ORIGINAL ARTICLE e-ISSN: 2349-0659 p-ISSN; 2350-0964

Prevalence of Computer Vision Syndrome and its Association with Sleep Quality among Undergraduate Medical Students: A Cross-Sectional Study

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Abstract

Background: Computer vision syndrome (CVS), also referred to as digital eye strain, comprises a broad range of visual, ocular-surface, and extraocular symptoms associated with prolonged use of digital screens. Medical students may be particularly vulnerable because digital devices are integral to academic learning, communication, and leisure. Sleep is another potentially relevant dimension because evening exposure to light-emitting screens may influence circadian timing and sleep. **Objectives:** To determine the prevalence of CVS among undergraduate medical students, describe the distribution of visual, ocular-surface, and extraocular symptoms, assess awareness and screen exposure, and evaluate the association between CVS and sleep quality. **Materials and Methods:** A cross-sectional questionnaire-based study was conducted among 321 undergraduate medical students. CVS was operationally defined as the presence of at least one reported symptom in the visual, ocular-surface, or extraocular symptom domains in relation to digital screen use. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). Descriptive statistics were used for participant characteristics and symptom profiles. The association between CVS and poor sleep quality (PSQI >5) was assessed using Pearson's Chi-square test and odds ratios with 95% confidence intervals. PSQI scores between students with and without CVS were compared using the Mann–Whitney U test. **Results:** CVS was identified in 288 of 321 participants (89.7%). Visual complaints were reported by 237/321 (73.8%), ocular-surface complaints by 199/318 (62.6%), and extraocular complaints by 238/319 (74.6%). Most students (263/321, 81.9%) reported at least 2 h of daily screen exposure, whereas only 103 (32.1%) had previously heard of CVS. The mean self-rated knowledge score was 2.04/10. Complete PSQI scores could be derived for 274 participants; 132 (48.2%) had poor sleep quality. Poor sleep was significantly more frequent among students with CVS than among those without CVS (51.4% vs. 18.5%; $\chi^2 = 9.27$, $P = 0.002$; odds ratio = 4.66, 95% confidence interval 1.71–12.69). The median PSQI score was also higher among students with CVS (6 vs. 3; U = 4990.5, $P < 0.001$). **Conclusion:** CVS was highly prevalent in this cohort, whereas awareness of the condition was low despite substantial daily screen exposure. Students with CVS had significantly poorer sleep quality than those without CVS. Incorporating digital eye-strain education, ergonomic measures, regular screen breaks, and sleep-hygiene counseling into undergraduate medical education may be beneficial.

Keywords: Computer vision syndrome, Digital eye strain, Medical students, Pittsburgh sleep quality index, Screen exposure, Sleep quality, Undergraduate medical education

Asian Pac. J. Health Sci., (2026); DOI: 10.21276/apjhs.2026.13.4.29

Introduction

Digital technology has become an integral component of contemporary education. Medical students increasingly depend on smartphones, tablets, and computers for accessing textbooks, lecture material, question banks, online classes, communication, and recreational activities. Prolonged digital-device use is associated with a constellation of visual and ocular complaints commonly described as computer vision syndrome (CVS) or digital eye strain. These may include eye strain, blurred vision, headache, ocular discomfort, dryness, burning, tearing, and musculoskeletal symptoms.[1,2]

The mechanisms underlying digital eye strain are multifactorial. Sustained near-work demands on accommodation and vergence, whereas reduced blink frequency during screen viewing may contribute to tear-film instability and ocular-surface symptoms. Environmental factors such as glare, poor illumination, inappropriate viewing distance, and suboptimal workstation arrangement can further aggravate symptoms.[1,3,4]

The reported prevalence of CVS varies substantially because studies use different symptom definitions, questionnaires, and thresholds. A recent systematic review and meta-analysis involving more than 66,000 participants estimated an overall prevalence of 69.0%, with a pooled prevalence of 76.1% among university students.[5] Another systematic review reported a pooled prevalence of 66%, whereas female sex, prolonged visual-display-terminal exposure, inadequate breaks, and poor ergonomic practices were among factors associated with higher risk.[6] Studies among Indian medical students have also demonstrated

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How to cite this article: Kumar KN, Panchakshari PK, Banavath S, Jalily QA. Prevalence of Computer Vision Syndrome and its Association with Sleep Quality among Undergraduate Medical Students: A Cross-Sectional Study. Asian Pac. J. Health Sci., 2026;13(4):133-139.

Source of support: Nil.

Conflicts of interest: None.

Received: 01/10/2026 **Revised:** 18/10/2026 **Accepted:** 28/10/2026

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substantial symptom burdens; Logaraj *et al.* reported CVS in 78.6% of medical students in Chennai.[7]

Awareness does not necessarily match symptom burden. In a study of medical students, Patil *et al.* found that only about one-third were aware of CVS, despite a prevalence of 77.5%, and also reported an association between CVS and poor sleep quality.[8] Other studies have similarly emphasized limited knowledge and the need for preventive education among medical students.[8-10]

Sleep is relevant because screen exposure, particularly in the evening, may interact with sleep timing and circadian physiology. Experimental work has demonstrated that evening use of light-emitting e-readers can delay circadian timing, suppress evening melatonin, and reduce next-morning alertness.[11] Although the relationship between screen exposure, CVS, and sleep is complex and cannot be assumed to be causal from cross-sectional data, the coexistence of these problems among medical students warrants investigation.

The present study therefore assessed CVS among undergraduate medical students using the symptom information collected in the study questionnaire and examined its relationship with sleep quality measured using the Pittsburgh Sleep Quality Index (PSQI). The study additionally evaluated screen exposure, awareness, and self-rated knowledge of CVS.

Materials and Methods

Study Design and Participants

A cross-sectional, questionnaire-based observational study was conducted among undergraduate medical students. The dataset comprised 321 completed responses from 1st- and 2nd-year MBBS students. Data were collected through an online questionnaire. Participation was voluntary, and responses were recorded anonymously.

Study Instrument

The questionnaire contained three broad sections. The first collected demographic information, academic year, prior awareness of CVS, and self-rated knowledge. The second assessed daily screen exposure and symptoms of CVS. Symptoms were grouped into visual complaints, ocular-surface complaints, and extraocular complaints. Participants also reported the frequency of symptoms and whether symptoms were associated with screen-use time. The third section incorporated the PSQI, a validated 19-item instrument assessing sleep over the preceding month. The PSQI generates seven component scores—subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction – and a global score ranging from 0 to 21. A global score >5 was considered indicative of poor sleep quality.[11]

Operational Definition of CVS

For the present analysis, CVS was defined as the presence of at least one reported complaint in any of the three symptom domains assessed in the questionnaire – visual, ocular-surface, or extraocular – among the symptoms recorded in relation to digital screen use. This operational definition was chosen to reflect the study questionnaire and is broader than validated questionnaire-based diagnostic thresholds. Current literature emphasizes that differences in definitions and instruments contribute substantially to variation in reported CVS prevalence.[5,12]

Data Processing and PSQI Scoring

The two study spreadsheets were reviewed, and the analysis dataset was cross-checked against the original response fields. Categorical responses were converted to numerical scores according to the response categories. The PSQI components were calculated according to the original scoring procedure. Most PSQI responses were already represented as coded component values in the analysis spreadsheet. Bedtime and waking-time responses, however, were entered as free text with variable formats. Where these entries could not be standardized sufficiently to calculate habitual sleep efficiency, the efficiency component and hence the global PSQI score were treated as missing. Complete-case PSQI analysis was therefore restricted to participants for whom all seven components could be derived.

Statistical Analysis

Categorical variables were summarized as frequencies and percentages. The mean and standard deviation were used for the self-rated knowledge score. CVS prevalence was calculated as the proportion of participants meeting the operational definition. Pearson's Chi-square test was used to examine categorical associations between CVS and poor sleep quality. The odds ratio (OR), with 95% confidence interval (CI), was calculated for poor sleep among participants with CVS compared with those without CVS. Because the PSQI is an ordinal-derived global score and its distribution was not assumed to be normal, scores were compared using the Mann–Whitney *U*-test. A two-sided $P < 0.05$ was considered statistically significant.

Ethical Considerations

The questionnaire was anonymous, and participation was voluntary. Institutional ethical approval and the relevant consent procedure should be documented by the investigators in accordance with the requirements of the institution and the target journal before submission.

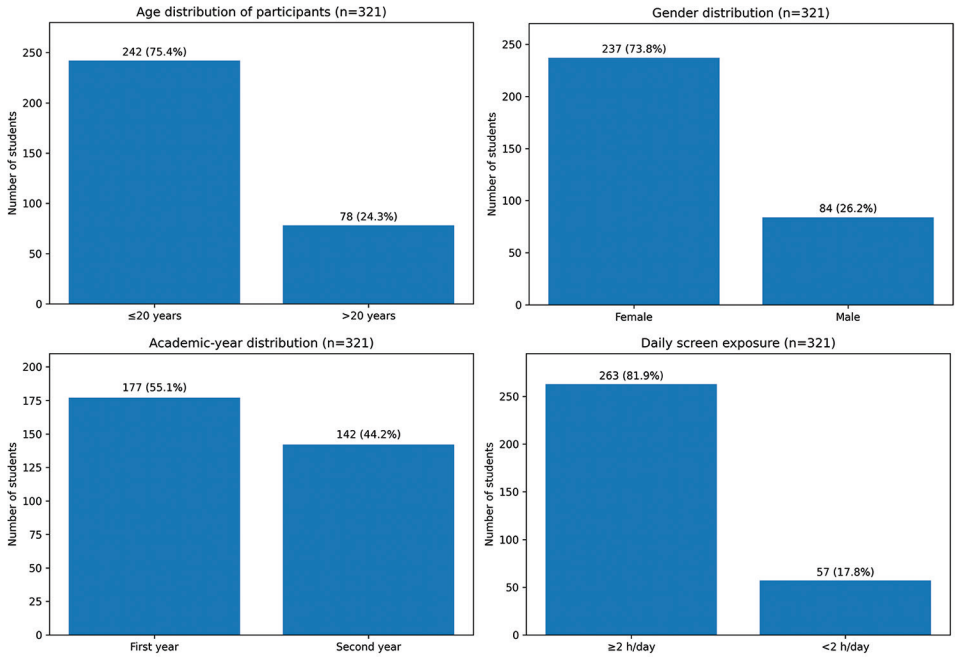
Results

Participant Characteristics

A total of 321 undergraduate medical students were included. Most participants were aged 20 years or younger (242, 75.4%), whereas 78 (24.3%) were older than 20 years, and one response was missing. Females constituted 237 (73.8%) participants and males 84 (26.2%). There were 177 (55.1%) 1st-year and 142 (44.2%) 2nd-year students, with two responses missing for the academic year (Table 1).

Screen Exposure, Awareness, and Knowledge

Daily screen exposure was substantial. At least 2 h of screen exposure per day was reported by 263 students (81.9%), compared with 57 (17.8%) who reported <2 h. Despite this level of exposure, only 103 students (32.1%) reported having heard about CVS previously, whereas 216 (67.3%) had not (Table 1). Among 317



participants who provided a numerical knowledge rating, the mean self-rated knowledge score was 2.04 ± 2.64 out of 10; the median was 0. A total of 170 students (53.6% of those with a valid knowledge response) rated their knowledge as 0, whereas only 25 (7.9%) rated it between 7 and 10.

The discrepancy between extensive screen exposure and limited awareness is notable. CVS is often under-recognized because symptoms can be transient, nonspecific, and attributed to routine academic fatigue. The finding supports the potential value of incorporating digital-eye-strain education into medical curricula.

Distribution of CVS Symptom Domains

Visual complaints were reported by 237 of 321 students (73.8%); 132 (41.1%) reported one visual complaint, and 105 (32.7%) reported two or more. Among 318 participants with complete ocular-surface responses, 199 (62.6%) reported at least one ocular-surface complaint, including 102 (32.1%) with one and 97 (30.5%) with two or more. Among 319 participants with complete extraocular responses, 238 (74.6%) reported at least one extraocular complaint, including 104 (32.6%) with one and 134 (42.0%) with two or more (Table 3).

Regarding frequency, 106 students (33.1%) described their complaints as rare, 134 (41.9%) as infrequent, and 80 (25%) as frequent; one response was missing. When asked whether complaints were associated with screen-use time, 227 (70.7%) answered sometimes, 73 (22.7%) never, and 20 (6.2%) always, with one missing response.

Prevalence of CVS

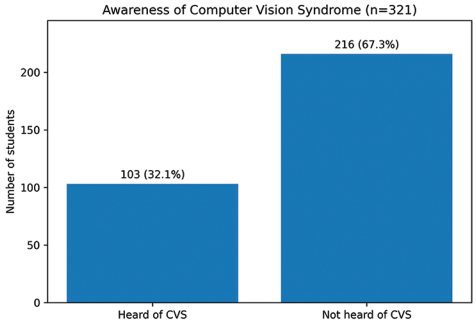
Using the study's operational definition, 288 of the 321 participants (89.7%) reported at least one symptom across the assessed visual, ocular-surface, or extraocular domains. Thirty-three participants (10.3%) reported no symptoms in the available symptom fields. CVS was more frequently reported among females than males (92.4% vs. 82.1%; $\chi^2 = 6.01$, $P = 0.014$). Prevalence did not differ significantly by academic year (88.7% in 1st year vs. 92.3% in second year; $P = 0.382$) or by daily screen exposure category (90.1% among those with ≥2 h/day vs. 87.7% among those with <2 h/day; $P = 0.765$).

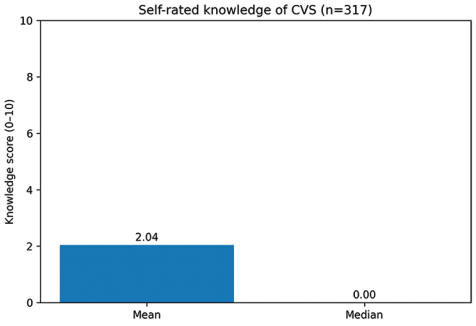
The high prevalence in this cohort is within the upper range reported in the literature, although direct comparison should be made cautiously because definitions and measurement instruments differ. A recent meta-analysis reported a pooled university-student prevalence of 76.1%, whereas individual studies have reported values approaching 97%.[5] The present estimate of 89.7% may therefore reflect both a substantial symptom burden and the broad symptom-based operational definition used in this study.[5]

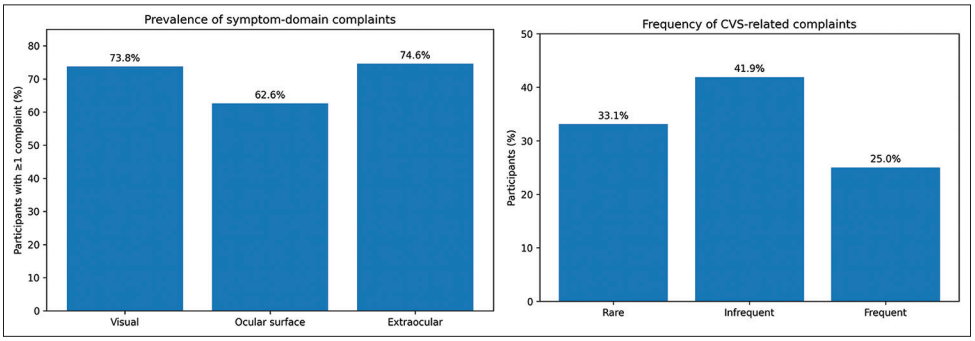
Sleep Quality and Association with CVS

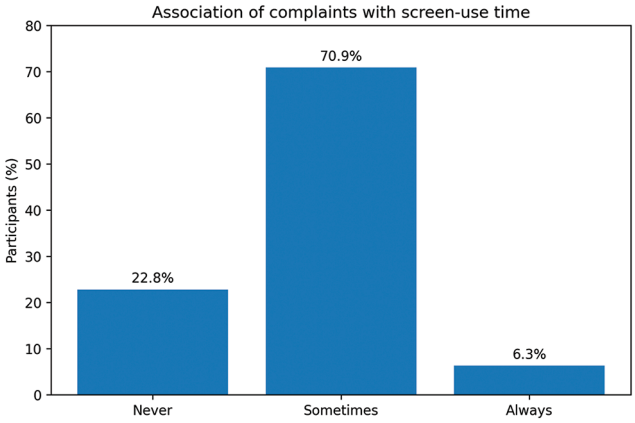
Complete global PSQI scores could be derived for 274 of the 321 participants (85.4%). The remaining 47 responses lacked sufficient information to derive all seven components, primarily because bedtime or waking-time entries were ambiguous free-text responses that could not be reliably standardized for habitual sleep-efficiency calculation. Among the 274 participants with complete PSQI scores, the mean global score was 5.75 ± 3.23, and the median was 5 (interquartile range, 4–7.75). Overall, 132 participants (48.2%) had poor sleep quality (PSQI >5), whereas 142 (51.8%) had good sleep quality.

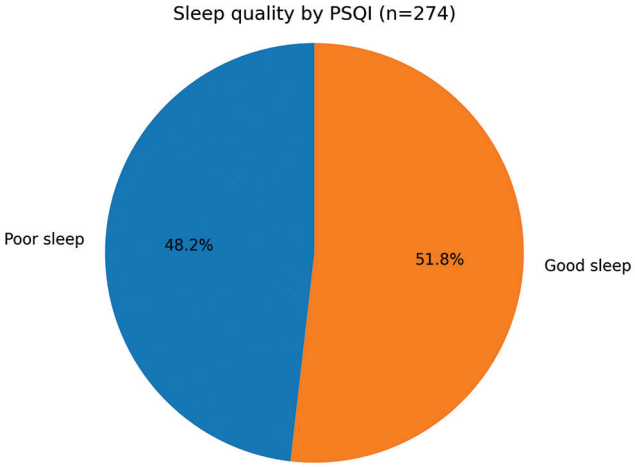
Among participants with complete PSQI data, poor sleep quality was present in 127 of 247 students with CVS (51.4%), compared with 5 of 27 students without CVS (18.5%) (Table 3). This difference was statistically significant (Pearson $\chi^2 = 9.27$, $P = 0.002$). Students with CVS had 4.66-fold higher odds of poor sleep quality than students without CVS (OR = 4.66, 95% CI 1.71–12.69).

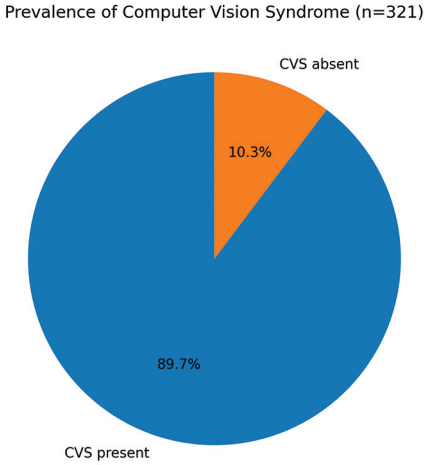








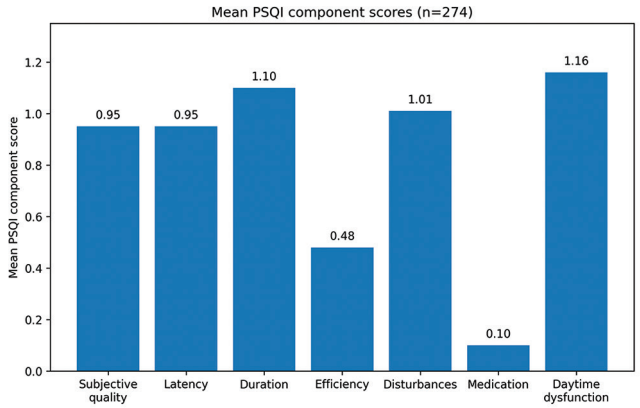


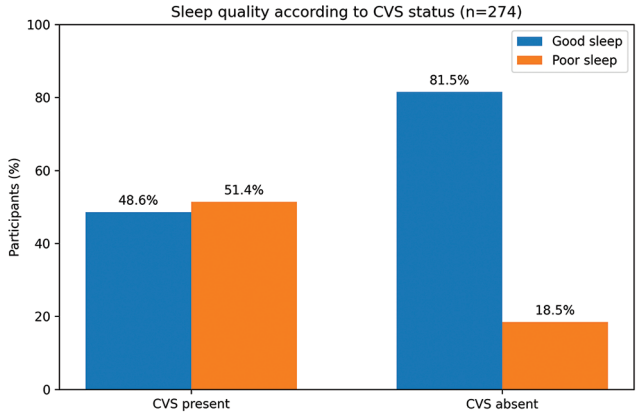


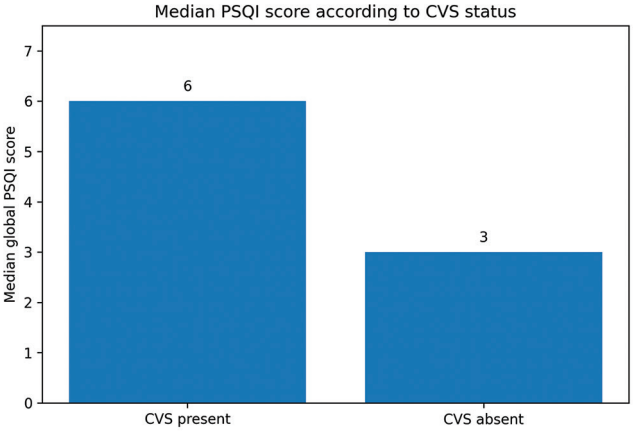
The distribution of global PSQI scores also differed between the two groups. Participants with CVS had a median PSQI score of 6 (IQR 4–8), whereas those without CVS had a median score of 3 (IQR 2–5). The Mann–Whitney U test demonstrated a statistically significant difference (U = 4990.5, $P < 0.001$).

Discussion

The principal finding of this study was the high prevalence of CVS among undergraduate medical students: 89.7% of the 321 respondents met the study's symptom-based definition. This substantial burden occurred in the context of extensive screen exposure, with more than four-fifths of participants reporting at least 2 h of daily screen use. At the same time, awareness was low; only about one-third had previously







heard of CVS, and the mean self-rated knowledge score was only 2.04 out of 10.

The prevalence observed here is higher than the pooled estimate reported in the recent systematic review by Ccami-Bernal *et al.*, which found a 69.0% overall prevalence and 76.1% among university students.[5] However, the authors of that review emphasized considerable heterogeneity and noted that prevalence varied according to the definition and instrument used. Another meta-analysis reported a pooled prevalence of 66%.[6] The present estimate should therefore not be interpreted as evidence that this population has a uniquely higher biological susceptibility. Rather, it indicates a high burden of screen-related symptoms when a broad symptom-based definition is applied.[5,6]

The findings are nevertheless consistent with earlier Indian studies. Logaraj *et al.* reported CVS in 78.6% of medical students in Chennai and found relationships between longer computer exposure and symptoms such as redness, burning, blurred vision, and dry eyes.[7] Patil *et al.* reported a prevalence of 77.5% among medical students and demonstrated that awareness was relatively limited.[8] The current study extends these observations by demonstrating that the symptom burden remains high in a cohort in which digital screen exposure is now an established component of medical education.[7,8]

The distribution of symptom domains provides additional context. Extraocular complaints were reported by 74.6% of participants with complete responses, visual complaints by 73.8%, and ocular-surface complaints by 62.6%. The prominence of extraocular symptoms is compatible with the broader concept of digital eye strain, which encompasses headache, neck and shoulder discomfort, and other musculoskeletal symptoms in addition to ocular complaints.[4] Ocular-surface symptoms are also biologically plausible because prolonged screen viewing is associated with reduced and incomplete blinking and increased ocular-surface stress.[4]

One important finding was the low level of awareness despite extensive screen exposure. Two-thirds of students had never heard of CVS, and more than half of those who rated their knowledge gave a score of zero. This suggests that students may recognize individual symptoms without understanding their potential relationship to digital-device use. Awareness alone does not prevent symptoms, but education can facilitate early recognition and encourage practical measures such as regular breaks, appropriate viewing distance, adequate lighting, and ergonomic positioning.[2,4,9]

The association with sleep quality was particularly noteworthy. In the complete-case PSQI analysis, poor sleep quality was present in 51.4% of students with CVS compared with 18.5% of students without CVS. The odds of poor sleep were approximately 4.7 times higher among students with CVS, and the global PSQI score was significantly higher in the CVS group. These findings are compatible with the earlier study by Patil *et al.*, which also identified poorer sleep quality among medical students with CVS.[8] They are biologically plausible because evening exposure to light-emitting screens can affect circadian timing and sleep physiology.[8,11]

The sleep findings should, however, be interpreted as an association rather than evidence of causation. CVS and poor sleep may share common determinants, including prolonged screen use, late-night studying, academic workload, and sedentary behavior. Conversely, students with poor sleep may spend more time on screens or perceive symptoms more strongly. Because the present study is cross-sectional, temporal direction cannot be established.

The high proportion of poor sleepers in the complete-case analysis also differs from the preliminary descriptive figure contained in the original study abstract. The present manuscript uses the raw questionnaire responses and the PSQI component structure to derive the global score, while excluding records in which free-text bedtime or waking-time information was insufficient to calculate all components. This approach provides a reproducible analysis of the available dataset and avoids presenting a statistic that cannot be traced to the underlying responses.

Table 1: Sociodemographic characteristics, screen exposure and awareness of CVS (*n*=321)

Characteristic	*n*	*%*
Age ≤20 years	242	75.4
Age >20 years	78	24.3
Female	237	73.8
Male	84	26.2
First year	177	55.1
Second year	142	44.2
Daily screen exposure ≥2 h	263	81.9
Daily screen exposure <2 h	57	17.8
Previously heard of CVS: Yes	103	32.1
Previously heard of CVS: No	216	67.3

CVS: Computer vision syndrome

Table 2: Distribution of participant-reported CVS symptom domains

Symptom domain	*None, n (%)*	*One, n (%)*	*≥2, n (%)*	*Any complaint, n (%)*
Visual (*n*=321)	84 (26.2)	132 (41.1)	105 (32.7)	237 (73.8)
Ocular surface (*n*=318)	119 (37.4)	102 (32.1)	97 (30.5)	199 (62.6)
Extraocular (*n*=319)	81 (25.4)	104 (32.6)	134 (42.0)	238 (74.6)

CVS: Computer vision syndrome

Table 3: Association between CVS and poor sleep quality among participants with complete PSQI data

CVS status	*Good sleep, n (%)*	*Poor sleep, n (%)*	*Total*
CVS present	120 (48.6)	127 (51.4)	247
CVS absent	22 (81.5)	5 (18.5)	27
Total	142 (51.8)	132 (48.2)	274

Pearson χ^2=9.27; *P*=0.002; OR=4.66 (95% CI 1.71–12.69). CVS: Computer vision syndrome, PSQI: Pittsburgh Sleep Quality Index

The lack of a statistically significant relationship between CVS and the broad daily screen-exposure categories is also informative. Although 81.9% reported at least 2 h of daily screen exposure, CVS prevalence was already high in the <2-h group. This may reflect the fact that duration alone does not capture intensity of near work, continuous viewing without breaks, device type, viewing distance, brightness, glare, posture, refractive status, or environmental conditions. Systematic-review evidence suggests that several of these ergonomic and behavioral factors contribute to CVS risk.[6,12]

The observed female predominance also warrants consideration. CVS prevalence was 92.4% among female students compared with 82.1% among male students. A recent meta-analysis found higher prevalence among women, although heterogeneity between studies was substantial. Sex differences may reflect differences in screen-use patterns, symptom reporting, ocular-surface factors, or other unmeasured variables. The current study was not designed to determine the mechanism, and the gender association should therefore be regarded as exploratory.[5]

From an educational and public-health perspective, the findings support a low-cost preventive strategy. Medical colleges can incorporate brief digital eye-health education into orientation and student wellness programs. Practical measures include scheduled breaks during prolonged near work, appropriate screen distance and height, reduction of glare, adequate ambient illumination, attention to blink frequency, and management of refractive or ocular-surface problems. Because sleep quality was also worse among students with CVS, sleep-hygiene counseling and avoidance of prolonged screen exposure immediately before bedtime may be reasonable components of a broader intervention. These measures should complement, rather than replace, individual ophthalmic assessment when symptoms are persistent or severe.

Strengths

The study included 321 undergraduate medical students and assessed multiple dimensions of screen-related symptoms rather than relying on a single complaint. It also examined awareness, self-rated knowledge, screen exposure, and sleep quality in the same cohort. The use of the PSQI provides a recognized framework for assessing multiple aspects of sleep quality.[13] A further strength of the present re-analysis is that the reported CVS prevalence and sleep statistics were derived directly from the underlying study dataset rather than reproduced from an unverified summary.

Limitations

Several limitations should be considered. First, the cross-sectional design prevents conclusions regarding causality or temporal direction between CVS and poor sleep. Second, CVS was defined using a broad symptom-based operational definition rather than a validated instrument such as the CVS Questionnaire.[14] Consequently, the prevalence estimate may not be directly comparable with studies using validated thresholds. Third, symptom information was self-reported and may be affected by recall and reporting bias. Fourth, the dataset included free-text bedtime and waking-time responses with inconsistent formatting; consequently, complete PSQI analysis was possible for 274 participants rather than all 321 respondents. Fifth, the study did not systematically record several potentially important determinants of CVS, including refractive error, contact-lens use, exact device type, viewing distance, lighting, blink behavior, frequency of screen breaks, and ergonomic practices. Finally, the study population was drawn from a limited academic setting and included predominantly 1st- and 2nd-year students, which may limit generalizability.

Conclusion

CVS was highly prevalent among the undergraduate medical students studied, affecting 89.7% of participants according to the study's symptom-based operational definition. Visual, ocular-surface, and extraocular complaints were common, whereas awareness and self-rated knowledge regarding CVS were low despite extensive daily screen exposure. Among participants with complete PSQI data, poor sleep quality was significantly more common in students with CVS, and their global PSQI scores were higher. The findings support the integration of digital-eye-health education, ergonomic counseling, regular screen breaks, and sleep-hygiene measures into undergraduate medical education. Future multicenter studies using validated CVS instruments and standardized PSQI data collection are needed to establish more precise prevalence estimates and clarify the temporal relationship between digital eye strain and sleep disturbance.

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