple visual symptoms occurred in 127/197 (64.5%) night-time users and 3/10 (30.0%) day-only users (OR 4.23; p=0.042) (Table 3).

Table 3: Unadjusted associations with night-time digital-device use

Outcome	Day only	Night or day-and-night	Effect estimate	p-value
Perceived sleep-wake disruption, n/N (%)	4/12 (33.3)	86/219 (39.3)	OR 1.29	0.770
Visual symptom count, median (IQR)	1 (1-1.75)	2 (1-2)	U=677.0	0.063
Two or more visual symptoms, n/N (%)	3/10 (30.0)	127/197 (64.5)	OR 4.23	0.042
Sleep-related/daytime-function count, median (IQR)	2 (2-2)	4 (3-5)	U=400.5	<0.001

Note. OR=odds ratio; IQR=interquartile range; U=Mann-Whitney U statistic. Fisher's exact test was used for binary outcomes. Visual checklists were missing for 3/13 day-only users and 29/226 night-time users (p=0.391). When all missing visual checklists were classified as fewer than two symptoms, the association remained statistically significant (OR 4.28; p=0.023); when all were classified as two or more symptoms, the estimate remained above one but was not significant (OR 2.60; p=0.124).

Multivariable Analysis

After adjustment, night-time use was not independently associated with perceived sleep-wake disruption (aOR 1.54, 95% CI 0.43-5.51; p=0.506). The adjusted estimate for multiple visual symptoms remained above one but was imprecise and not statistically significant (aOR 3.35, 95% CI 0.81-13.93; p=0.096). Only 10 day-only users had valid timing and visual-symptom data, contributing to the wide confidence interval

Table 4: Complete-case multivariable logistic-regression models

Outcome and predictor	aOR	95% CI	p-value	Model N
Perceived sleep-wake disruption: night-time use	1.54	0.43-5.51	0.506	220
Female sex	1.33	0.74-2.39	0.343	
Age, per year	0.92	0.82-1.04	0.191	
>6 h daily screen use	1.14	0.65-1.99	0.640	
Work in a dark room	1.40	0.80-2.43	0.236	
Refractive error	0.98	0.54-1.78	0.957	
Multiple visual symptoms: night-time use	3.35	0.81-13.93	0.096	195
Female sex	0.52	0.27-1.00	0.050	
Age, per year	1.12	0.97-1.29	0.110	
>6 h daily screen use	0.99	0.54-1.83	0.979	
Work in a dark room	1.61	0.87-2.99	0.129	
Refractive error	1.60	0.83-3.09	0.164	

Note. aOR=adjusted odds ratio; CI=confidence interval. Each model simultaneously includes all predictors shown and used complete cases.

Discussion

Principal Findings

Night-time exposure was nearly universal during COVID-19 e-learning. Night-time users reported a greater sleep-related/daytime-function symptom burden and had higher unadjusted odds of multiple visual symptoms than day-only users. However, adjusted associations were not statistically significant. The results therefore describe co-occurring exposure and symptoms and do not establish that night-time device use caused them.

Sleep-Related and Daytime-Function Complaints

The 39.1% prevalence of perceived sleep-wake disruption represents a student-health concern, although it is not directly comparable with the pooled 55.6% prevalence of poor sleep quality among medical students because the present survey used an attribution item rather than a validated sleep-quality scale (Binjabr et al., 2023). The higher symptom count among night-time users is biologically and behaviourally plausible. Evening display light may delay melatonin timing and sleep onset, while screen use may displace bedtime, sustain arousal or resume after nocturnal awakening (Chang et al., 2015; Schöllhorn et al., 2023; Liebig et al., 2026). Nevertheless, the composite measured complaints, not circadian phase or circadian-rhythm disruption. The non-significant binary sleep result is important. Only 12 day-only respondents had complete sleep data, limiting power and precision. The exposure item also did not measure clock time, duration before bed, content, brightness or nocturnal awakenings, and the outcome required participants to attribute the sleep effect to their device. These

limitations may explain why symptom counts differed while the binary attribution item did not.

Visual Symptoms

Headache and eye strain dominated the visual profile, consistent with pandemic-era studies among online learners. Ganne et al. (2021) associated digital eye strain with longer exposure, dark-room use and infrequent breaks, while Bhatnagar et al. (2024) reported eye strain in approximately half of medical students. The present study's significant unadjusted association for multiple symptoms weakened after adjustment, and the wide confidence interval reflects the very small day-only group. The direction of effect warrants confirmation but should not be presented as an independent or causal relationship.

Implications

Prevention should emphasise practical, low-risk measures: current refractive correction, adequate ambient lighting, comfortable viewing distance and posture, complete blinking, regular task breaks and reduced avoidable use near intended sleep. Institutions can avoid unnecessary late-night scheduling and include digital wellbeing in student orientation. Recommendations should not overstate commercial interventions: blue-light-filtering spectacle lenses may not reduce short-term eye strain, and evidence for sleep benefit remains uncertain (Singh et al., 2023). Break reminders may help some users, but evidence does not establish that the precise 20-20-20 schedule is uniquely effective (Talens-Estarelles et al., 2023).

Strengths and Limitations

The study assessed visual symptoms, device behaviour, perceived sleep effects and daytime function in the same population during compulsory e-learning. Strengths includeexplicit outcome definitions, valid denominators, multivariable adjustment and sensitivity analyses for missing visual responses. The integrated questionnaire also captured behaviouraland sleep domains not covered by the CVS-Q alone. The single-school non-probability sample may not represent all Nigerian medical students, and the response rate could not be calculated because the number of questionnaires distributed was unavailable. Exposures and symptoms were self-reported. The adapted questionnaire was not formally validated as a diagnostic scale, so the results do not represent CVS-Q prevalence or a diagnosed sleep disorder. The cross-sectional design precludes temporal or causal inference; the small day-only group reduced precision; and academic stress, caffeine, mental health, physical activity and chronotype were not measured.

Conclusion

During COVID-19 e-learning, visual, sleep-related and daytime-function complaints were common among medical students in Enugu. Students reporting night or combined day-and-night screen use had a greater sleep-related/daytime-function symptom burden and higher unadjusted odds of multiple visual symptoms than day-only users. The adjusted estimates were imprecise and not statistically significant, and the study design cannot establish causation. The findings support pragmatic eye-health, ergonomic and sleep-hygiene measures

while larger multicenter prospective studies using validated instruments and objective device-timing measures test these relationships.

Recommendations

1. Medical schools should include digital eye health, ergonomics and sleep hygiene in student orientation and health programmes.
2. Students should reduce non-essential device use near intended sleep and avoid returning to screens after nocturnal awakening where feasible.
3. Online timetables and deadlines should minimise avoidable late-night screen dependence and allow breaks during prolonged sessions.
4. Students should use adequate ambient lighting, appropriate viewing distance and posture, regular task breaks and deliberate complete blinking.
5. Persistent eye strain, headache, blur or diplopia should prompt an eye examination, including refraction and assessment of the ocular surface and binocular vision.
6. Institutions should not present blue-light-filtering spectacles as a proven universal remedy.
7. Future studies should use longitudinal or intervention designs, objective device logs, validated digital-eye-strain and sleep instruments, chronotype and mental-health measures, and adequate low-exposure comparison groups.

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Conflict of Interest

The authors declare no conflict of interest.

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