

THE RELATIONSHIP BETWEEN SHORT-TERM INSOMNIA AND SHORT-TERM MEMORY IN UNDERGRADUATE MEDICAL STUDENTS OF UDAYANA UNIVERSITY

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ABSTRACT

Background: Students at the Faculty of Medicine, Udayana University, engage in a wide variety of academic and non-academic activities, such as competitions and organizational activities. Sleep deprivation can impact concentration, decision-making, and participation in daily activities. Short-term insomnia is one reason why students at the Faculty of Medicine, Udayana University, cannot get enough sleep. Insomnia can reduce short-term memory performance, making it difficult to remember what has happened and learned during the day. When someone experiences insomnia, one of the symptoms is fatigue, which disrupts concentration related to memory. This can lead to a decline in a student's academic performance. **Objective:** To investigate the correlation between short-term insomnia and short-term memory performance among undergraduate medical students at Udayana University.

Methods: This study used a cross-sectional analytic design. Seventy-nine students were recruited using consecutive sampling. Data were collected through structured interviews with questionnaires and short-term memory tests. Statistical analysis used the Spearman correlation test with a significance level of $p < 0.05$.

Results: The data analysis results point out that out of 236 respondents who completed the questionnaire, 79 experienced insomnia, comprising 45 females (57%) and 34 males (43%). The respondents were predominantly 21 years old (70 respondents, 88.6%), followed by those aged 22 (9 respondents, 11.4%). The results of the Spearman analysis demonstrated a significant weak correlation between short-term insomnia and short-term memory, with a correlation coefficient of -0.320 and a significance value of 0.004.

Conclusion: A study of the relationship between short-term insomnia and short-term memory in undergraduate medical students at the Faculty of Medicine, Udayana University, found a weak and significant relationship between insomnia and short-term memory.

Keywords : students, short-term insomnia, short-term memory.

INTRODUCTION

College student is a term referring to an individual pursuing education at a university. Specifically, students at the Faculty of Medicine, Udayana University engage in a wide range of academic and non-academic activities, such as competitions and organizational responsibilities, which involve various physiological processes, one of which is sleep. Sleep is a resting process experienced by every individual and is vital for health¹. While sleep is essential for restoring bodily functions, this need is often not adequately met due to various factors that may subsequently lead to health disturbances. Insomnia serves as a primary cause of unmet sleep needs among students of the Faculty of Medicine, Udayana University. Factors contributing to

insomnia in students include academic stress such as anxiety regarding exams and accumulating assignments late-night gaming, personal issues like breakups or the loss of a loved one, and unhealthy lifestyles such as smoking and caffeine consumption before bedtime.

Physiologically, sleep is a state of rest wherein the body undergoes recovery of stamina and energy, as well as the restoration of bodily and brain functions aimed at homeostasis, brain restoration, immune function, repair of damaged cells, and maintenance of metabolic and biochemical balance^{2,3}. Sleep comprises two main stages: rapid eye movement (REM) and non-rapid eye movement (NREM). REM sleep is a condition where cortical activity becomes desynchronized with increased metabolism and rapid eye movements, playing a role in

processing new sensory and motor information. Conversely, NREM sleep is characterized by relatively low brain activity but preserved body movement, functioning in cognitive processes and sleep homeostasis^{4,5}. Furthermore, sleep is regulated by biological rhythms or circadian rhythms. When the circadian rhythm is active and peaked, an individual remains awake; conversely, when it is low, the individual falls asleep⁶. Adolescent sleep patterns often differ due to changes at the end of puberty that cause them to sleep late at night yet require waking up early for school, resulting in shortened sleep duration⁷.

When sleep rhythm and quality are disrupted, a condition known as sleep disorder (somnipathy) arises. This is a medical disorder affecting sleep patterns that can impair an individual's mental, social, emotional, and physical functions⁸. These disorders encompass the inability to sleep at night, frequent awakenings, or the inability to return to sleep after waking^{9,10}. The etiology is multifactorial, including physical illnesses (such as pain), environmental conditions, emotional stress, fatigue, and the influence of alcohol, smoking, and diet¹¹. Shift work sleep disorder is also prevalent among those working night rotations¹². In the context of the Faculty of Medicine, Udayana University, a 2015 study indicated that the prevalence of sleep disorders tends to be higher in females compared to males, although other studies suggest the difference is not significant¹³. The primary triggers include migration (living away from home), academic challenges, economic issues, and adaptation to new environments.

An inability to fulfill sleep requirements in both quality and quantity characterizes insomnia, one of the most common sleep disorders, causing excessive daytime sleepiness¹⁴. The primary symptoms are difficulty initiating and maintaining sleep¹⁵. According to Spielman, insomnia is caused by three factors: predisposing (demographic, biological, psychological), precipitating (illness, life pressure), and perpetuating (behavioral and cognitive changes)¹⁶. In students, insomnia is closely related to excessive gadget use for assignments, social media, or online gaming. Higher gadget usage correlates with greater disruption of melatonin regulation¹⁴. Additionally, situational stress, anxiety about the future, and the consumption of stimulants like coffee are dominant factors^{17,18}. Insomnia can also manifest as a pathophysiological consequence of other diseases or anxiety resulting from a disease diagnosis¹⁹.

According to the International Classification of Sleep Disorders, Third Edition (ICSD-3), insomnia consists of three major categories, including chronic, short-term, and other insomnia disorders. Individuals with chronic insomnia experience ongoing problems with sleep initiation or maintenance that result in daytime consequences, persisting for at least three months with a frequency of three times per week, and can occur in isolation or comorbid with other conditions. Meanwhile, Short-term Insomnia involves sleep dissatisfaction lasting less than three months, often triggered by stress or occurring episodically with symptoms such as fatigue and irritability. The other insomnia disorder category is reserved for individuals who exhibit specific insomnia symptoms but don't strictly meet the full diagnostic criteria for either chronic or short-term classifications⁴⁷. Insomnia is classified into primary (unrelated to other medical conditions/substances) and secondary (related to substance abuse or health issues)¹⁵. Based on duration, it is divided into short-term insomnia (lasting days/weeks) and

chronic insomnia (persisting for at least 3 nights/week for months)²⁰. Severity is measured using the Insomnia Severity Index (ISI), ranging from no insomnia (score <8), mild (8-14), moderate (15-21), to severe (≥ 22). Higher scores indicate a greater impact on physical, mental, and quality of life aspects^{21,22}. The primary mechanism explaining chronic insomnia is the neurocognitive model and hyperarousal. Hyperarousal is a state of heightened cognitive, emotional, and physiological arousal persisting throughout the 24-hour cycle. This is characterized by elevated body temperature, heart rate, and cortisol and adrenaline levels that disrupt sleep^{23,24}. Increased Corticotrophin-Releasing Hormone (CRH) from the hypothalamus also causes increased sleep EEG frequency and a reduction in slow-wave sleep.

Beyond environmental and behavioral factors, genetics also play a role. The heritability of insomnia suggests that specific gene variants, such as Single Nucleotide Polymorphisms (SNPs) and Variable Number Tandem Repeats (VNTRs), can increase risk. Examples include the 5HTTLPR gene (serotonin transport) and MAO-A gene (serotonin metabolism), as well as the Apoe4 allele associated with increased insomnia incidence²⁵. Genetic analysis shows signal enrichment in the prefrontal cortex and basal ganglia. Regarding treatment, an understanding of orexin neuropeptides—which trigger wakefulness—has led to new therapeutic strategies. Orexin receptor antagonists have been developed to block these wakefulness signals, thereby inducing drowsiness and increasing sleep duration to aid insomnia patients²⁶.

Adequate sleep is crucial for memory. Memory is a cognitive activity involving the encoding, storage, and retrieval of information^{27,28}. The process of remembering can take the form of recall (without cues), recognition (with cues), or redintegrative (linking concepts). Memory is divided into short-term (working memory) and long-term memory. Short-term memory has limited capacity (5-9 items) and brief duration but significantly influences daily cognitive speed^{29,30}. It can be measured using the Digit Span Test (Forward and Backward), where the normal score is approximately 6 ± 1 ^{31,32}. Meanwhile, long-term memory encompasses episodic (personal experiences), semantic (general facts), and procedural (skills) memory, which are stored over long periods²⁷.

The correlation between insomnia and memory decline is significant. Common insomnia symptoms such as fatigue and lack of concentration directly impair memory function because sleep serves to enhance neuronal plasticity and memory consolidation^{12,20,33}. The mechanism involves the HPA axis. Stress in students activates the HPA axis, triggering cortisol spikes and hyperarousal that interfere with sleep onset^{34,35}. Chronic cortisol elevation and epinephrine activity can trigger vasoconstriction and hypertension through the renin-angiotensin-aldosterone system (RAAS)³⁶. Hypertension and reduced cerebral blood flow, particularly to the hippocampus, threaten cortical and subcortical tissue health, leading to cognitive decline and short-term memory impairment^{37,38,39}. However, cognitive function can be restored through exercises that stimulate neuroplasticity^{40,41}.

METHODS

This research employs an observational analytic design with a cross-sectional approach, conducted at the Faculty of Medicine, Udayana University from February to July 2025. The target population comprises active undergraduate medical students from the class of 2022, with a minimum sample size of 71 respondents calculated using Slovin's formula from a total population of 236 individuals. The sampling technique utilizes consecutive sampling, wherein recruitment is conducted via the distribution of questionnaires to eligible students until the required quota is fulfilled.

Subject selection is strictly governed by specific inclusion and exclusion criteria. The inclusion criteria encompass students experiencing short-term insomnia according to ICSD-3 standards who agree to sign the informed consent. Conversely, the exclusion criteria disqualify students presenting with comorbid sleep disorders (like chronic insomnia, snoring, nightmares, or sleep-related movement disorders), severe physical or psychiatric morbidity, chronic pain, obesity, as well as those currently consuming alcohol or sleep-related medications.

The independent variable in this study is insomnia, defined as persistent difficulty in sleep initiation, duration,

and quality²⁰. Its severity is measured using the Insomnia Severity Index (ISI) questionnaire on an ordinal scale categorized from mild to severe²². The dependent variable is short-term memory, defined as a limited information storage system²⁷, which is evaluated using the Digit Span Test (Forward and Backward) to assess the capacity to recall the final digit series, with scores interpreted across low, moderate, and high ranges³².

The collected data will undergo editing, coding, and entry phases before being processed using SPSS software for Mac version 29. Univariate analysis was conducted to characterize insomnia severity and memory capability, after which bivariate analysis using the Spearman correlation test was performed to assess the association between insomnia and short-term memory in the study sample.

RESULTS

The data collection process involved structured interviews and questionnaires, accompanied by memory assessments lasting 15–20 minutes, conducted on 79 respondents who met the inclusion criteria out of the 236 students who provided informed consent.

Tabel 1. Data characteristic

Variable	Frequency	Percentage (%)
Gender		
Male	34	43
Female	45	57
Age		
21 years old	70	88,6
22 years old	9	11,4
Total	79	100

Demographic characteristics of the subjects revealed a relatively homogeneous age range, dominated by 70 respondents aged 21 years, while the remaining 9 were aged 22 years. Additionally, the proportion of female respondents

(57%) was recorded as higher than that of males (43%), indicating a trend in insomnia prevalence based on gender within this population.

Tabel 2. Severity of short-term insomnia based on the ISI

Insomnia categories	Frequency	Percentage (%)
Mild insomnia	69	87,3
Moderate insomnia	9	11,4
Severe insomnia	1	1,3
Total	79	100

Descriptively, measurements by utilizing ISI demonstrated that the majority of respondents experienced mild insomnia,

accounting for 69 individuals (87.3%), followed by moderate insomnia with 9 individuals (11.4%), and only 1 individual (1.3%) suffering from severe insomnia. Concurrently, the evaluation of cognitive function using the *Digit Span Test*

indicated that most respondents with these sleep disturbances maintained short-term memory capacity within the moderate category, although variations showing both decline and improvement were observed in some individuals.

Tabel 3. Spearman Bivariate Analysis Results

		Insomnia	Short-term memory
Insomnia	Correlation Coefficient	1.000	-.320*
	Sig. (2-tailed)	.	.004
	N	79	79
Short-term memory	Correlation Coefficient	-.320*	1.000
	Sig. (2-tailed)	.004	.
	N	79	79

Bivariate statistical analysis using the Spearman Rank correlation test yielded a significance value of $p=0.004$ ($p<0.05$), confirming a statistically significant relationship between the two variables. The correlation coefficient of -0.320 indicates a negative relationship with weak strength. This suggests that as the severity of insomnia increases among students, there is a tendency for short-term memory capability to decline, although the correlation between these variables is classified as weak.

DISCUSSION

Data analysis based on gender reveals that the prevalence of insomnia in female respondents (57%) is higher compared to males (43%). This finding aligns with a 2025 global epidemiological study noting that among 852,325,091 adults with insomnia, the prevalence in females reached 501,588,081, significantly surpassing males¹¹. Similar trends were found in various student populations, such as Medical Faculty students in Kupang²⁴, Medical Faculty students at Atma Jaya Jakarta¹⁶, high school students in Denpasar⁵, and high school students in Ambarawa^{5 9}. A meta-analysis in China also confirmed that females have a more significant risk of insomnia ($OR = 1.58$; $p < 0.0001$)^{6 1}. The high prevalence in females is multifactorial, encompassing susceptibility to socio-economic factors, risk of mental disorders like depression and anxiety, and hormonal fluctuations during the menstrual cycle that affect sleep architecture and circadian rhythms¹⁰. Meanwhile, age-based analysis shows a dominance of respondents aged 21 years (70 individuals) compared to 22 years (9 individuals). This reflects the vulnerability of students in this age range to insomnia due to academic burden, stress, and gadget exposure, as explained in a case study during the pandemic²⁹.

Based on the Spearman Rank test, a correlation coefficient of -0.320 was obtained with a significance of $p = 0.004$ ($p < 0.05$). This result indicates a weak negative

correlation; implying that higher insomnia scores correlate with lower short-term memory scores, and vice versa^{6 12}. These findings are consistent with research on high school students in Batam^{5 2}, Medical Faculty students at Tarumanagara University^{4 2}, and a cohort study in India showing significant cognitive deficits in insomnia sufferers³⁶. This decline in memory function relates to the definition of insomnia according to ICSD-3, where disturbances in sleep quality and quantity impede cognitive recovery^{4 7}. However, these results differ from studies on the 2019 cohort of Medical students at Udayana University¹³ and YARSI University Medical Faculty^{4 5}, which found no significant relationship between sleep variables and memory retention.

Short-term memory decline in insomnia patients occurs due to the disruption of the brain's restorative functions. Poor sleep quality causes fatigue and decreased concentration, which hinders the memory storage process³⁷. Molecularly, sleep deprivation triggers an increase in proinflammatory cytokines such as Interleukin-6 and C-reactive protein, leading to inflammation in the hippocampus the memory control center via the NF- κ B pathway. Activation of this pathway disrupts the circadian clock and elevates cortisol levels in the Hypothalamus-Pituitary-Adrenal (HPA) axis, which directly negatively impacts cognitive function and short-term memory^{5 5}.

Although a negative correlation exists, the weak strength of the relationship in this study can be explained through brain compensatory mechanisms, namely neuroplasticity and Cognitive Reserve (CR). Neuroplasticity allows the brain to undergo structural reorganization, such as changes in grey matter volume and axonal connectivity, triggered by intensive learning in the medical education environment. This process can compensate for cognitive decline due to insomnia so that the resulting memory deficit is not excessive¹⁴. Additionally, medical students tend to possess high Cognitive Reserve, formed by educational background, IQ, and complex intellectual activity. High CR enables the

brain to maintain cognitive function despite experiencing physiological disturbances like insomnia. Therefore, the impact of insomnia on short-term memory decline in this population can be mitigated by their cognitive reserve capacity^{4 0 .5 3}.

CONCLUSION

As shown by the results of the study, on the relationship between short-term insomnia and short-term memory in students of the Faculty of Medicine, Udayana University, there was a significant weak relationship between insomnia and short-term memory.

ETHICS STATEMENT

The study was conducted following the issuance of ethical clearance by the Ethics Committee of the Faculty of Medicine, Udayana University, under reference number 1387/UN14.2.2.VII.14/LT/2025. The research commenced in June 2025, involving students from the Undergraduate Medical Study Program at Faculty of Medicine, Udayana University, Class of 2022, in Denpasar, Bali. Data collection was performed through structured interviews using a questionnaire.

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