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Original Article

Screen Time and its Association with Sleep and Immunity among Undergraduate Medical Students: A Cross-Sectional Study

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ABSTRACT

Background and Aim: With advancing technology, screen-based activities have evolved globally, leading to excessive usage and addictions that can disrupt sleep and impair immunity. The Neutrophil-Lymphocyte Ratio (NLR) serves as a biomarker for inflammation and stress, indicating the balance between innate and adaptive immunity. So, we attempted to study the relationship between Screen Time (ST) sleep and NLR among undergraduate students at a central Medical Institute. **Methods:** A questionnaire-based, cross-sectional study was conducted among undergraduate students for 1 year using the Self-reported HELENA Scale and Android App Tracker for ST, Epworth Sleepiness Scale (ESS) for Sleep quality assessments and immunity status was assessed by NLR estimation. Collected Data was entered in SPSS V.26 and analysed using descriptive statistics. **Results:** A total of 126 participants responded, out of which 100 (61 females, 39 males) were included after screening. ST >4 hr/day among 80% participants, higher in females (51 F, 29 M); 11% had ST of 2-4hrs/day and 9% had <2hrs/ day. Sleep quality score showed moderate daytime sleepiness in 19% (12F, 7M) while 58% (35F, 23M) had excessive sleepiness, indicating poor sleep in these participants. Normal NLR (0.78-3.58) was seen in 90% participants while the remaining 10% (8F, 2M) had elevated NLR (>3.58). Screen time was positively and significantly associated with ESS and NLR having r-values of 0.110 and 0.965, respectively ($p<0.001$). **Conclusion:** We conclude that increased screen time affects the sleep quality adversely, resulting in excessive daytime sleepiness and decreased immunity among participants.

Keywords: Neutrophil-Lymphocyte Ratio, Screen time, Sleep, Undergraduate Medical students.

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INTRODUCTION

Advancing technology is continuously evolving screen-based activities. Excessive usage and addictions are frequently reported among individuals. The ever-rising use of screen-based devices is of great concern, especially among medical students.[1] "Screen time" signifies the time spent on any screen namely smartphone, tablet, television, video games, computer or any other.[2] Over the past few decades screen time has increased significantly due psychological needs and social requirements such as increased digitalization, increased sedentary behaviour, COVID-19, communal conflict, online academic curriculum.[3,4]

Sleep is a critical yet often overlooked aspect of health and well-being. Sufficient sleep is essential for cognitive function, psychological health and overall performance.[5] Exposure to blue light from electronic devices, especially at night, disrupts sleep by altering the communication between the sleep-wake cycle and the internal clock, leading to reduced melatonin production and delayed sleep onset.[6,7] This disruption can result in poor sleep quality, increasing the risks of weight gain, obesity, metabolic syndrome, hypertension and diabetes. Additionally, sleep deprivation adversely affects cognitive functions and can lead to mental health issues like depression, stress and anxiety.[8-10]

In 2001, the Neutrophil Lymphocyte Ratio (NLR) was established as a key parameter for assessing immune-inflammatory reactions and neuro-endocrine stress. It effectively reflects the balance between innate and adaptive immune responses, serving as an important indicator of inflammation and stress.[11] Evaluating the NLR and the Platelet-to-Lymphocyte Ratio (PLR) in peripheral blood provides reliable insights into inflammatory status.[12] Recognized as a marker of low-grade inflammation, the NLR predicts clinical outcomes in various diseases such as cardiovascular disease, Alzheimer's, Parkinson's and Major Depressive Disorder (MDD).[13,14] It also serves as an effective and cost-efficient marker for Suicidal Behavior (SB) and assessing

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suicidal risk in individuals experiencing depressive episodes.[15] Recent studies show that NLR levels change in MDD and are linked to suicidal behavior, as well as chronic stress and impulsivity.[16,17]

Therefore, the proposed study aimed to find out the correlation between screen time and immune status among undergraduate students studying in a central Medical Institute in the North-East India.

MATERIALS AND METHODS

This observational, Cross-sectional study was carried out in Department of Physiology, Regional institute of Medical Sciences, Imphal, Manipur for a duration of 1 year (June 2023- June 2024).

Ethical Approval

Prior to commencement, the study protocol was approved by the Institutional Ethics Committee, RIMS (Approval No. A/206/REB-Comm (SP)/RIMS/2015/1039/70/2023). Written informed consent was obtained from all participants and confidentiality was maintained throughout the study.

Study Participants

The study included undergraduate medical students (MBBS and BDS) of both genders enrolled in RIMS. A universal sampling method was adopted to recruit participants who met the inclusion and exclusion criteria.

Inclusion Criteria

- Age ≥ 18 years,
- Both genders,
- Students using screen-based devices (mobile phones, tablets, computers, televisions, or video consoles).

Exclusion Criteria

- Participants who denied consent after two attempts,
- History of acute or chronic infection,
- Use of sedatives or sleeping pills,
- Presence of chronic systemic diseases,
- Females during the bleeding phase (1^{st}-7^{th} day) of the menstrual cycle.

Sample Size Estimation

Sample size was calculated using the formula $n=4PQ / L^2$, based on a previous study by Gupta *et al.*,[18] which reported a stress prevalence (P) of 94%. Therefore, the total sample size was estimated as 100.

Study Procedure

Eligible participants completed a structured questionnaire assessing screen time and sleep quality. Screen time was assessed using the HELENA questionnaire and validated through the inbuilt Android screen time recorder, while sleep quality was evaluated with the Epworth Sleepiness Scale (ESS). A 3 mL of venous blood sample was collected in an EDTA vial for Complete Blood Count (CBC) analysis and NLR was calculated using formula

$$NLR = \frac{\text{Absoulte neutrophil count}}{\text{Absolute lymphocyte count}}$$

Statistical Analysis of Data

Data were entered into SPSS version 26 and analyzed with descriptive statistics, including percentages, means and standard deviations. The Chi-square test evaluated the association between screen time and NLR, while Student's *t*-test compared numerical variables across two groups, with a p value <0.05 considered statistically significant.

RESULTS

Demographic Details

A total of 100 participants were included in the study, comprising 61 females and 39 males (Table 1). The majority of students (75%) resided in urban areas. MBBS students formed the bulk of the sample (94%), while BDS students represented 6%. Among MBBS participants, 41% were in the 2nd year, 22% in the 3rd year and the remaining distributed across other years.

As shown in Figure 1, the participants were predominantly young adults aged 18-25 years, with a mean age of 21.06±1.37 years. The highest proportion belonged to the 21-year age group (27%), followed by 20 years (24%) and 22 years (22%), indicating that the study population mainly consisted of students in their early twenties.

Screen Time Use

Figure 2 illustrates the distribution of daily screen time among participants. Only 9% reported screen time of less than 2 hr/day

Table 1: Demographic characteristics of participants (n=100).

Characteristics		N
Gender	Male	39
	Female	61
Residence	Urban	74
	Rural	26
Speciality	MBBS	94
	BDS	6
Academic year	1^{st} Year	37
	2^{nd} Year	41
	3^{rd} Year	22

and 11% reported 2-4 hr/day. A striking 80% of students reported screen exposure exceeding 4 hr/day.

Sleep Quality

Based on the Epworth Sleepiness Scale (ESS), 19% (7 males and 12 females) of participants experienced moderate daytime sleepiness, while 58% (23 males and 35 females) reported excessive daytime sleepiness (Figure 3).

Neutrophil-Lymphocyte Ratio

The mean NLR among participants was 2.32±0.99. Elevated NLR values were observed in 13% of females and 5% of males, with an overall male-to-female ratio of 1:2.6 (Figure 4).

Correlation Analysis

As shown in Table 2, screen time demonstrated a strong positive correlation with ESS scores ($p<0.05$). Furthermore, Figure 5 depicts a strong positive correlation between screen time and NLR ($r=0.965$, $p<0.001$).

Table 2: Correlation of Screen time with ESS.

Variables	Mean±SD	Screen time
Screen time (hr)	8.96±4.93	-
ESS Score	9.67±4.283	r-value 0.110
		p-value <0.001**

p value less than 0.05 was considered to be statistically significant. r: Regression. coefficient; ESS: Epworth sleepiness scale.

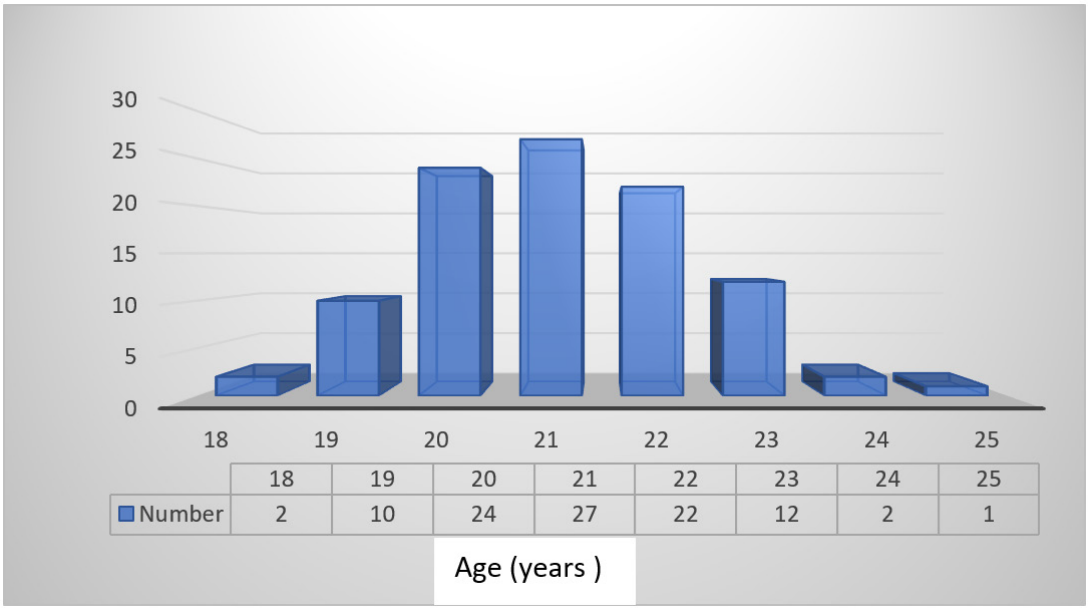

Figure 1: Distribution of participants by age in years (*n*=100).

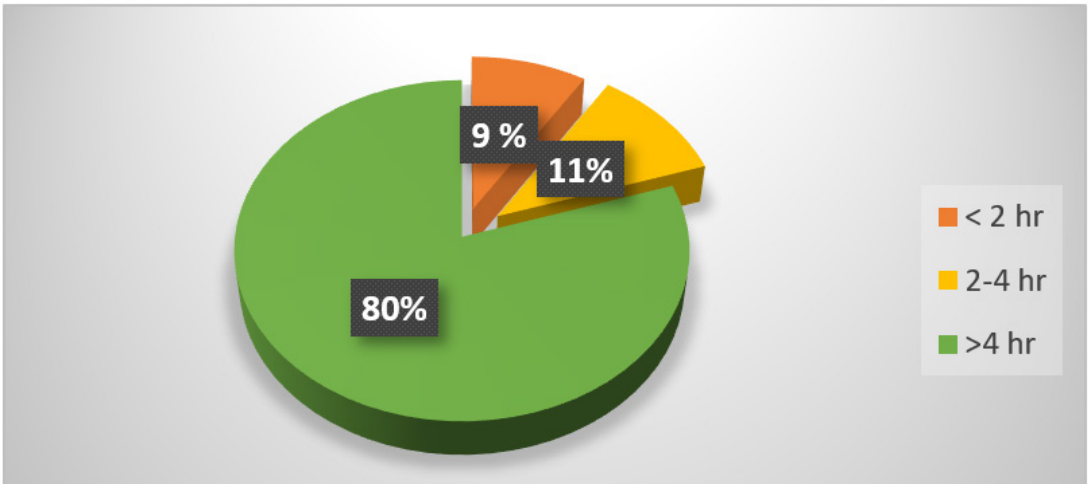

Figure 2: Average screen time use/day by the participants (*n*=100).

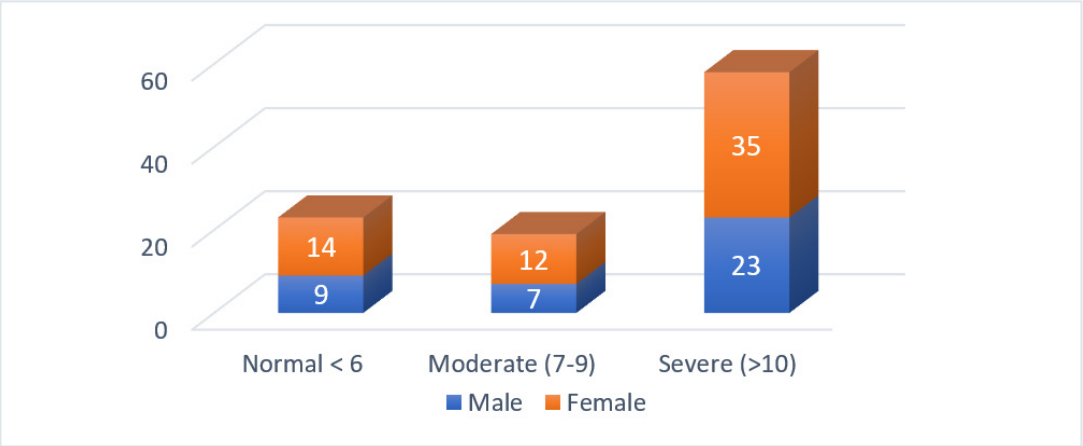

Figure 3: Gender wise ESS score of participants. ESS: Epworth sleepiness scale.

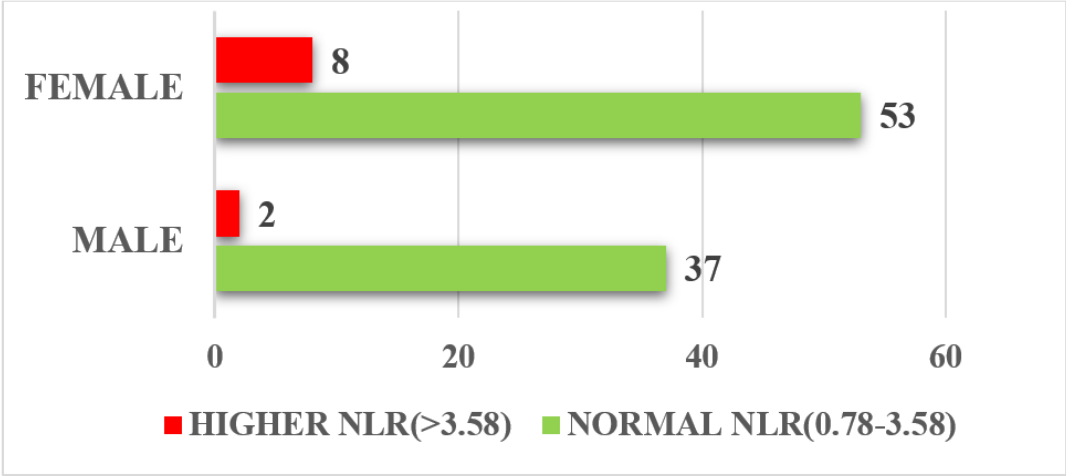

Figure 4: Gender-wise NLR distribution (n=100). NLR: Neutrophil-lymphocyte ratio.

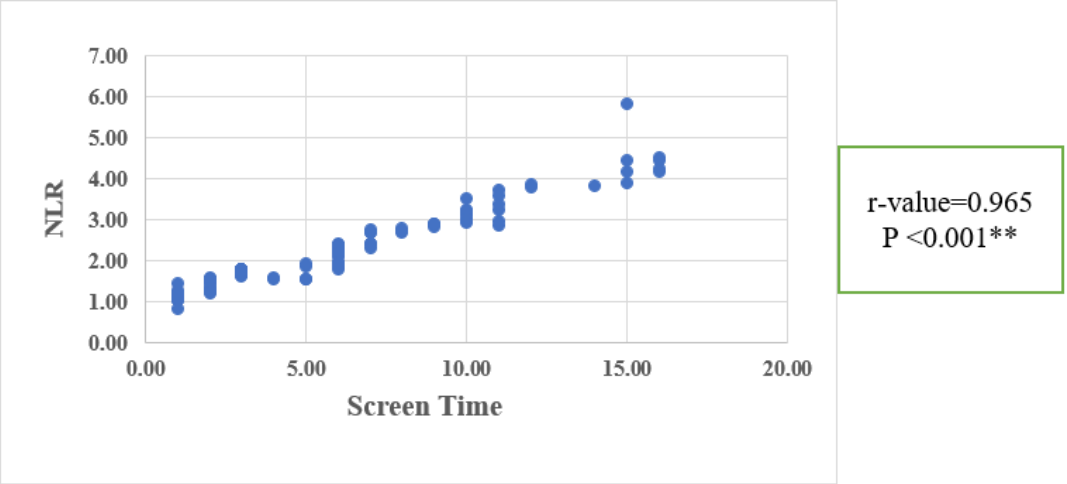

Figure 5: Correlation of Screen Time with NLR. NLR: Neutrophil-lymphocyte ratio.

DISCUSSION

Economic and technological advancements are leading to increased Screen Time (ST) among individuals in developing countries. Research shows that excessive ST negatively impacts health, contributing to issues like cardiovascular disease, mental health problems, poor sleep quality and lower academic performance.[19,20]A study conducted by Nestler S. *et al.*,[21] at Magdeburg-Stendal University found that 68.9% of students had poor sleep quality, with evening screen use for online study linked to worse sleep hygiene. Similarly, research by Mao Y. *et al.*,[22] at Shantou University revealed that using entertainment screens for over 60 min after 10 p.m. was associated with poor sleep quality (Adjusted Odds Ratio ≈ 1.87) and lower academic performance.

Sleep is vital for health, with adults needing at least 7 hr of sleep per night. Chronic sleep deprivation may be a result of work, smartphone use and poor diet.[23] Blue light exposures from smart phone or screen based devices hinders melatonin production, leading to stress and increased Neutrophil-to-Lymphocyte Ratios (NLR).[24] Research shows low sleep quality correlates with higher NLR and stress activates inflammatory responses.[25] Additionally, among medical students in Ahmedabad, excessive social media use after bedtime is linked to longer sleep latency, disturbances and poorer sleep quality.[26]

Digital media plays a crucial role in the knowledge acquisition of medical students, particularly during the COVID-19 pandemic and periods of communal conflict. Our study found that females generally have higher screen time than males, likely due to their prioritization of loved ones and their focus on social connections and caregiving. This strong inclination toward thoroughness enables effective learning through screen use. Understanding these trends can help promote healthier screen habits and enhance digital engagement for everyone. Chen M *et al.*,[27] did a study among university students and the average total Screen Viewing (SV) reported was approximately 14.3 hr per day, with females consistently logging more screen time than males for both academic and recreational purposes.

In our study, screen time averaged 8.96±4.93 hr, with females at 10.32±4.65 hr, aligning with findings from Bianni LG *et al.*,[28] who suggest that female students engage more with digital media for social and educational purposes. Kadier K *et al.*,[29] found a link between daytime sleepiness and increased NLR levels ($p=0.021$), which supports our results. Additionally, Obayashi K *et al.*,[30] demonstrated that poor sleep efficiency and longer wake times correlated with elevated total WBC in women, indicating a stronger sleep-inflammation connection for females.

An extensive literature search reveals no studies on the correlation between screen time and NLR values. However, our study suggests a strong positive correlation (r-value: 0.965, $p<0.001$) between excessive screen time and elevated NLR values. Females exhibited higher NLR than males (M: F=1:2.6), indicating a possible hormonal influence or greater inflammation in young women. Research shows that neutrophil counts vary throughout the menstrual cycle, with increased levels during the ovulatory and bleeding phases.[31] Estrogen and progesterone fluctuations elevate inflammatory markers like NLR and Total Leukocyte Count (TLC) rises during the secretory phase, consistent with findings from Mathur *et al.*,[32] and Tikare *et al.*,[33] Moreover, Rajnee *et al.*,[34] reported that TLC increases from the menstrual to the proliferative phase, peaking around mid-cycle.

Limitations of the Study

Its cross-sectional nature does not allow for assessing causation. A future comparative study between medical students and general students is recommended. Additionally, the study had a small sample size and relied on self-reported data for screen time assessment and sleep scoring. A thorough evaluation of NLR changes during various menstrual phases in females is also suggested.

CONCLUSION

Our findings show that prolonged screen exposure is linked to poor sleep quality and higher NLR values, particularly in females. This suggests that increased screen time negatively affects sleep quality and may reduce immunity in some students. However, the complexity of individual differences in screen habits and social context must be considered. Further research is needed to understand these mechanisms.

Given the rising screen time among students, which is linked to poor sleep quality and an increased Neutrophil-to-Lymphocyte Ratio (NLR), we recommend awareness programs to educate students about these health risks. Encouraging lifestyle changes to reduce screen time can promote better well-being for both students and society.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ABBREVIATIONS

ST: Screen Time; **ESS:** Epworth Sleepiness Scale; **NLR:** Neutrophil-Lymphocyte Ratio.

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