Association of screen time, quality of sleep and dry eye in college-going women of Northern India

Parul Chawla Gupta, Minakshi Rana, Mamta Ratti, Mona Duggal, Aniruddha Agarwal, Surbhi Khurana, Deepak Jugran, Nisha Bhargava, Jagat Ram

Purpose: To evaluate the association of daily screen time and quality of sleep with the prevalence of dry eye among college-going women. Methods: This study was a cross-sectional, comparative questionnaire-based study of 547 college-going women in northern India. A 10-item Mini Sleep Questionnaire was used to check the quality of sleep, and the Standard Patient Evaluation of Eye Dryness (SPEED) scale was used to examine the prevalence of dry eye among college-going women. Results: Multinomial logistic regression showed a significant association between dry eye with daily screen time spent ($P < 0.05$) and the quality of sleep ($P < 0.05$) among college-going girls. Using Latent Class Analysis, two latent classes were selected based on the Bayesian Information Criteria. It was found that the majority population falls in class two and was having Severe Sleep-Wake difficulty. It was seen that the participants in class two belonged to the age bracket of 18–21 years, were from stream Humanities, education of father and mother equal to graduation, father working only, belonging to the nuclear family, having one sibling, hailing from the urban locality, spending more than 6 h daily on-screen, a majority of them using mobile phones, not using eye lubricants, and reported an increase in screen time during COVID-19. Conclusion: Dry eye and sleep quality are essential global health issues, and coupled with increased screen time, may pose a challenge in the present era. Preventive strategies need to be incorporated in school and college curriculums to promote physical, social, and psychological well-being and quality of life.

Key words: Computer vision syndrome, digital eye strain, Latent Class Analysis, Mini Sleep Questionnaire, SPEED questionnaire

Computer vision syndrome has a prevalence of more than 50% among computer users.$[1]$ An increase in websites and societal groups has enticed the youth to devote additional time to digital devices or computer monitor screens. Online education and entertainment platforms for gaming and movies are prevalent since the last decade. Consequently, there has been a constant upsurge in screen time for the youth in many countries.$[1]$ Several studies in the past have found an association between increased multimedia exposure and health issues. While there is substantial public understanding of the harmful effects of cellphone radiation, society is less aware of the additional consequences of increased screen time on well-being, leading to stress on the visual and musculoskeletal system, besides leading to circadian rhythm disturbances.

Circadian rhythm disturbances are due to the blue light emitted by these devices and the electromagnetic fields they produce.$[5]$ Blue light leads to melatonin suppression which is a facilitator of sleep.$[3,4]$ Computer-associated symptoms have been divided into two groups: those associated with the accommodation (blurring of vision while refocusing, headache, eye strain) and those linked to dry eyes (burning, grittiness, tearing, and dryness).$[5]$ Dry eye from digital media use is produced due to decreased and incomplete blinks leading to an unstable tear film.$[8]$ Digital device use has increased during the COVID-19 pandemic as people were compelled to stay homebound, especially during nationwide lockdowns, to safeguard themselves from the deadly virus.$[7]$ The main objective of this survey was to examine the association of daily screen time and the quality of sleep with the prevalence of dry eye among college-going women. Women were chosen as respondents in our study due to the higher prevalence of dry eye disease in females.$[7–11]$ Methods

The study was an exploratory and cross-sectional, comparative questionnaire-based study. The study was approved by the
Institutional Ethics Committee and adhered to the tenets of the Helsinki Declaration. A pre-structured and pre-validated questionnaire was used to collect information on the prevalence of dry eye and quality of sleep. With the help of the snowball technique, the primary respondents, i.e., college-going girls in northern India, were contacted. The questionnaire was transcribed into a Google Form and provided to the participants through WhatsApp or Email. The survey was reported according to the Checklist for Reporting of Internet E-surveys (CHERRIES).[13] Informed consent was obtained from the participants preceding the study. Anonymity and confidentiality were maintained throughout the study. A 10-item Mini Sleep Questionnaire was used to check the quality of sleep,[13] and the Standard Patient Evaluation of Eye Dryness (SPEED)[14] dry eye scale was used to examine the prevalence of dry eye among college-going women. A few general questions were asked to review the screen time of the respondents. The reliability/consistency of the questionnaire was checked using Cronbach alpha for the Mini Sleep Scale and dry eye scale, the Cronbach alpha was found to be 0.780 and 0.867, respectively, which indicates a good internal consistency and reliability. Hair et al. 2006[15] proposed that Cronbach alpha coefficient of 0.6 is acceptable, and it indicates internal reliability and consistency.

The questionnaire contains five domains

**Demographic domain:** This consisted of the demographic and socioeconomic details of the participants, namely age (18–21, 22–26, and 27–30 years); stream (Humanities, Science, and Commerce); education pursued to date (up to 12th, under graduation, post-graduation); education of the father (illiterate, up to 10th, up to 12th, graduate, post-graduate, doctorate/any other); education of the mother (illiterate, up to 10th, up to 12th, graduate, post-graduate, doctorate/any other); working status of parents (both working, only father working, only mother working); type of family (joint, nuclear [only parents and child]); the number of sibling(s) in the family (1, 2, 3, and more than 3); place of residence (urban, rural).

**General question domain:** This consisted of the following questions: Your daily screen time in the number of hours (0–2 h, 2–4 h, 4–6 h, and more than 6 h); Device on which maximum time spent (television, laptop/desktop, mobile phone and tablet/iPad); Mention the purpose of use of screen most of the time (social media, studies, movies, and gaming); Has your screen time increased during the COVID-19 pandemic? (Yes and No); If Yes, then by how much? (25, 25–50, 50–75, and 75–100%); Do you use eye drops for lubrication? (Yes and No).

**Sleep-Wake Domain:** The Mini Sleep Questionnaire consists of 10 items based on the 7-Point Likert Scale: difficulty falling asleep, waking up too early, hypnotic medication use, falling asleep during the day, feeling tired upon waking up in the morning, snoring, mid-sleep awakenings, headaches on awakening, excessive daytime sleepiness, excessive movement during sleep.

**Dry Eye Domain:** This domain consisted of the following items based on the SPEED questionnaire: frequency and severity of dryness, grittiness, or scratchiness, soreness or irritation, burning or watering, and eye fatigue symptoms.

**Creation of categories based on the grading of responses to the Sleep-Wake Domain and Dry Eye Domain**

The responses to the Sleep-Wake Domain and Dry Eye Domain were graded to give a higher score for the options indicating more Sleep-Wake problems and frequency and severity of dry symptoms.

For each respondent, the sum of the responses for each domain was added and divided into categories. For the Sleep-Wake Domain, the respondents were divided into four categories:[15] 10–24 points for Good Sleep-Wake quality; 25–27 points for mild Sleep-Wake difficulties; 28–30 points for moderate Sleep-Wake difficulties; and >30 points for Severe Sleep-Wake difficulties. For the Dry Eye Domain, based on the score of the items on severity and frequency of the dry eye symptoms, the respondents were divided into three categories[14,17]: 0–5 (no symptoms), 6–14 (mild to moderate symptoms), and 15–28 (severe symptoms).

**Development of dry eye assessment model**

We established a multinomial logistic regression model for the prediction of the association of dry eye with daily screen time spent and the quality of sleep following the methodology described in the statistical analysis of the study.

**Development of latent class models to identify the hidden cohort**

We followed the methodology of the development of latent class described by Kumar-M et al.[18] It consisted of five steps: (1) selection of questions based on univariate analysis; (2) removal of questions with overlapping context; (3) addition of the selected questions to develop latent class model; (4) back exploration of the established latent class model for understanding the demographic pattern of the developed latent class model; (5) repetition of the process till a distinctive pattern is obtained.[18] Further, the number of hidden classes was identified after assessing the model diagnostics of the different number of classes. The Bayesian Information Criteria (BIC) was utilized for appraisal. The smaller the BIC, the superior the model.

**Statistical analysis**

A total of 547 respondents participated in the study. The data were recorded into an Excel sheet and analyzed using SPSS Version 20 and R version 4.0.4. In addition to the base package, the additional package used was gtsmummery,[19] plyr,[20] readxl,[21] and poLCA[22] for conducting the Latent Class Analysis. The categorical variables were defined using frequencies along with percentages. For the evaluation of continuous variables between more than two groups, the Analysis of Variance was used, and for the comparison of categorical variables, the Chi-square test of association/Fisher’s exact test was used. A P value of less than 0.05 was considered statistically significant for all the tests.

**Results**

In the present study, a total of 547 college-going girls in northern India agreed to participate. The overall demographic profile of the participants is shown in Table 1. The major characteristics of the participants were ages between 18 and 21 years (81.4%), a majority of the participants were from the Humanities stream (63.4%), studied up to graduation (79.7%), the education of father equal to graduation (36.9%), the education of mother equal to graduation (34.4%), having one sibling (57.4%), only father working (68.7%), hailing from the urban locality (79.7%), belonging to the nuclear family (60.3%), spending more than 6 h daily on-screen (45.5%).
Among the demographic factors for the Sleep-Wake Domain, education of father, place of residence, and the number of hours daily spent on-screen came as significant predictors in the univariate analysis. Similarly, among the demographic factors for the dry eye domain, the education of the father and the number of hours daily spent on-screen came as significant predictors in the univariate analysis.

The questionnaire provided to the girls is given in Supplementary Table 1, and the summary of the responses for individual questions for Sleep-Wake and dry eye domain are presented in Supplementary Table 2. The univariate analysis of the responses based on the Good Sleep-Wake quality, Mild Sleep-Wake difficulty, Moderate Sleep-Wake difficulty, Severe Sleep-Wake difficulty in the Sleep-Wake Domain and no symptoms, mild to moderate symptoms, severe symptoms in the dry eyes domain are shown in Table 2.

Multinomial logistic regression was applied for the prediction of the association of the dry eye with the daily screen time spent and the quality of sleep among the respondents. As per the results, there was a significant association between dry eye with the daily screen time spent ($P$ value = 0.00 <0.05) and the quality of sleep/Sleep-Wake ($P$ value = 0.00 <0.05) among college-going women. Further, the power of the logistic multinomial model developed in the study was 58.86% of the
known observations and can be likely to design forthcoming estimations [Table 3].

With the help of the Latent Class Analysis, two latent classes were selected based on the BIC, where there was a significant difference between the two classes based on the Sleep-Wake Domain (having Good Sleep-wake quality, Mild Sleep-Wake difficulty, Moderate Sleep-Wake difficulty, Severe Sleep-Wake difficulty) [Table 4]. Further, it was found that the majority of the population falls in class two and was having Severe Sleep-Wake difficulty. On further exploring the characteristics between the two classes, it was found that the participants in class two

| Table 2: Description of responses for General Domain and comparison of responses between Sleep-Wake Domain and Dry Eyes Domain |
|---------------------------------|-----------------|-----------------|-----------------|
| **Statements**                  | **Responses**   | **Overall**     | **Sleep-Wake Domain P** | **Dry Eyes Domain P** |
| --------------------------------|-----------------|-----------------|--------------------------|------------------------|
| **Count=547**                   |                 | **Percent**     | **0.7844** Fisher's exact test | **0.01053** Fisher's exact test |
| **Device on which maximum time spent** | Television      | 17 3.10%       |                           |                         |
|                                 | Laptop/Desktop  | 97 17.70%      |                           |                         |
|                                 | Mobile Phone    | 425 77.70%     |                           |                         |
|                                 | Tablet/iPad     | 8 1.50%        |                           |                         |
| **Purpose**                     | Social media    | 160 29.30%     |                           |                         |
|                                 | Studies         | 333 60.90%     |                           |                         |
|                                 | Movies          | 38 6.90%       |                           |                         |
|                                 | Gaming          | 16 2.90%       |                           |                         |
| **Increase in screen time**     | No              | 30 5.50%       |                           |                         |
|                                 | Yes             | 517 94.50%     |                           |                         |
| **How much increase**           | 25%             | 58 11.20%      |                           |                         |
|                                 | 25-50%          | 153 29.70%     |                           |                         |
|                                 | 50-75%          | 222 43.00%     |                           |                         |
|                                 | 75-100%         | 83 16.10%      |                           |                         |
| **Use of eye drops**            | No              | 449 82.10%     |                           |                         |
|                                 | Yes             | 98 17.90%      |                           |                         |
| **Dry eyes system reported**    | No symptom reported | 70 12.80%  | **0.000** Fisher's exact test | **0.000** Fisher's exact test |
|                                 | Symptoms reported | 477 87.20%  |                           |                         |
| **Sleep-wake**                  | Good Sleep-Wake quality | 110 20.1%   |                           |                         |
|                                 | Mild Sleep-Wake difficulty | 48 8.8%    |                           |                         |
|                                 | Moderate Sleep-Wake difficulty | 55 10.1% |                           |                         |
|                                 | Severe Sleep-Wake difficulty | 334 61.1% |                           |                         |
| **Dry eye**                     | Mild dry eye    | 130 23.8%      |                           |                         |
|                                 | Moderate dry eye | 94 17.2%      |                           |                         |
|                                 | Severe dry eye  | 323 59.0%      |                           |                         |

*Statistics presented: n (%). **Statistical tests performed: Chi-square test of independence; Fisher’s exact test

| Table 3a: Association of dry eye with number of hours spent on screen and quality of sleep (sleep-wake) |
|---------------------------------|-----------------|-----------------|-----------------|
| **Effect**                      | **Model Fitting Criteria** | **Likelihood Ratio Tests** |
|                                 | **-2 Log Likelihood of Reduced Model** | **Chi-square** | **df** | **Sig.** |
|                                 |                             | **0.000** | 0 | 0.000 |
| No. of hours daily time         | 136.908                    | 17.189   | 2 | 0.000 |
| Sleep-wake                      | 188.741                    | 69.021   | 6 | 0.000 |

| Table 3b: Classification of dry eye based on the developed regression model |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| **Observed**                    | **Predicted**   | **Percent Correct** |
|                                 | No Symptoms | Mild to Moderate Symptoms | Severe Symptoms |   |
| No symptoms                     | 127         | 91                 | 0               | 58.3%           |
| Mild to moderate symptoms       | 63          | 195                | 0               | 75.6%           |
| Severe symptoms                 | 6           | 65                 | 0               | 0.0%            |
| Overall percentage              | 35.8%       | 64.2%              | 0               | 58.9%           |
Table 4: Descriptive characteristics of the selected model

| Characteristics                  | Class 1* |          | Class 2* |          | $P^{**}$          |
|----------------------------------|----------|----------|----------|----------|-------------------|
|                                  | Count=267| Percent  | Count=280| Percent  |                   |
| **Age**                          |          |          |          |          |                   |
| 18‑21 years                      | 206      | 77.15    | 239      | 85.36    | 0.02536 Fisher's exact test |
| 22‑26 years                      | 59       | 22.1     | 40       | 14.29    |                   |
| 27‑30 years                      | 2        | 0.749    | 1        | 0.357    |                   |
| **Stream**                       |          |          |          |          |                   |
| Humanities                       | 164      | 61.42    | 183      | 65.36    | 0.01005           |
| Sciences                         | 46       | 17.23    | 63       | 22.5     |                   |
| Commerce                         | 57       | 21.35    | 34       | 12.14    |                   |
| **Class**                        |          |          |          |          |                   |
| Up to 12th                       | 2        | 0.749    | 3        | 1.071    | 0.697             |
| Graduate                         | 210      | 78.65    | 226      | 80.71    |                   |
| Post-graduate                    | 55       | 20.6     | 51       | 18.21    |                   |
| **Education of father**          |          |          |          |          |                   |
| Illiterate                       | 10       | 3.745    | 1        | 0.357    | 0.00              |
| Up to 10th                       | 37       | 13.86    | 0        | 0        |                   |
| Up to 12th                       | 94       | 35.21    | 2        | 0.714    |                   |
| Graduate                         | 113      | 42.32    | 89       | 31.79    |                   |
| Post-graduate                    | 12       | 4.494    | 142      | 50.71    |                   |
| Doctorate/any other              | 1        | 0.375    | 46       | 16.43    |                   |
| **Education of mother**          |          |          |          |          |                   |
| Illiterate                       | 17       | 6.367    | 0        | 0        | 0.00              |
| Up to 10th                       | 56       | 20.97    | 0        | 0        |                   |
| Up to 12th                       | 98       | 36.7     | 5        | 1.786    |                   |
| Graduate                         | 90       | 33.71    | 98       | 35       |                   |
| Post-graduate                    | 6        | 2.247    | 151      | 53.93    |                   |
| Doctorate/any other              | 0        | 0        | 26       | 9.286    |                   |
| **Working status of parents**    |          |          |          |          |                   |
| Both working                     | 28       | 10.49    | 132      | 47.14    | 0.00              |
| Only father working              | 233      | 87.27    | 143      | 51.07    |                   |
| Only mother working              | 6        | 2.247    | 5        | 1.786    |                   |
| **Type of family**               |          |          |          |          |                   |
| Joint                            | 129      | 48.31    | 88       | 31.43    | 0.00              |
| Nuclear (only parents and child) | 138      | 51.69    | 192      | 68.57    |                   |
| **No of siblings**               |          |          |          |          |                   |
| 1                                | 119      | 44.57    | 195      | 69.64    | 0.00              |
| 2                                | 88       | 32.96    | 64       | 22.86    |                   |
| 3                                | 42       | 15.73    | 18       | 6.429    |                   |
| More                             | 18       | 6.742    | 3        | 1.071    |                   |
| **Place of residence**           |          |          |          |          |                   |
| Urban                            | 178      | 66.67    | 258      | 92.14    | 0.00              |
| Rural                            | 89       | 33.33    | 22       | 7.857    |                   |
| **No of hours daily time**       |          |          |          |          |                   |
| 0‑2 h                            | 15       | 5.618    | 6        | 2.143    | 0.001841          |
| 2‑4 h                            | 58       | 21.72    | 37       | 13.21    |                   |
| 4‑6 h                            | 90       | 33.71    | 92       | 32.86    |                   |
| More than 6 h                    | 104      | 38.95    | 145      | 51.79    |                   |
| **Device on which maximum time spent** |    |          |          |          |                   |
| Television                       | 13       | 4.869    | 4        | 1.429    | 0.00              |
| Laptop/Desktop                   | 30       | 11.24    | 67       | 23.93    |                   |
| Mobile Phone                     | 224      | 83.9     | 201      | 71.79    |                   |
| Tablet/iPad                      | 0        | 0        | 8        | 2.857    |                   |
| **Purpose**                      |          |          |          |          |                   |
| Social media                     | 82       | 30.71    | 78       | 27.86    | 0.07754           |
| Studies                          | 161      | 60.3     | 172      | 61.43    |                   |
| Movies                           | 21       | 7.865    | 17       | 6.071    |                   |
| Gaming                           | 3        | 1.124    | 13       | 4.643    |                   |
| **Increase in screen time**      |          |          |          |          |                   |
| No                               | 22       | 8.24     | 8        | 2.857    | 0.009996          |
| Yes                              | 245      | 91.76    | 272      | 97.14    |                   |
| **Use of eye drops**             |          |          |          |          |                   |
| No                               | 230      | 86.14    | 219      | 78.21    | 0.02115           |
| Yes                              | 37       | 13.86    | 61       | 21.79    |                   |

Contd...
belonged to the age bracket of 18–21 years, a majority of them were from the Humanities stream, education of father and mother equal to graduation, only father working, belonging to the nuclear family, having one sibling, hailing from the urban locality, spending more than 6 h daily on-screen, a majority of them using mobile phones, not using eye lubricants, and reported an increase in screen time during COVID-19.

Discussion

Increased digital device use for professional and social causes is considered a new normal these days. Studies have documented that odds of an unhealthy lifestyle and subjective complaints increase with the use of electronic media beyond 1 h.[23] These ill effects on the health/lifestyle include depression and anxiety,[24] sedentary behavior and obesity,[25] headache, neck/shoulder pain, backache,[1,26,27] shorter sleep duration,[24] and dry eye.[27]

In our study, out of the 547 total respondents, 425 respondents (77.7%) were spending maximum time on mobile phones, and out of these, 47.06% of the respondents were facing mild-moderate dry eye symptoms. The purpose of screen use for 60.9% of the total respondents was studying. However, 66.37% of these respondents were facing Severe Sleep-Wake difficulties. Moreover, 94.5% of the participants mentioned that their screen time had increased during the COVID-19 pandemic, and out of these, 63.24% reported Severe Sleep-Wake difficulties, and 48.16% were having mild-moderate dry eye symptoms. In a recent review, 90% of the studies found an association between screen use and late bedtime and/or diminished total sleep time.[26] The prevalence of poor sleep quality was 37.94% among 5,233 Chinese college students in another study. High screen time and less physical activity were significantly associated with suboptimal physiological, psychological/mental, social health, and poor sleep quality.[29,30] A greater screen time has been significantly associated with an increased dietary intake of sugary drinks, fast foods, and bakery items.[31]

In our study, for 43% of the participants, the screen time had reportedly increased during COVID-19 by 50–75%. Bahkir et al.[7] reported an average increase of screen time by 5 h during the pandemic in 51.1% of their study respondents.

Further, in our analysis, 87.2% of the participants mentioned dry eye symptoms, and out of these, 53.24 and 14.46% were facing mild/moderate dry eyes and severe dry symptoms, respectively. In another study, 94 medical students using smartphones for over a year and without pre-existing dry eye disease or ocular surface pathology were included. A statistically significant escalation in the dry eye disease symptom score and the prevalence of computer vision syndrome symptoms with increasing duration of use and daily exposure to smartphones was found.[32]

Most importantly, 65.61% of the women who reported dry eye symptoms had Severe Sleep-Wake difficulties. In some studies, it is anticipated that more than 40% of people with dry eye have sleep disorders.[33,34] In a questionnaire-based study of 3,070 participants, the subjects with sleep anomalies had an augmented probability of dry eye severity.[35] Lee et al.[36] demonstrated that lack of sleep increased the tear osmolarity, reduced the tear film break-up time, and lessened the tear secretions, each one of which independently triggered or exacerbated the ocular surface disease. Sleep ailments have a propensity to be linked with autonomic dysfunction that affects the parasympathetic fibers in the lacrimal glands, resulting in decreased tear secretions. Sleep loss generates a buildup of lipids and lacrimal gland dysfunction. It decreases endogenous lipid palmitolethanolamide (PEA) expression in the lacrimal glands which are responsible for the homeostasis of lipid metabolism.[37]

Sleep helps in memory consolidation.[38] Sleep deprivation and poor sleep quality can pose a challenge to college students and can lead to lesser academic scores, impaired learning, and an augmented menace of vehicular accidents.[39] According to a study in Korea, individuals having a sleeping length lesser than 5 h were found to have 20% increased chances of suffering from dry eye in comparison to those people with more than 6 h of sleep duration.[40]

We need to focus on sleep-friendly screen-behavior recommendations for the youths worldwide. These include limiting screen time to 30–60 min before bedtime, restricting all digital devices from the bedrooms, and avoiding snacking on fast foods and sugars.[28,33] Dry eyes associated with digital device use need to be addressed by promoting complete, frequent, and forceful blinks, which can help release lipids from the meibomian gland leading to amelioration of the evaporative dry eye. Preservative-free lubricant eye drops and proper screen positioning of 4–5 inches below eye level to decrease ocular surface evaporation can be employed. Frequent pauses during screen use using customized Apps[41] or the 20-20-20 rule (to focus on a distance of 20 feet every 20 min for 20 s), utilizing small plus powered computer glasses to relax accommodation are other modalities to lessen eye strain. To minimize the circadian rhythm disturbances affecting sleep, blue light filtering (yellow tinted) glasses can be worn.[1,42]
The strength of our study lies in the fact that this is the first largest single-gender community-based study evaluating the connection between screen time, sleep quality, and dry eye, as well as multiple elements of sleep quality with a high response rate. The self-reported assessment of symptoms and quality through questionnaires may be considered complementary to objective examination findings documented in other studies. Moreover, we focused on the life quality and the self-assessment of the disease variables themselves, which might have more weightage than clinical evaluations.

The limitations of our study include the following: first, the cross-sectional nature of our study limits the establishment of a temporal relation between screen time, sleep, and dry eye. Second, recall and misclassification bias is possible in questionnaire-based studies. Third, snowballing being a non-random sampling technique of data collection, can contribute to selection/sampling bias as new participants may be recruited from their circle of acquaintances.[43]

**Conclusion**

To conclude, dry eye and sleep quality are essential global health issues, and coupled with increased screen time, may pose a challenge in the present era. Preventive strategies need to be incorporated in school and college curriculums to promote physical, social, and psychological well-being and quality of life.

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**Conflicts of interest**

There are no conflicts of interest.

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Supplementary Table 1: Association of Screen time, Sleep and Dry Eye in college-going girls in northern India

**A. Basic Information**

1. **Age**  
   a. 18–21 years  
   b. 22–26 years  
   c. 27–30 years  

2. **Stream**  
   a. Humanities  
   b. Sciences  
   c. Commerce  

3. **Class**  
   a. Up to 12th  
   b. Graduate  
   c. Post-graduate  

4. **Education of father**  
   a. Illiterate  
   b. Up to 10th  
   c. Up to 12th  
   d. Graduate  
   e. Post-graduate  
   f. Doctorate/any other  

5. **Education of mother**  
   a. Illiterate  
   b. Up to 10th  
   c. Up to 12th  
   d. Graduate  
   e. Post-graduate  
   f. Doctorate/any other  

6. **Working status of parents**  
   a. Both working  
   b. Only father working  
   c. Only mother working  

7. **Type of family**  
   a. Joint  
   b. Nuclear (only parents and child)  

8. **No. of siblings**  
   a. 1  
   b. 2  
   c. 3  
   d. More than 3  

9. **Place of residence**  
   a. Urban  
   b. Rural  
   c. Inadvertently  

**B. Screen-time Review**

10. **No. of hours daily time**  
    a. 0–2 h  
    b. 2–4 h  
    c. 4–6 h  
    d. More than 6 h  

11. **Device on which maximum time spent**  
    a. Television  
    b. Laptop/Desktop  
    c. Mobile Phone  
    d. Tablet/iPad
12. Purpose
   a. Social media
   b. Studies
   c. Movies
   d. Gaming

13. Increase in screen time
   a. No
   b. Yes

14. How much increase
   a. 25%
   b. 25–50%
   c. 50–75%
   d. 75–100%

C. Mini Sleep Questionnaire

15. Difficulty in falling asleep
   a. Never
   b. Very rarely
   c. Rarely
   d. Sometimes
   e. Often
   f. Very often
   g. Always

16. Waking up too early
   a. Never
   b. Very rarely
   c. Rarely
   d. Sometimes
   e. Often
   f. Very often
   g. Always

17. Hypnotic medication use
   a) Never
   b) Very rarely
   c) Rarely
   d) Sometimes
   e) Often
   f) Very often
   g) Always

18. Falling asleep during the day
   a) Never
   b) Very rarely
   c) Rarely
   d) Sometimes
   e) Often
   f) Very often
   g) Always

19. Feeling tired upon waking up in the morning
   a) Never
   b) Very rarely
   c) Rarely
   d) Sometimes
   e) Often
   f) Very often
   g) Always

20. Snoring
   a. Never
   b. Very rarely
   c. Rarely
   d. Sometimes
   e. Often
   f. Very often
   g. Always
21. Mid-sleep awakenings
   a. Never
   b. Very rarely
   c. Rarely
   d. Sometimes
   e. Often
   f. Very often
   g. Always

22. Headaches on awakening
   a. Never
   b. Very rarely
   c. Rarely
   d. Sometimes
   e. Often
   f. Very often
   g. Always

23. Excessive daytime sleepiness
   a. Never
   b. Very rarely
   c. Rarely
   d. Sometimes
   e. Often
   f. Very often
   g. Always

24. Excessive movement during the sleep
   a. Never
   b. Very rarely
   c. Rarely
   d. Sometimes
   e. Often
   f. Very often
   g. Always

25. Report the type of symptoms you experience within the last 3 months

   | Symptom                           | Yes | No |
   |-----------------------------------|-----|----|
   | Dryness, grittiness, or scratchiness |     |    |
   | Soreness or irritation             |     |    |
   | Burning or watering                |     |    |
   | Eye fatigue                        |     |    |

26. Report the frequency of your symptoms in the eye using the list mentioned. 0 = Never, 1 = Sometimes, 2 = often, 3 = Constant

   | Symptom                           | 0 | 1 | 2 | 3 |
   |-----------------------------------|---|---|---|---|
   | Dryness, grittiness, or scratchiness |   |   |   |   |
   | Soreness or irritation             |   |   |   |   |
   | Burning or watering                |   |   |   |   |
   | Eye fatigue                        |   |   |   |   |

27. Report the severity of your symptoms using the list mentioned. 0 = no problem, 1 = tolerable—not perfect but not uncomfortable, 2 = uncomfortable—irritating but does not interfere with my day, 3 = bothersome—irritating, interferes with my day, 4 = intolerable—unable to perform my daily tasks

   | Symptom                           | 0 | 1 | 2 | 3 | 4 |
   |-----------------------------------|---|---|---|---|---|
   | Dryness, grittiness, or scratchiness |   |   |   |   |   |
   | Soreness or irritation             |   |   |   |   |   |
   | Burning or watering                |   |   |   |   |   |
   | Eye fatigue                        |   |   |   |   |   |

28. Do you use eye drops for lubrication?
   a. Yes
   b. No
Supplementary Table 2

**Item-wise analysis of Sleep-wake Domain and comparison of responses based on Dry eye Domain**

| Statements                          | Responses       | Never | Very Rarely | Rarely | Sometimes | Often | Very Often | Always | Dry Eyes Domain P |
|-------------------------------------|-----------------|-------|-------------|--------|-----------|-------|------------|--------|------------------|
| Difficulty in falling asleep        | Count           | 49    | 46          | 68     | 192       | 68    | 64         | 60     | 0.000**          |
| Waking up too early                 | Count           | 64    | 49          | 92     | 166       | 68    | 68         | 69     | 0.004**          |
| Hypnotic medication use             | Count           | 380   | 30          | 49     | 55        | 17    | 6          | 10     | 0.1007** Fisher's exact test |
| Dryness, grittiness, or scratchiness| Count           | 224   | 203         | 94     | 26        | 10    | 8          | 0.002816** Fisher's exact test |
| Soreness or irritation              | Count           | 233   | 193         | 91     | 30        | 8     | 8          | 0.000**          |
| Burning or watering                 | Count           | 202   | 168         | 129    | 48        | 34    | 34         | 0.000**          |
| Eye fatigue                         | Count           | 165   | 164         | 147    | 71        | 45    | 45         | 0.000**          |

**Item-wise analysis of Dry eye Domain and comparison of responses based on Sleep-wake Domain**

| Frequency of symptoms |
|-----------------------|
| Statements            | Responses       | Never | Sometimes | Often | Constant | Sleep-wake Domain P |
| Dryness, grittiness, or scratchiness | Count           | 259   | 183        | 67    | 28       | 10    | 0.002816** Fisher's exact test |
| Soreness or irritation  | Count           | 246   | 173        | 89    | 31       | 12    | 8          | 0.000** Fisher's exact test |
| Burning or watering    | Count           | 212   | 179        | 100   | 44       | 37    | 37         | 0.000** Fisher's exact test |
| Eye fatigue            | Count           | 183   | 179        | 115   | 53       | 17    | 17         | 0.000** Fisher's exact test |

**Severity of symptoms**

| Statements            | Responses       | No problem | Tolerable-not uncomfortable | Uncomfortable but does not interfere with my day | Bothersome-irritating, interferes with my day | Intolerable-unable to perform my daily tasks | Sleep-Wake Domain P |
|-----------------------|-----------------|------------|-----------------------------|-----------------------------------------------|-----------------------------------------------|---------------------------------------------|-------------------|
| Dryness, grittiness, or scratchiness | Count           | 259        | 183                         | 67                                            | 28                                            | 10                                           | 0.002816** Fisher's exact test |
| Soreness or irritation  | Count           | 246        | 173                         | 89                                            | 31                                            | 12                                           | 8                  | 0.000** Fisher's exact test |
| Burning or watering    | Count           | 212        | 179                         | 100                                           | 44                                            | 37                                           | 37                 | 0.000** Fisher's exact test |
| Eye fatigue            | Count           | 183        | 179                         | 115                                           | 53                                            | 17                                           | 17                 | 0.000** Fisher's exact test |

**Statistical tests performed: Chi-square test of independence; Fisher's exact test**