MULTIFACTORIAL DETERMINANTS OF TENSION TYPE HEADACHE IN COLLEGE STUDENTS WITH EMPHASIS ON ACADEMIC STRESS SLEEP QUALITY AND SCREEN EXPOSURE

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Abstract

Tension-type headache (TTH) is one of the most prevalent primary headache disorders among college students and is often aggravated by modifiable lifestyle factors, including excessive screen exposure, poor sleep quality, and academic stress. Despite the rising burden of TTH in student populations, limited evidence has systematically examined the combined influence of these factors on its prevalence and severity. The present study aimed to evaluate the association of academic stress, sleep quality, and screen time with TTH among college students in Chengalpattu district, Tamil Nadu, India. A cross-sectional study was conducted among 296 physiotherapy and pharmacy students selected through a convenience sampling approach. Data were collected using a structured online questionnaire incorporating validated tools, including the Student Academic Stress Scale for assessing stress levels and the Pittsburgh Sleep Quality Index for evaluating sleep quality. Screen exposure was assessed using a structured questionnaire, while TTH diagnosis and severity were classified according to the International Classification of Headache Disorders, third edition criteria. The mean age of participants was 19.44 ± 2.61 years. A high prevalence of daytime sleepiness and prolonged screen exposure was observed. Academic stress demonstrated a strong positive correlation with poor sleep quality ($r = 0.850$, $p < 0.01$). Increased screen time was significantly associated with higher stress levels, impaired sleep, and greater headache occurrence ($p < 0.001$). Overall, TTH frequency and severity were significantly linked to academic stress, sleep disturbances, and extended screen exposure. These findings highlight the importance of targeted interventions such as stress management, sleep hygiene promotion, and digital wellness strategies to reduce TTH burden and enhance student well-being.

Keywords

Academic stress, sleep quality, screen time, tension-type headache, college students, cross-sectional study.

Introduction

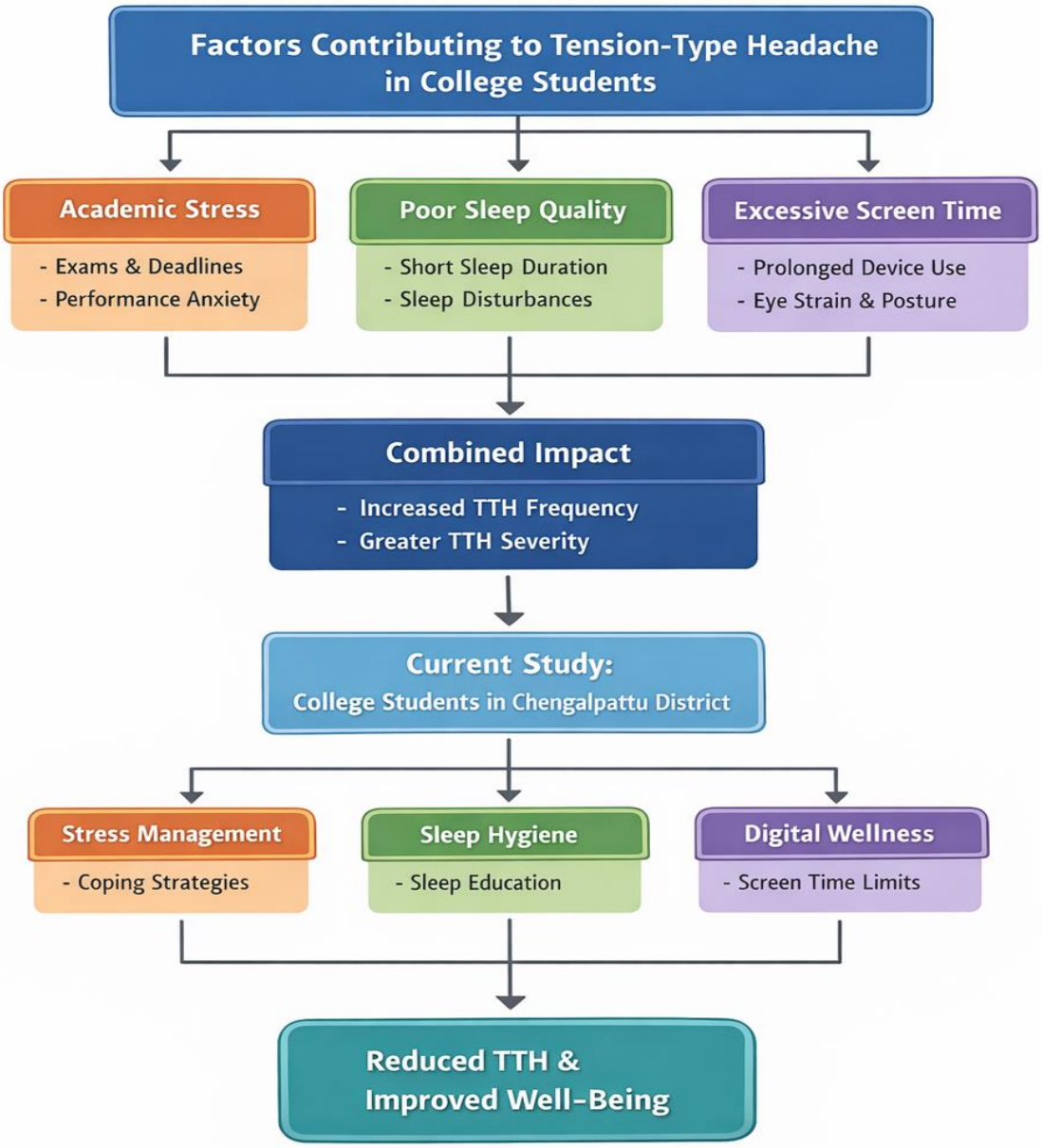
Tension-type headache (TTH) is the most prevalent primary headache disorder worldwide, with lifetime prevalence estimates reaching up to 78% in the general population [1]. Clinically, TTH is characterized by recurrent episodes of mild to moderate, bilateral, non-pulsating pain with a pressing or tightening quality, commonly affecting the frontal, temporal, and occipital regions [2]. Unlike migraine, TTH is not aggravated by routine physical activity and is typically not associated with nausea or vomiting. It is classified as episodic when occurring on fewer than 15 days per month and chronic when present on 15 or more days per month [3]. Although often considered a less severe condition, TTH contributes substantially to public health burden, particularly among college students, where its onset and severity may be influenced by academic, behavioral, and psychological stressors.

The transition to university life is frequently associated with increased academic demands, performance-related anxiety, irregular sleep patterns, and prolonged exposure to digital screens. These factors have been implicated in the pathophysiology of TTH. Existing literature reports that approximately 43% to 76% of college students experience TTH [4]. However, most studies have examined these risk factors independently, with limited attention to their combined or interactive effects. Academic stress, a well-recognized contributor to primary headache disorders, has been shown to induce dysregulation of the hypothalamic–pituitary–adrenal axis, increase pericranial muscle tension, and alter serotonergic pathways, thereby lowering pain thresholds and facilitating central sensitization [5].

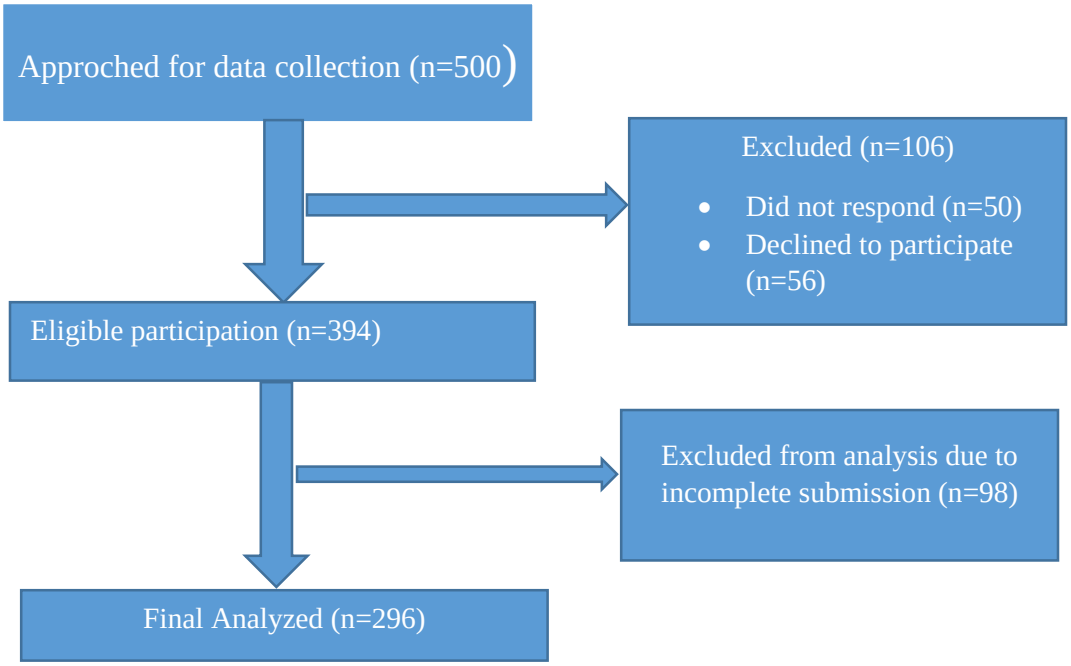
Sleep disturbances, including insufficient duration, poor quality, and circadian rhythm disruption, are also recognized as both precipitating and perpetuating factors for recurrent headaches [(6)]. Sleep deprivation may impair descending pain inhibitory mechanisms, thereby increasing headache frequency and sensitivity [(7)]. In parallel, extensive use of digital devices among students represents another modifiable risk factor. Prolonged screen exposure, often involving close viewing distances and minimal breaks, may lead to ocular strain, poor posture, reduced physical activity, and sleep disruption [(8)]. Evidence suggests that excessive screen time is associated with increased frequency and severity of headaches [(9)].

Despite recognition of these individual risk factors, limited research has explored their combined influence on TTH, particularly within the context of Indian higher education settings. Regional academic pressures, sociocultural factors, and patterns of digital technology use may uniquely shape the manifestation and reporting of TTH among Indian students. Therefore, the present cross-sectional study aims to examine the association between academic stress, sleep quality, and screen exposure with the prevalence and severity of TTH among physiotherapy and pharmacy students in Chengalpattu district. Understanding these modifiable determinants may support the development of targeted interventions, including stress management strategies, sleep hygiene promotion, and digital wellness education, to reduce headache burden and improve student well-being and academic outcomes.

Graphical Abstract



Flow chart of study



Materials and Methods

Study Design and Setting

A cross-sectional study was carried out among undergraduate students enrolled in physiotherapy and pharmacy programs across institutions in the Chengalpattu district of Tamil Nadu, India, during the period from March to April 2025. The study aimed to assess the association of academic stress, sleep quality, and screen exposure with the prevalence and severity of tension-type headache (TTH).

The study was designed and reported in accordance with the STROBE Statement for cross-sectional research. Ethical approval was obtained from the Institutional Human Ethics Committee prior to the initiation of the study (Approval No: IHEC-II/0846/25). Participant confidentiality and anonymity were strictly maintained throughout the study. All procedures related to data collection, storage, and analysis were conducted in compliance with the ethical principles outlined in the Declaration of Helsinki (2013 revision).

Participants and Sampling

A total of 296 undergraduate students were recruited using a convenience sampling approach. Participants were eligible if they were aged between 18 and 30 years, currently enrolled in a bachelor's degree program in physiotherapy or pharmacy, and provided written informed consent. Exclusion criteria included a prior diagnosis of neurological disorders or headache conditions other than tension-type headache (TTH), presence of chronic medical illnesses such as endocrine or autoimmune disorders that could influence headache occurrence, regular use of analgesic or prophylactic medications for headache management, clinically diagnosed psychiatric disorders requiring pharmacological treatment, and refusal to provide informed consent.

Sample Size Determination

The sample size was calculated using the standard formula for estimating a single population proportion, assuming a 95% confidence level, 5% margin of error, and an expected TTH prevalence of 22.6%, as reported in a recent Indian study by Guruswamy et al [10.] The minimum required sample size was estimated to be 269

participants. After accounting for a potential 10% non-response rate, the final sample size was adjusted to 296, which was considered adequate for statistical analysis.

Data Collection Procedure

Data collection was conducted using a structured, self-administered online questionnaire developed through Google Forms. The survey link was disseminated via institutional email systems and official academic WhatsApp groups to enhance accessibility and encourage widespread participation among eligible students. The study population comprised undergraduate students currently enrolled in physiotherapy and pharmacy programs within the Chengalpattu district, Tamil Nadu, India. Eligibility was established based on confirmed academic enrolment in the specified disciplines. Participation in the study was entirely voluntary, and respondents retained the right to decline or withdraw at any stage without any penalty or loss of benefits.

Before proceeding to the questionnaire, participants were required to review and accept an electronic informed consent form by checking a mandatory consent box. The consent form explicitly outlined the objectives of the study, the voluntary nature of participation, the absence of financial incentives or foreseeable risks, and the strict measures implemented to maintain data confidentiality and anonymity. No personally identifiable information was collected. All data were encrypted and securely stored, with access restricted exclusively to the research team in accordance with institutional and ethical guidelines.

The questionnaire comprised the following sections:

1. Demographic Information: Age, gender, course of study, and academic year

2. Academic Stress: Assessed using the validated Student Academic Stress Scale (SASS) [11]

3. Sleep Quality: Evaluated using selected components of the Pittsburgh Sleep Quality Index (PSQI) [12]

4. Screen Time: Measured through self-reported estimates of daily screen use for academic and non-academic purposes

5. Tension-Type Headache (TTH): Diagnosed according to the International Classification of Headache Disorders, 3rd Edition (ICHD-3) criteria [13]

The estimated time required to complete the survey was approximately 10 minutes. No personal identifiers were collected. All responses were anonymized, encrypted, and securely stored with access restricted solely to the principal investigators, in full compliance with institutional and international research ethics standards.

Validation and Reliability of the Survey

The questionnaire underwent content validation by an expert panel comprising specialists in physiotherapy, neurology, and health sciences. Each item was evaluated for clarity, relevance, and alignment with the study objectives. The Content Validity Ratio was calculated as 1.00, indicating complete agreement among experts. Reliability testing was performed through a pilot study involving ten undergraduate students from the target population. Internal consistency was assessed using Cronbach's alpha, which yielded a value of 0.92 ($p = 0.01$), indicating excellent reliability and supporting the suitability of the instrument for data collection.

RESULTS

Descriptive Statistics

A total of 296 participants were included in the study. The mean age was **19.44 ± 2.61 years**, indicating a predominantly young adult population. The mean stress score was **21.20 ± 2.14**, suggesting moderate stress

levels. Sleep quality scores were relatively high (**8.48 ± 0.85**), indicating generally good perceived sleep. The average daily screen time was **10.40 ± 1.07 hours**, reflecting substantial exposure.

Participants reported an average of **1.50 ± 0.50 hours** of non-screen activity. Headache symptom scores were **4.17 ± 0.48**, indicating mild symptom severity overall.

Table 1. Descriptive Statistics of Study Variables (N = 296)

Variable	Mean ± SD	Min–Max
Age	19.44 ± 2.61	17–50
Stress Total	21.20 ± 2.14	20–25
Sleep Likert	8.48 ± 0.85	8–10
Screen Time	10.40 ± 1.07	9–12
Hours	1.50 ± 0.50	1–2
Headache Symptoms	4.17 ± 0.48	4–7

Participant Characteristics

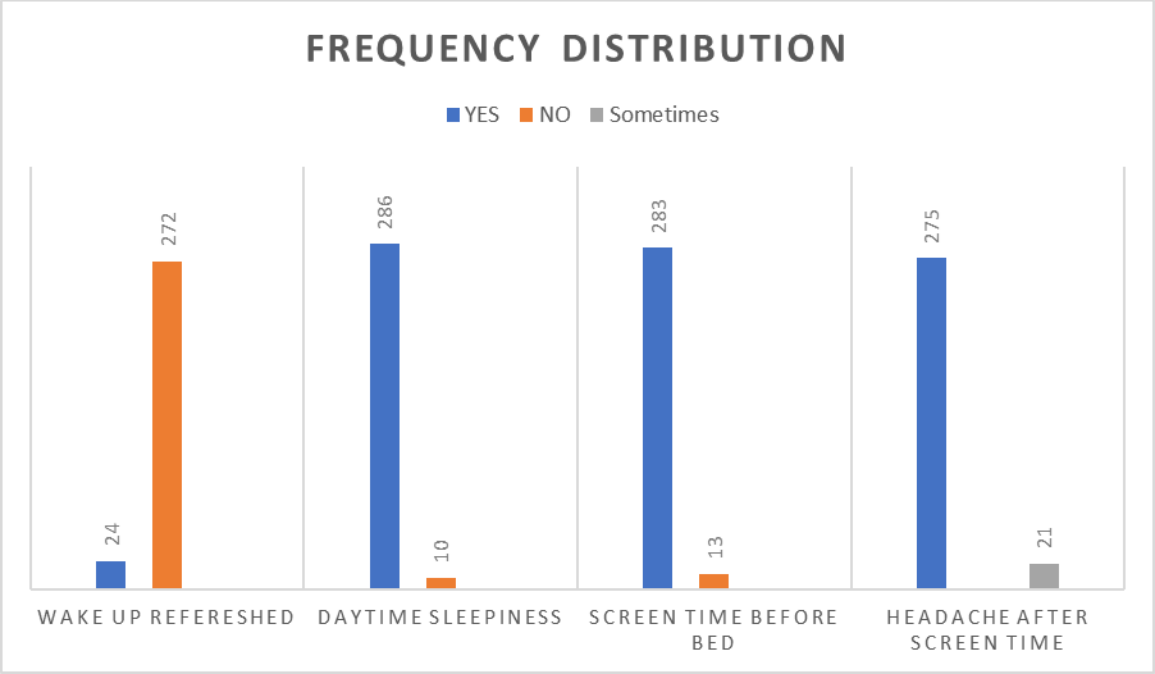
The sample was predominantly female (**77.0%**) and mainly comprised physiotherapy students (**75.7%**). Most participants were in their first year (**62.2%**). A high proportion reported Sleepiness (**96.6%**), Screen use before bedtime (**95.6%**) and Headache after screen exposure (**92.9%**). Frequent screen exposure was reported by **89.2%**, and **65.2%** used screens for more than 4 hours daily.

Table 2. Participant Characteristics (N = 296)

Variable	Category	n (%)
Gender	Male	68 (23.0)
	Female	228 (77.0)
Course	Physiotherapy	224 (75.7)
	Pharmacy	65 (22.0)
	Others	7 (2.4)
Year	1st Year	184 (62.2)
	2nd Year	74 (25.0)
	3rd–4th/Intern	38 (12.8)
Sleepiness	Yes	286 (96.6)

Variable	Category	n (%)
Screen Before Bed	Yes	283 (95.6)
Headache After Screen	Yes	275 (92.9)
Screen Exposure	Regular	264 (89.2)
Duration	>4 hours	193 (65.2)

FIGURE 1 SHOWING FREQUENCY DISTRIBUTION



Correlation Analysis

Pearson correlation analysis revealed a **strong positive correlation between stress and sleep quality** ($r = 0.850$, $p < 0.01$). A **weak negative correlation** was observed between stress and screen exposure frequency ($r = -0.145$, $p < 0.05$). Sleep quality was **negatively correlated with screen exposure frequency** ($r = -0.183$, $p < 0.01$). Screen time showed a **weak positive correlation with hours of activity** ($r = 0.155$, $p < 0.01$). Other relationships were not statistically significant.

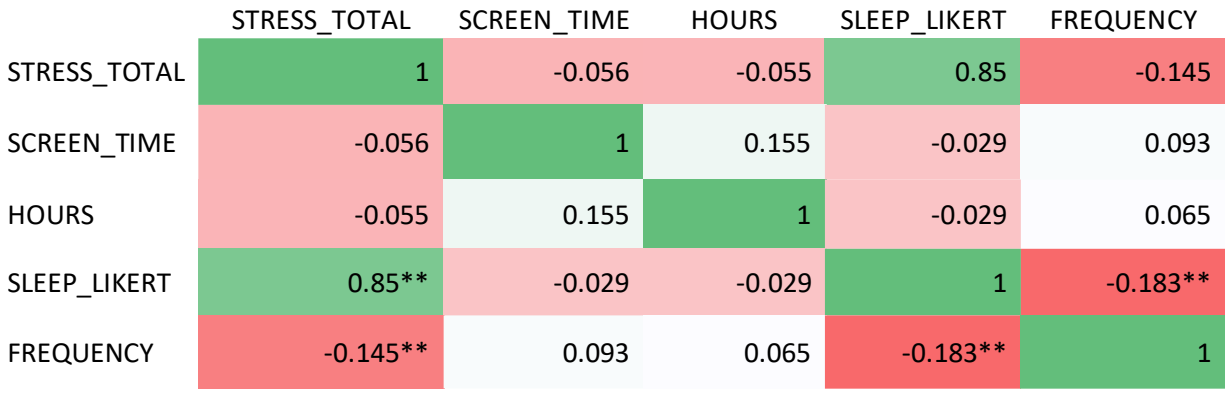
TABLE 3. PEARSON CORRELATION MATRIX

Variable	1	2	3	4	5
Stress	1				
Screen Time	-0.056	1			
Hours	-0.055	0.155**	1		
Sleep	0.850**	-0.029	-0.029	1	

Variable	1	2	3	4	5
Frequency	-0.145*	0.093	0.065	-0.183**	1

Note: *p < 0.05, **p < 0.01

FIGURE 2: SHOWING CORRELATION HEAT MATRIX OF STRESS, SLEEP HOURS, SCREEN TIME AND FREQUENCY OF HEADACHE.



CHI-SQUARE ANALYSIS

TABLE 4. ASSOCIATION BETWEEN SCREEN EXPOSURE AND OUTCOMES

Outcome Variable	χ^2	df	p-value	Interpretation
Sleepiness	25.97	1	<0.001**	Significant
Feeling Refreshed	0.93	1	0.335	Not Significant
Screen Before Bed	26.12	1	<0.001**	Significant
Headache After Screen	40.51	1	<0.001**	Significant

Chi-square analysis demonstrated that **frequency of screen exposure was significantly associated with sleepiness, screen use before bedtime, and headache occurrence** ($p < 0.001$). However, no significant association was found with feeling refreshed ($p > 0.05$). These findings indicate that increased screen exposure is strongly linked to **fatigue, disrupted sleep behavior, and headache symptoms**.

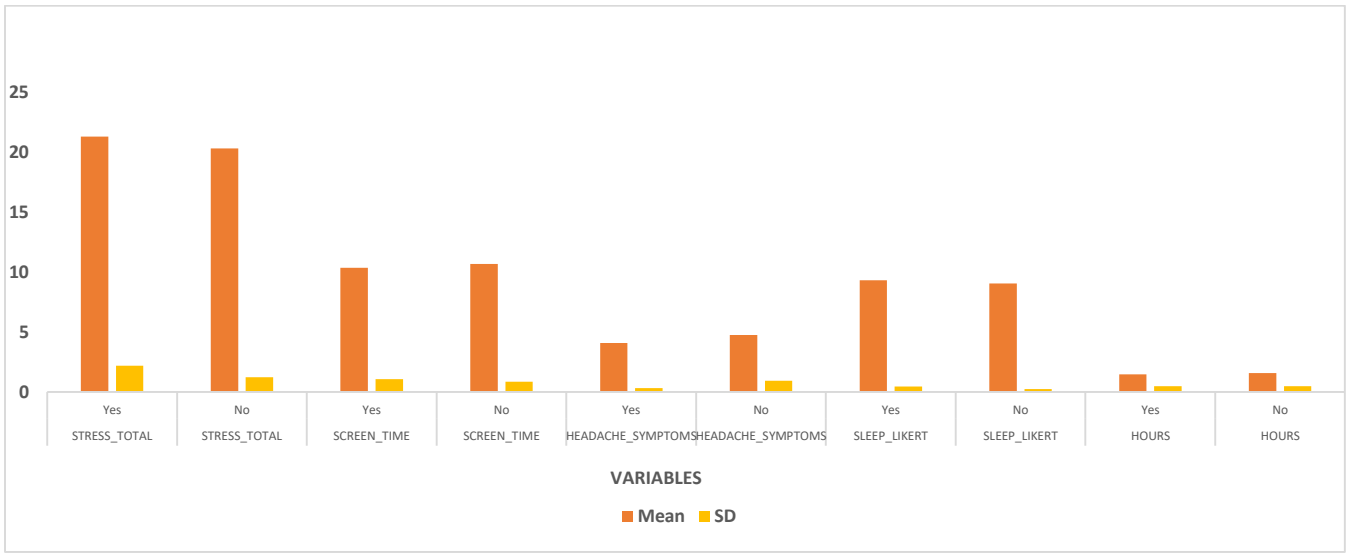
INDEPENDENT SAMPLES T-TEST

TABLE 5. COMPARISON OF CONTINUOUS VARIABLES BETWEEN GROUPS

Variable	t	df	p-value	MD	95% CI
Stress Total	3.882	58.71	<0.001**	0.994	0.482 – 1.507
Screen Time	-1.929	44.03	0.060	-0.320	-0.655 – 0.014
Headache Symptoms	-3.828	31.90	0.001**	-0.648	-0.992 – -0.303
Sleep Likert	5.179	63.42	<0.001**	0.271	0.166 – 0.375
Hours	-1.125	38.96	0.268	-0.105	-0.294 – 0.084

Note: *p < 0.05, **p < 0.01

FIGURE 3: SHOWING MEAN VALUES OF CONTINUOUS VARIABLES IN THE STUDY



Significant differences between groups were observed for **stress levels, headache symptoms, and sleep quality** (p < 0.01). Individuals with higher screen exposure demonstrated **higher stress and poorer sleep outcomes**, along with increased headache symptoms. No significant differences were found for **screen time and hours of activity** (p > 0.05).

Discussion

This cross-sectional study examined the prevalence and severity of tension-type headaches among college students and their associations with academic stress, sleep quality, and screen time. Among 296 participants, moderate levels of academic stress (mean = 21.20 ± 2.14), elevated daily screen time (mean = 10.40 ± 1.07 hours), and mild-to-moderate headache symptoms were observed. A substantial proportion of students reported experiencing headaches following screen use, with a high prevalence of sleepiness (96.6%) and frequent screen exposure (89.2%). Correlation analysis revealed a significant association between academic stress and sleep quality, while chi-square analysis identified strong associations among frequent screen exposure, sleepiness,

screen usage before bedtime, and headache incidence. Collectively, these findings suggest that academic stress, prolonged screen time, and disrupted sleep patterns contribute to the prevalence and severity of tension-type headaches in college students.

These results align with earlier research highlighting the contribution of behavioral and psychosocial risk factors to primary headache disorders. Using a cross-sectional survey of students, Omogbiya et al. (2021) found a high positive correlation between student stress levels and the occurrence of tension-type headaches (TTH), indicating that academic stressors were a significant precipitant of TTH[14]. According to Souza-e-Silva et al. (2011), tension-type headaches were found in 42.4% of college students, and large impact scores were linked to higher absenteeism and academic failure. Their findings suggest that the perceived impact of a headache has a stronger correlation with its functional burden than its clinical subtype[15]. This supports the current study's focus on screen time, sleep quality, and academic stress as important modifiable factors affecting TTH severity in student populations.

Despite maintaining normal sleep duration, students with tension-type headaches (TTH) have been reported to experience lower subjective sleep quality and higher exhaustion, which is consistent with the findings of Engstrøm et al. (2013) [16]. In the present study, although average sleep scores appeared adequate, the high prevalence of sleepiness indicates underlying disturbances in sleep quality. This suggests that inadequate restorative sleep may increase pain sensitivity and contribute to headache frequency. Our findings are further supported by recent data from Roy et al. (2024), which shows that extended screen time in student populations is associated with a higher headache burden[17].

The pathophysiological processes linking academic stress to tension-type headache (TTH) are multifactorial. Chronic stress stimulates the hypothalamic–pituitary–adrenal (HPA) axis, leading to the release of glucocorticoids, chiefly cortisol, which is essential for stress adaptation (Herman et al., 2016) [18]. Persistent elevation of cortisol has been associated with increased pericranial muscular tension, potentially intensifying headache-related discomfort (Knezevic et al., 2023) [19]. Furthermore, prolonged stress interferes with central pain modulation, leading to central sensitization, a condition characterized by increased responsiveness of the nervous system to pain stimuli[20]. Stress also activates limbic and cortical regions, including the anterior cingulate cortex and amygdala, thereby amplifying pain perception. These neurophysiological changes contribute to the chronification of TTH by lowering pain thresholds and sustaining central sensitization (Cathcart et al., 2010) [21].

Sleep disruption is another critical factor in the development and persistence of tension-type headaches. Sleep deprivation lowers pain thresholds and facilitates central sensitization. Both insufficient sleep and irregular sleep patterns can increase headache frequency and intensity by altering circadian rhythms and increasing sympathetic activation[22]. According to Cho et al. (2019), individuals with chronic TTH demonstrate a significantly higher prevalence of insomnia[23]. The present findings support this bidirectional relationship, where sleep disturbances and headache symptoms reinforce each other.

Prolonged screen exposure contributes to headache development through integrated visual, musculoskeletal, and neuroendocrine mechanisms. Digital eye strain, characterized by blurred vision and ocular discomfort, is a common consequence of extended screen use. Additionally, prolonged screen exposure is strongly associated with postural dysfunction, particularly forward head posture and sustained cervical muscle loading, which are known contributors to tension-type headaches[24]. Furthermore, blue light exposure suppresses melatonin secretion, disrupts circadian rhythms, and impairs sleep quality, thereby increasing headache susceptibility[25].

The significant association observed in this study between screen exposure, sleep-related variables, and headache occurrence reinforces these mechanisms.

The current study emphasizes the importance of non-pharmacological interventions for managing TTH in college students, a population particularly vulnerable due to high academic stress, irregular sleep patterns, and prolonged screen exposure. Sub occipital inhibition has demonstrated effectiveness in reducing pain by decreasing sub occipital muscle tension[26]. Psychological interventions such as cognitive-behavioral therapy (CBT) are effective in addressing stress and anxiety, which are key triggers of TTH[27]. Relaxation techniques, including autogenic training combined with physiotherapy, have been shown to reduce headache frequency and intensity. Regular physical activity contributes to symptom reduction by improving neuromuscular function and regulating stress[28]. Complementary therapies such as electro acupuncture and acupuncture also provide additional benefits in reducing headache severity[29].

Sleep hygiene plays a crucial role in managing TTH, particularly in student populations where irregular schedules and academic demands are common. Sleep disorders such as insomnia and obstructive sleep apnea have been linked to TTH. Maintaining regular sleep–wake cycles can help stabilize circadian rhythms and reduce headache frequency and intensity[30]. Given the multifactorial nature of TTH, a multidisciplinary approach is essential. Integrated care involving neurologists, psychologists, physiotherapists, and behavioral health specialists allows for comprehensive management, improving clinical outcomes and treatment adherence[31]. These results emphasize the necessity of campus-based preventive measures that focus on stress reduction, screen time control, and good sleep hygiene in order to lessen the burden of headaches among students.

Despite these findings, several limitations must be considered. The cross-sectional design limits the ability to establish causality. Additionally, reliance on self-reported data introduces potential bias, including recall and social desirability bias. The study sample was restricted to students from specific disciplines within a single geographic region, which may limit generalizability. Future research should adopt longitudinal designs to better understand causal relationships and explore additional mediating factors such as gender differences, coping strategies, and resilience. Further investigation into the long-term impact of TTH on academic performance, psychological well-being, and quality of life will provide deeper insights and support the development of targeted interventions.

Conclusion

This cross-sectional study demonstrates a significant association between the increased prevalence and severity of tension-type headache (TTH) among college students and key modifiable factors, including academic stress, impaired sleep quality, and prolonged screen exposure. These findings underscore the critical role of behavioural and psychosocial determinants in the pathogenesis of TTH within academically intensive and digitally driven environments. The results highlight the necessity for implementing evidence-based, multidimensional preventive strategies, including structured stress management interventions, optimization of sleep hygiene, regulation of screen usage, and targeted physiotherapeutic approaches addressing cervicogenic contributors. Integration of such interventions into institutional health and wellness programs may substantially reduce headache burden, enhance academic performance, and improve overall quality of life among students. However, given the cross-sectional nature of the study, causal inferences cannot be established. Therefore, future longitudinal and interventional studies are warranted to elucidate causal relationships and to inform the development of scalable, institution-level preventive and management strategies.

Conflict of interest: Nil.

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