

CLINICAL RESEARCH

SLEEP DURATION AND PAIN INTENSITY IN MEDICAL STUDENTS WITH TENSION-TYPE HEADACHE: A CROSS-SECTIONAL STUDY

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Abstract

Introduction: Tension-type headache (TTH) is the most common primary headache disorder and frequently affects medical students. Sleep disturbances, particularly insufficient sleep duration, have been implicated as risk factors that may worsen headache intensity. This study aimed to investigate the relationship between sleep duration and pain intensity among medical students with TTH at Universitas Pelita Harapan.

Methods: A cross-sectional analytic study was conducted from February to May 2025. A total of 186 students were screened, and 84 met the inclusion criteria. TTH was assessed using a validated 13-item questionnaire, pain intensity was measured with the Numeric Rating Scale (NRS), and sleep duration was self-reported and categorized as sufficient (≥ 7 hours) or insufficient (< 7 hours). Stress levels were controlled using the 10-item Perceived Stress Scale (PSS-10). Data were analyzed with the Pearson Chi-Square test, and odds ratios (OR) with 95% confidence intervals (CI) were calculated.

Results: Most participants were female (70.2%), and the majority reported insufficient sleep (65.5%). Moderate and severe TTH pain was reported by 39.3% and 39.3% of respondents, respectively. A significant association was observed between insufficient sleep and higher pain severity ($p < 0.001$). Students with insufficient sleep were 32.6 times more likely to report moderate–severe pain compared to those with sufficient sleep (OR = 32.615, 95% CI: 6.650–159.973).

Conclusion: Short sleep duration is strongly associated with increased pain intensity in medical students with TTH.

Keywords: Tension-Type Headache, Sleep Duration, Pain Intensity, Medical Students, Numeric Rating Scale

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Introduction

Tension-type headache (TTH) is the most common primary headache disorder, defined by the International Classification of Headache Disorders (ICHD-3) as a bilateral, pressing, or tightening pain of mild to moderate intensity that is not aggravated by routine physical activity and usually not accompanied by nausea or vomiting.¹ Epidemiological data show that

TTH is highly prevalent, with lifetime prevalence in the general adult population ranging from 30 % to 78 % across various studies.^{1,2} The Global Burden of Disease 2021 further estimated that headache disorders, including migraine and TTH, affected approximately 2.81 billion individuals worldwide, marking a 57% increase since 1990 and underscoring their significant impact on quality of life and

productivity.³ This burden appears even more pronounced among medical students, where TTH prevalence is consistently high. For example, a study in Vietnam reported a one-year prevalence of 54.0% among medical students,⁴ while research by Sabah et al. in Saudi Arabia found that 56.1% of medical and dental undergraduates experienced TTH.⁵

Sleep disturbances, including reduced sleep duration, have been strongly implicated in the pathophysiology of TTH. The National Sleep Foundation (NSF) recommends 7–9 hours of nightly sleep for adults to maintain optimal physical and cognitive function. Several studies have highlighted the bidirectional relationship between sleep and TTH, suggesting that poor sleep can worsen headache burden, while frequent headaches can in turn impair sleep quality.

Evidence supporting the role of sleep disturbances in exacerbating TTH severity is substantial. Oh et al., using data from the Korean Headache Sleep Study, found that insufficient sleep was more prevalent among individuals with TTH and was associated with higher pain scores and greater headache-related disability.⁶ Kolosvoka et al. similarly reported that 94% of women with chronic TTH had poor sleep quality, with impaired sleep parameters such as reduced subjective sleep quality, lower habitual sleep efficiency, and daytime dysfunction showing strong correlations with headache frequency and intensity.⁷ Ødegård et al., in a large population-based survey, further demonstrated that individuals with TTH were three times more likely to experience severe sleep disturbances than headache-

free participants, indicating that sleep problems can significantly heighten headache risk and severity.⁸

Conversely, there is also evidence suggesting that TTH itself may negatively affect sleep quality. Engstrøm et al. observed that patients with TTH reported more awakenings, poorer subjective sleep quality, and increased daytime tiredness compared with healthy controls.⁹ Changes in sleep architecture, including alterations in slow-wave sleep and arousals, suggested that recurrent headache episodes may disrupt restorative sleep and contribute to ongoing sleep inefficiency. These findings imply a reinforcing cycle, in which sleep problems increase headache burden, and chronic TTH further deteriorates sleep quality.

Given this bidirectional relationship, assessing pain intensity in TTH becomes crucial. Pain severity is commonly measured using the Numeric Rating Scale (NRS), a validated instrument that allows patients to rate their pain from 0 (no pain) to 10 (worst imaginable pain). The NRS is favored for its simplicity, reproducibility, and sensitivity to changes in pain levels, making it particularly suitable for epidemiological and clinical research in student populations.¹⁰ Despite the growing evidence linking poor sleep and headache burden, few studies have specifically examined how sleep duration relates to TTH pain intensity among medical students. To address this gap, the present study investigates the relationship between sleep duration and NRS-measured pain severity in medical students with TTH at Universitas Pelita Harapan.

Materials and Methods

This study employed a cross-sectional analytic design to investigate the correlation between sleep duration and pain scale among medical students at Universitas Pelita Harapan who experienced tension-type headache. The study was conducted from February to May 2025 at the Faculty of Medicine, Universitas Pelita Harapan.

Participants were selected through purposive sampling. From a total of 186 respondents, 84 were included in the final analysis, a total of 102 respondents were excluded due to not meeting the inclusion criteria, including not fulfilling the diagnostic criteria for tension-type headache, having high stress levels (PSS >26), a history of head trauma, or incomplete questionnaire responses. The inclusion criteria were active medical students who had experienced headache within the past month and were identified as having TTH based on a validated screening questionnaire adapted from HO K-H and Ong BK-C. All participants provided informed consent prior to participation. Exclusion criteria included a history of head trauma within the past six months, high levels of psychological stress as measured by the 10-item Perceived Stress Scale (PSS), and incomplete questionnaire responses.

The minimum required sample size was calculated using the Lemeshow formula for comparing two independent proportions¹¹, assuming a two-sided significance level of 5% ($\alpha = 0.05$) and a statistical power of 90% ($\beta = 0.10$). The expected proportions were obtained from the study by Putra et al.¹² Based on these assumptions, the minimum required

sample size was 42 participants per group (84 participants in total). The final sample comprised 84 participants, meeting the calculated minimum sample size.

Data collection was conducted using a structured, self-administered questionnaire comprising four sections: demographic data, TTH screening, pain intensity, and sleep duration. TTH was assessed using a 13-item questionnaire adapted from HO K-H and Ong BK-C, which aligns with the diagnostic features of tension-type headache. Pain intensity was measured using the Numeric Rating Scale (NRS), categorized into mild (1–3), moderate (4–6), and severe (7–10).¹³ For statistical analysis, pain intensity categories were further dichotomized into mild and moderate-severe to meet the assumptions required for 2x2 contingency table analysis and odds ratio calculation. Sleep duration was self-reported and categorized as sufficient (≥ 7 hours) or insufficient (< 7 hours) per National Sleep Foundation (NSF) guidelines.¹⁴ Stress levels were assessed the Indonesian version of the 10-item Perceived Stress Scale (PSS-10); which was validated by Asram et al. with all items showing acceptable validity ($r > 0.333$) and high reliability (Cronbach's $\alpha = 0.888$).¹⁵ Stress levels were categorized as low (0–13), moderate (14–26), and high (27–40).¹⁶ To reduce psychological confounding, only respondents with low or moderate stress levels (PSS ≤ 26) were included in the final analysis.

Statistical Analysis

All collected data were compiled using Microsoft Excel and analyzed using SPSS version 23.0. Descriptive statistics

were used to summarize participant characteristics, sleep duration, and pain intensity. The association between sleep duration and pain scale was assessed using the Pearson Chi-Square test. For dichotomous analysis, the Continuity Correction method was applied to calculate odds ratios (ORs) with 95% confidence intervals (CIs). A p-value of <0.05 was considered statistically significant.

Because the primary objective of this study was to determine whether insufficient sleep was associated with an increased likelihood of clinically relevant headache pain, the Numeric Rating Scale (NRS) was categorized *a priori* into mild (scores 1–3) and moderate-to-severe pain (scores 4–10) using conventional cut-off points widely applied in pain and headache research.^{12,17} This categorization enabled the outcome to be analysed as a binary variable and facilitated estimation of the odds ratio, which provides a clinically meaningful measure of association for epidemiological studies. Accordingly, the association between sleep duration and headache pain severity was evaluated using the Chi-square test.

Results

A total of 186 respondents were assessed for eligibility. After applying the inclusion and exclusion criteria, 84 participants were included in the final analysis, while 102 respondents were excluded: 98 did not meet the diagnostic criteria for tension-type headache, one had severe stress, and three had a history of head trauma.

Table 1 presents the demographic and clinical characteristics of the 84 study participants. The majority were female (70.2%), and more than half were in their third year of study (53.6%). Most participants reported insufficient sleep duration (<7 hours) at 65.5%. In terms of TTH pain severity, 39.3% experienced moderate pain, 39.3% severe pain, and only 21.4% reported mild pain. Stress levels were predominantly moderate (60.7%), while 39.3% of participants had low stress levels.

Table 1. Characteristic of Study Participants (n = 84)

Variable	n (84 participants)
Age (years)	
Mean ± SD	19.17 ± 1.01
Median (min–max)	20 (18–21)
Gender, n(%)	
Male	25 (29.8%)
Female	59 (70.2%)
Year of Study, n(%)	
Year 1	30 (35.7%)
Year 2	9 (10.7%)
Year 3	45 (53.6%)
Sleep Duration, n(%)	
Sufficient (≥7 hours)	29 (34.5%)
Insufficient (<7 hours)	55 (65.5%)
TTH Pain Scale, n(%)	
Mild (NRS 1–3)	18 (21.4%)
Moderate (NRS 4–6)	33 (39.3%)
Severe (NRS 7–10)	33 (39.3%)
NRS score	
Mean ± SD	5.57 ± 0.20
Median (min–max)	6 (2–9)
Stress Level	
Low (PSS score 0–13)	33 (39.3%)
Moderate (PSS score 14–26)	51 (60.7%)

Table 2 shows a significant association between sleep duration and TTH pain severity. Pain intensity categories were dichotomized into mild and moderate-severe for the purpose of this analysis. Participants with insufficient sleep were more likely to experience

moderate–severe TTH pain compared to those with sufficient sleep ($p < 0.001$). The odds of having moderate–severe pain among those with insufficient sleep were 32.615 times higher (95% CI: 6.650–159.973) than in participants with sufficient sleep. The relatively high odds ratio observed in this study may be influenced by the small sample size and the presence of low cell counts in the contingency table, which can lead to unstable estimates and wide confidence intervals.

Table 2. Association between Sleep Duration and Risk of Moderate–Severe TTH Pain

Sleep Duration	TTH Pain Scale		p-value	OR (95% CI)
	Mild Pain (NRS 1–3)	Moderate–Severe (NRS 4–10)		
Sufficient (≥ 7 hours)	16	13	$p < 0.001$	32.615 (6.650–159.973)
Insufficient (< 7 hours)	2	53		

Discussion

Tension-type headache (TTH) is one of the primary headaches that is bilateral pressing or squeezing, with mild to moderate pain intensity, and is not accompanied by photophobia, phonophobia, nausea, or vomiting.¹⁸ Sleep is defined as an unconscious state in which a person can be awakened by sensory or other stimuli. Factors that can affect sleep quality are the amount of sleep time, difficulty falling asleep, time spent awake, sleep efficiency, and disturbances during sleep.^{19,20} A history of poor sleep quality and short sleep duration are risk factors for TTH.⁶

This study found that the majority of medical students at Universitas Pelita

Harapan had insufficient sleep duration (55 respondents) and tended to experience moderate to severe tension-type headache (TTH) pain, with 33 respondents reporting moderate pain and 33 respondents reporting severe pain. Bivariate analysis using the Pearson Chi-Square test demonstrated a significant association between sleep duration and TTH pain scale ($p < 0.001$), which was further supported by the Continuity Correction test results (95% CI = 6.650–159.973).

These findings are consistent with previous studies indicating that inadequate sleep duration increases both the frequency and intensity of tension-type headaches. Vgontzas et al. (2020) reported that individuals sleeping less than 7 hours per day have a higher risk of developing chronic headaches compared to those with adequate sleep duration.²¹ Similarly, in a study among university students, found a significant relationship between poor sleep quality and increased headache intensity.⁶

Physiologically, insufficient sleep can affect central pain modulation systems in the brain, including the thalamus, somatosensory cortex, and limbic system, which are involved in pain perception.²² Reduced sleep duration may disrupt the regulation of neurotransmitters such as serotonin and dopamine, both of which play key roles in the pathophysiology of TTH.²³ Additionally, sleep deprivation can trigger increased stress levels and activate the hypothalamic-pituitary-adrenal (HPA) axis, leading to pericranial muscle tension and subsequent headache onset.²⁴

The implications of these findings highlight the importance of sleep management education for medical students, given that academic demands often compromise sleep duration.^{25,26} Raising awareness about adequate sleep and implementing stress management strategies may serve as effective interventions to reduce the prevalence of TTH in this population.^{6,25}

There are several limitations to this study. First, this study has limitations in terms of the number of respondents, where only about 25% of the total students from three batches participated in filling out the questionnaire, so the results of the study are not representative of the overall prevalence of Tension-Type Headache (TTH) in the target population. Second, in this study, the method of diagnosing Tension-Type Headache (TTH) was only based on questionnaires, so its accuracy is still limited. Third, the pain scale assessment was only asked in general when respondents experienced headaches, without clarifying whether it referred to the last pain scale, so the data obtained may not accurately reflect the pain scale.

Some methodological considerations should also be acknowledged. Pain intensity was analysed as a dichotomised variable (mild versus moderate–severe) rather than as a continuous score. Although this approach improves clinical interpretability and permits estimation of an odds ratio, it inevitably discards information on the gradation of pain within each category and may over- or underestimate the strength of the association. The wide confidence interval

observed here, driven by the small number of participants in the mild-pain/insufficient-sleep cell, should therefore be interpreted with caution, and the point estimate of the odds ratio should not be taken as a precise measure of effect size. Future studies with larger samples should analyse NRS scores as a continuous or ordinal outcome, for example using correlation or ordinal regression models.

Conclusion

This study demonstrates a significant association between short sleep duration and higher pain intensity in medical students with tension-type headache. Students with insufficient sleep were more likely to report moderate to severe headache pain. However, due to the cross-sectional design, causal relationships cannot be established. Further longitudinal studies are needed to better understand the direction and mechanisms of this relationship.

Conflict of Interest

The authors declared no conflict of interest.

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