

Original Research Article

Sleep Quality and Gastroesophageal Reflux Disease Symptoms: A Cross-Sectional Study Among Medical Students in Surabaya

ABSTRACT

Declining sleep quality and rising complaints of Gastroesophageal Reflux Disease (GERD) are common among medical students, driven by academic pressure and unhealthy lifestyle patterns. However, evidence on sleep quality as an independent explanatory factor for GERD symptoms in Indonesian medical student populations remains limited. This study aimed to analyze the association between sleep quality and GERD symptoms among medical students in Surabaya. A cross-sectional analytical observational design was employed, involving 120 students from the 2022–2024 intakes at Hang Tuah University, selected through purposive sampling. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), and GERD symptoms were assessed using the GERD-Q questionnaire. Data were analyzed using univariate description and Spearman's rho correlation. The results show that 85.0% respondents had poor sleep quality, and 59.2% were classified as likely to have GERD. Bivariate analysis revealed a statistically significant, weak-to-moderate positive correlation between sleep quality and GERD symptoms ($r = 0.256$; $p = 0.005$, two-tailed). These findings indicate that poorer sleep quality is associated with greater GERD symptom burden among medical students, supporting the inclusion of sleep hygiene and stress-management components alongside conventional dietary and pharmacological approaches in GERD prevention strategies within medical education settings.

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Article Info

Submitted : 01 June 2026
In reviewed : 05 June 2026
Accepted : 05 August 2026
Available Online : 03 Okt 2026

Keywords:

Sleep Quality;
Gastroesophageal Reflux Disease;
Medical Students.

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How to Cite:

Abdullah SN et al, 2026, Sleep Quality and Gastroesophageal Reflux Disease Symptoms: A Cross-Sectional Study Among Medical Students in Surabaya, Jurnal Berkala Kesehatan, 12(2): 89-96.

INTRODUCTION

Gastroesophageal Reflux Disease (GERD) is a chronic gastrointestinal disorder characterized by the recurrent reflux of gastric contents into the esophagus, leading to symptoms such as heartburn and regurgitation.¹ When this condition persists over time, prolonged acid exposure to the esophageal mucosa may result in irritation, histopathological changes, and an increased risk of Barrett's esophagus and esophageal carcinoma, conferring substantial clinical burden beyond symptomatic discomfort.^{2,3} Globally, GERD prevalence has risen markedly over the past two decades. The World Gastroenterology Organization (2015) reported western countries consistently record prevalence rates exceeding 20%,

whereas East Asian regions consistently demonstrate lower figures, generally below 10%, suggesting that environmental, dietary, and behavioral factors play a meaningful role in modulating disease expression across populations. In Indonesia, nationally representative epidemiological data on GERD remain limited. However, hospital-based evidence indicates that the condition carries clinical significance in local settings. A study conducted at Karawang Regional Hospital reported a GERD prevalence of 55.6%, with age, dietary patterns, and lifestyle behaviors identified as contributing risk factors⁴. Although this estimate derives from a single clinical setting and may not reflect population-level prevalence, it nonetheless underscores that GERD constitutes a relevant public health concern in Indonesia and warrants further investigation in specific population groups, including those with distinct behavioral risk profiles.

Established risk factors for GERD encompass a broad range of lifestyle and behavioral determinants, including obesity, smoking, alcohol consumption, consumption of trigger foods such as coffee and spicy meals, psychological stress, physical inactivity, and a positive family history of reflux disease.^{5,6} Among these, sleep disturbance has attracted increasing scientific attention as a factor that may not merely result from GERD, but may independently contribute to its pathogenesis through measurable biological mechanisms. Sleep deprivation has been shown to increase esophageal acid exposure.^{7,8} Notably, among GERD patients, the proportion with abnormal pH testing rose from 54.5% following normal sleep to 90.9% following deficient sleep, while healthy controls also showed a significant increase in reflux parameters after sleep deprivation compared with normal sleep conditions. Beyond acid exposure, sleep deprivation exerts a hyperalgesic effect on esophageal perception, lowering the sensitivity threshold such that even mild reflux stimuli are perceived as more severe symptoms through central sensitization mechanisms.⁷ Additionally, impaired sleep quality is associated with decreased esophageal peristalsis, prolonged nocturnal acid clearance, and dysregulation of autonomic function specifically, increased sympathetic and reduced parasympathetic activity all of which may further facilitate mucosal injury and symptom amplification.⁹ A systematic review and meta-analysis by Tan et al. (2024) subsequently confirmed a statistically significant bidirectional relationship between GERD and sleep disturbance across multiple populations, reinforcing that these two conditions mutually exacerbate one another rather than following a unidirectional causal pathway.⁷ Nevertheless, the relative contribution of sleep quality as an independent explanatory variable in GERD symptom development, particularly in non-clinical populations remains insufficiently characterized.

Medical students represent a population with a documented and quantifiable burden of sleep insufficiency that distinguishes them from the general adult population. A systematic review and meta-analysis encompassing 109 studies and 59,427 participants reported that the average sleep duration among medical students globally is only 6.5 hours per night falling below the 7–9 hours per night recommended by the American Academy of Sleep Medicine with at least 30% obtaining less than the minimum recommended threshold. The pooled prevalence of poor sleep quality in this population reaches 55.64%, with an additional 33.32% experiencing excessive daytime sleepiness.¹⁰ This pattern of chronic short sleep is structurally driven by high academic workloads, intensive examination cycles, irregular study schedules, and sustained psychological stress collectively compress available sleep time and disrupt sleep architecture.¹¹ Chronic academic stress further activates the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system, inducing physiological hyperarousal that simultaneously impairs sleep initiation and maintenance while heightening visceral sensitivity.¹² The convergence of these mechanisms chronic sleep deficit averaging 6.5 hours per night, autonomic dysregulation, and heightened esophageal sensitivity positions medical students as a population in which sleep-related GERD risk may be substantially elevated relative to the general population, yet remains poorly characterized empirically.^{13,14}

Despite the mechanistic plausibility of a sleep–GERD association in medical students, important gaps persist in the existing literature. First, most prior studies have been conducted in general adult or clinical populations, and their findings cannot be readily extended to young academic cohorts such as medical students, who present with distinct behavioral patterns, stress profiles, and physiological characteristics. Second, while sleep disturbance has been increasingly recognized as a potential contributor to GERD pathogenesis, most available studies in Indonesia have examined sleep quality solely as a downstream consequence of gastrointestinal symptoms, rather than as an upstream explanatory variable. Third, no study has specifically examined the association between sleep quality and GERD symptoms among medical students in Surabaya using two concurrently administered, locally validated instruments. This gap in population-specific evidence limits the scientific foundation for designing sleep-targeted health interventions within medical education settings in Indonesia.

This study addresses these gaps by examining the association between sleep quality and GERD symptoms among medical students at Hang Tuah University, Surabaya. The novelty of this study lies in three aspects: the concurrent use of two locally validated instruments, the positioning of sleep quality as an independent explanatory variable rather than a dependent outcome, and the focus on a specific academic cohort in Surabaya for which no prior empirical data exist. Although the cross-sectional design precludes causal inference and the absence of covariates limits control for confounding, the findings are intended to provide preliminary evidence to inform the development of sleep-based promotive and preventive health strategies within medical education settings, and to serve as a reference for future longitudinal and multivariable studies capable of more rigorously characterizing the sleep–GERD relationship in Indonesian student populations.

METHODS

This study employed an analytical observational design with a cross-sectional approach to examine the association between sleep quality and GERD symptoms among medical students of the Faculty of Medicine, Hang Tuah University, Surabaya. The study population comprised all active medical students from the 2022, 2023, and 2024 student intakes, totaling 713 individuals. The minimum required sample size was calculated using the Slovin formula with a 10% margin of error, yielding a minimum threshold of 88 respondents; the study ultimately enrolled 120 respondents, exceeding this minimum requirement. Participants were selected using purposive sampling, whereby students were recruited based on predetermined eligibility criteria rather than random or exhaustive selection from the full population. Inclusion criteria were: (1) active enrollment as a medical student in the 2022, 2023, or 2024 intake at the Faculty of Medicine, Hang Tuah University, Surabaya; and (2) willingness to participate and provide written informed consent prior to data collection. Exclusion criteria were: (1) incomplete questionnaire responses that precluded accurate scoring of the PSQI or GERD-Q; and (2) duplicate submissions identified from the same respondent.

Sleep quality was measured using the Indonesian-language Pittsburgh Sleep Quality Index (PSQI), validated by Setyowati and Chung (2020) in a sample of 528 Indonesian adolescents aged 13–16 years, demonstrating adequate internal consistency (Cronbach's $\alpha = 0.72$), satisfactory item-total correlations ($r = 0.36\text{--}0.56$), construct validity against the Beck Depression Inventory-II ($r = 0.22$, $p < 0.05$), and acceptable discriminative ability (AUC = 0.74; the original validation study did not report a corresponding 95% confidence interval).¹⁵ Respondents were categorized as having good sleep quality (global PSQI score ≤ 5) or poor sleep quality (global PSQI score > 5), following the original threshold established by Buysse et al. (1989), which remains the internationally accepted standard across adult populations.¹⁶ As the validation sample consisted of adolescents rather than young adults, this constitutes a methodological limitation, and re-validation of the PSQI within a medical student population is warranted. GERD symptoms were measured using the Indonesian-language GERD Questionnaire (GERD-Q), validated by Simadibrata et al. (2011) in 40 endoscopically confirmed GERD patients across Jakarta, Bandung, and Surabaya (Cronbach's $\alpha = 0.834$). Respondents scoring ≤ 7 were classified as unlikely to have GERD, and those scoring 8–18 was classified as likely to have GERD, consistent with the instrument's established diagnostic threshold.¹⁷ As with the PSQI, the GERD-Q validation sample consisted of clinically diagnosed adult patients rather than an asymptomatic student population, representing a comparable limitation in cross-population applicability.

Data were collected using a self-administered questionnaire distributed via Google Forms incorporating the informed consent sheet, PSQI, and GERD-Q. Eligible participants completed the questionnaires independently online. Submitted responses were screened for completeness and consistency prior to analysis. Data were exported to Microsoft Excel for cleaning, including removal of duplicate and incomplete entries. Statistical analyses were performed using SPSS 27 Version. Univariate analysis described the frequency distribution and percentage of each variable. Bivariate analysis examined the association between sleep quality and GERD symptoms using Spearman's rho correlation test, given the ordinal scale of both variables, with statistical significance set at $p < 0.05$. This study underwent ethical review by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Hang Tuah. The study was subsequently approved and granted ethical clearance under No. I/179/UHT.KEPK.03/XI/2025. All research procedures were conducted in accordance with established ethical principles, including respect for participants' autonomy, assurance of data confidentiality, and the acquisition of written informed consent prior to data collection.

RESULT AND DISCUSSION

Univariate Results

Table 1. Frequency Distribution of Sleep Quality among Medical Students of Hang Tuah University Surabaya 2022-2024

Category	Frequency	Percentage
Poor	102	85
Good	18	15
Total	120	100

Source: Primary Data, 2025

Based on the table above, the majority of medical students from the 2022–2024 cohorts at Hang Tuah University, Surabaya, had poor sleep quality, with 102 respondents (85.0%) classified in the poor category, while only 18 students (15.0%) demonstrated good sleep quality. The predominance of poor sleep quality indicates that most respondents experienced disturbances in sleep duration, sleep latency, and sleep efficiency. The very high prevalence of students with poor sleep quality observed in this study indicates that medical students are experiencing a state of chronic sleep deficit. This finding is consistent with the stress–sleep dysregulation theory. This framework posits that sustained cognitive and emotional demands activate the hypothalamic pituitary adrenal (HPA) axis and the sympathetic nervous system, resulting in hyperarousal that disrupts sleep initiation and maintenance.¹² Study by Yildirim (2020) reported that university students, particularly those in medical programs, are highly vulnerable to sleep disturbances due to academic pressure, intensive study demands, and performance-related stress. A dense and competitive curriculum often compels students to sacrifice rest time, leading to sleep fragmentation and reduced sleep efficiency.¹⁸ From a physiological perspective, chronic sleep disruption alters autonomic nervous system regulation and increases sympathetic activity, which may subsequently influence gastrointestinal function.^{19,20}

Table 2. Frequency Distribution of GERD Symptoms among Medical Students of Hang Tuah University Surabaya 2022–2024

Category	Frequency	Percentage
Unlikely to Have GERD	49	40.8
Likely to Have GERD	71	59.2
Total	120	100.0

Source: Primary Data, 2025

Table 2 shows that the majority of medical students from the 2022–2024 cohorts at Hang Tuah University, Surabaya, were classified as likely to have GERD, with 71 respondents (59.2%) falling into this category, while 49 students (40.8%) were categorized as unlikely to have GERD. The high proportion of students classified as likely to have GERD in this study further suggests that reflux symptoms are not uncommon in the medical education environment. This result aligns with the biopsychosocial model of gastrointestinal disorders, which emphasizes the interaction between psychological stressors, behavioral factors, and physiological responses.²¹ Study conducted by Vernia et al. (2021) explained that psychological stress increases gastric acid secretion and lowers the esophageal sensitivity threshold, making individuals more prone to perceive reflux symptoms. In other words, an academically demanding environment may create a biological context that facilitates the development of GERD.²² Similarly, Tan et al. (2024) found that students with high perceived stress had significantly higher GERD-Q scores. Compared with clinical populations where structural abnormalities dominate, GERD in student populations appears more strongly driven by functional and stress-related mechanisms.⁸

Bivariate Results

Prior to conducting the bivariate analysis, the distributional characteristics of both variables were considered. As sleep quality (PSQI) and GERD symptoms (GERD-Q) are measured on an ordinal scale, derived from the summation of ordered categorical items rather than continuous measurement, their score distributions are inherently bounded and prone to skewness, particularly within a relatively homogeneous population such as preclinical medical students. Given this ordinal nature and the associated non-normal

distributional pattern, a non-parametric statistical approach was deemed appropriate for testing the association between the two variables. Accordingly, Spearman's rho correlation test was employed, consistent with standard statistical practice for ordinal-scale variables.

Table 3. Spearman's rho Correlation between Sleep Quality and GERD Symptoms

Spearman's rho		PSQI (Sleep Quality)	GERD-Q (GERD Symptoms)
PSQI	Correlation Coefficient	1.000	0.256**
	Sig. (2-tailed)	.	0.005
	N	120	120
GERD-Q	Correlation Coefficient	0.256**	1.000
	Sig. (2-tailed)	0.005	.
	N	120	120

** Correlation is significant at the 0.01 level (2-tailed).

Source: Primary Data, 2025

Based on Table 3, Spearman's rho correlation analysis revealed a statistically significant positive association between sleep quality (PSQI) and GERD symptoms (GERD-Q) among 120 respondents ($r = 0.256$, $p = 0.005$, two-tailed), significant at the 0.01 level. The positive direction of the correlation indicates that respondents with poorer sleep quality tended to report greater GERD symptom burden. Although the correlation strength falls within the weak-to-moderate range ($r = 0.20$ – 0.39), the association is statistically robust and clinically plausible, consistent with established mechanisms linking sleep disturbance to increased esophageal acid exposure, impaired mucosal defense, and heightened visceral sensitivity. These findings support the study hypothesis that sleep quality constitutes a relevant contributing factor to GERD symptom manifestation among preclinical medical students.

The observed association between sleep quality and GERD symptoms in this study is most coherently explained through the bidirectional gut–brain axis framework, which conceptualizes sleep and gastrointestinal function as mutually regulated systems rather than independent processes. Central to this framework is the reciprocal signaling between the central nervous system and the enteric nervous system, mediated via vagal afferent and efferent pathways, through which disruptions in one system propagate measurable physiological consequences in the other.²³ Within this framework, nocturnal reflux episodes are understood not merely as isolated gastrointestinal events but as active disruptors of sleep architecture, while fragmented or poor-quality sleep concurrently undermines the esophagus's own protective mechanisms, creating a self-reinforcing cycle rather than a unidirectional cause-and-effect relationship.¹⁴

Mechanistically, this bidirectionality operates through at least two distinct but complementary pathways. First, sleep fragmentation markedly reduces the frequency of spontaneous swallowing and salivary secretion, both of which are essential for esophageal acid clearance. Zielinski et al. (2016) demonstrated that these physiological changes during sleep prolong mucosal acid exposure time, thereby increasing the likelihood of symptomatic reflux. Second, chronic sleep deprivation appears to lower the esophageal pain threshold through a process of visceral hyperalgesia, such that reflux episodes that would otherwise be subclinical are instead perceived and reported as overt symptoms.²⁴ Zhang et al. (2023) reported that this heightened sensitivity may explain why individuals with poor sleep quality tend to report more pronounced reflux-related complaints even in the absence of marked structural abnormality.²⁵ Considered together, these two pathways offer a physiologically coherent explanation for why sleep quality, despite being only one of several determinants of GERD, demonstrated a statistically significant and clinically interpretable association with symptom burden in this study population.

This finding is broadly consistent with prior investigations conducted specifically among medical student populations. Teimouri and Amra (2021), studying Iranian medical students using the same PSQI instrument alongside a validated reflux symptom scale, similarly reported a significant correlation between poor sleep quality and gastroesophageal symptoms, reinforcing the plausibility of this relationship within academically demanding cohorts.¹³ At the aggregate level, the systematic review and meta-analysis by Tan et al. (2024) further supports this direction of association, reporting a pooled odds ratio of 1.98 (95%

CI = 1.58–2.50) for the relationship between sleep disturbance and GERD across multiple study populations.⁸ However, the present findings should not be interpreted as universally replicated. Notably, Fauzana et al. (2024) reported a markedly different pattern among medical students with Spearman's correlation analysis revealing no significant relationship between sleep quality and GERD. A parallel pattern emerges when sleep duration, rather than quality is examined by Turab et al. (2025), in a cross-sectional study of medical and dental students, similarly found no statistically significant association between hours of sleep and the presence of GERD.²⁶ Taken together, these mixed findings across studies indicate that the relationship between sleep and GERD symptoms, while biologically plausible, is not uniformly observed across populations, and likely depends on contextual and methodological factors that warrant closer scrutiny in future research.

However, the weak-to-moderate strength of the correlation observed in this study ($p = 0.256$) warrants deliberate interpretation rather than dismissal. Rather than undermining the clinical relevance of the finding, this effect size is consistent with the broader empirical understanding of GERD as a multifactorial condition in which sleep quality functions as one contributing determinant among several, including dietary composition, body mass index, psychological stress, and lifestyle behaviors.^{6,27} This positions the present findings within a risk-factor network model rather than a single-cause paradigm, suggesting that sleep quality should be understood as a modifiable component embedded within a broader constellation of GERD risk factors, rather than as a standalone predictor sufficient to explain symptom variation on its own. From an applied standpoint, these findings carry direct implications for student health policy within medical education settings. Given that GERD prevention strategies have traditionally emphasized dietary modification and pharmacological management, the present findings suggest that sleep hygiene interventions and structural adjustments to academic scheduling may constitute an underutilized but physiologically justified complementary strategy. Embedding sleep health education within existing student wellness programs may therefore offer a low-cost, non-pharmacological avenue for mitigating GERD symptom burden among a population already recognized as being at heightened risk for both sleep disturbance and gastrointestinal complaints.

Several limitations temper the interpretation of these findings. The cross-sectional design precludes any inference of causal or temporal directionality between sleep quality and GERD symptoms, meaning that the bidirectional mechanisms discussed above remain theoretically plausible rather than empirically demonstrated within this dataset. Both instruments relied on self-report, introducing the possibility of recall bias and subjective symptom amplification independent of objective physiological measurement. Furthermore, as sleep quality accounted for only a modest proportion of the variance in GERD symptom burden, unmeasured confounders such as dietary intake, body mass index, and psychological stress likely contribute substantially to the residual variation, and their absence from the analytical model constrains the extent to which the observed association can be generalized or clinically applied without further multivariate investigation.

CONCLUSION

This study confirms that sleep quality is significantly associated with GERD symptom burden among medical students in Surabaya, thereby addressing the study's objective of characterizing this relationship in a population and setting for which concurrent, locally validated measurement had not previously been undertaken. Rather than functioning as a standalone predictor, sleep disturbance emerges as one modifiable component within a broader network of GERD risk factors, indicating that sleep-focused interventions such as maintaining a consistent sleep–wake schedule, limiting late-night caffeine and screen exposure, and adjusting examination or clinical rotation schedules to allow adequate rest warrant consideration as a complementary, non-pharmacological strategy alongside existing dietary and stress-management approaches such structured relaxation techniques or access to campus counseling services) in medical education settings. Given the cross-sectional nature of this study, its reliance on self-report instruments, and the lack of adjustment for known confounding factors such as dietary intake, body mass index, and psychological stress, it is recommended that future studies employ a longitudinal and multivariate design with objective measures of sleep and reflux to establish the temporal direction and assess the independent contribution of sleep quality to GERD symptoms in this population

AUTHOR'S CONTRIBUTION STATEMENT

The contribution of each author is as follows: SNA conceptualized the study, collected data, and wrote the entire original draft; HEA contributed to study design, methodology, and manuscript supervision;

FOHP provided guidance on data analysis and manuscript editing; AI contributed to discussion, manuscript review, and final approval.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest related to this article. All authors have no competing financial, personal, or professional interests that could influence the research or its publication.

ACKNOWLEDGMENTS

The authors would like to thank to all medical students who voluntarily participated in this research for their time and valuable cooperation.

REFERENCES

1. Lunawat AK, Raikwar S. Advancements in GERD Treatment: Exploring Innovative Therapies. *Int J Gastroenterol Hepatol Dis* [Internet]. 2024;03. Available from: <https://doi.org/10.2174/0126662906299185240520112218>
2. Maret-Ouda J, Markar SR, Lagergren J. Gastroesophageal Reflux Disease: A Review. *J Am Med Assoc* [Internet]. 2020;324(24):2536–47. Available from: <https://doi.org/10.1001/jama.2020.21360>
3. Hassan HN, Al-Hadrawy ZAA, Shehab S, Al-Fahham AA. Gastroesophageal Reflux Disease: Epidemiology, Pathogenesis and Therapeutic Approaches. *Int J Heal Med Res* [Internet]. 2024;3(7). Available from: <https://doi.org/10.58806/ijhmr.2024.v3i07n11>
4. Fatimah LS, Wikarta DB, Lee YY, Gisrianti RS. Prevalence and Determinants of Gastroesophageal Reflux Disease in a Regional Indonesian Hospital Gastroesophageal Reflux Disease: Patterns and Risk Factors in a West Java Hospital Setting. *Indones J Gastroenterol Hepatol Dig Endosc* [Internet]. 2024;25(2). Available from: <https://doi.org/10.24871/2522024329>
5. Sadafi S, Azizi A, Pasdar Y, Shakiba E, Darbandi M. Risk factors for gastroesophageal reflux disease: a population-based study. *BMC Gastroenterol* [Internet]. 2024;24(1):64. Available from: <https://doi.org/10.1186/s12876-024-03143-9>
6. Haydar A, Saber M, Saleh GN, Al-Banna DA. Lifestyle Factors and Symptoms of Gastroesophageal Reflux Disease: A Cross-sectional Study. *Erbil J Nurs Midwifery* [Internet]. 2022;5(2):98–104. Available from: <https://doi.org/10.15218/ejnm.2022.11>
7. Yamasaki T, Quan SF, Quan SF, Fass R. The effect of sleep deficiency on esophageal acid exposure of healthy controls and patients with gastroesophageal reflux disease. *Neurogastroenterol Motil* [Internet]. 2019;31(12). Available from: <https://doi.org/10.1111/NMO.13705>
8. Tan X, Wang S, Wu F, Zhu J. Bidirectional correlation between gastroesophageal reflux disease and sleep problems: a systematic review and meta-analysis. *PeerJ* [Internet]. 2024;12:e17202. Available from: <https://doi.org/10.7717/peerj.17202>
9. Almojali AI, Almalki SA, Alothman AS, Masuadi EM, Alaqeel MK. The prevalence and association of stress with sleep quality among medical students. *J Epidemiol Glob Health* [Internet]. 2017;7(3):169–74. Available from: <https://doi.org/10.1016/j.jegh.2017.04.005>
10. Alzahrani RA, Albalawi O, Hamzah R, Husni M, BaHammam AS, Vitiello M V., et al. The Worldwide Prevalence of Sleep Problems Among Medical Students by Problem, Country, and COVID-19 Status: a Systematic Review, Meta-analysis, and Meta-regression of 109 Studies Involving 59427 Participants. *Curr Sleep Med Reports* [Internet]. 2023;1–19. Available from: <https://doi.org/10.1007/s40675-023-00258-5>
11. Mohamed NA, Mohamud RYH, Hassan MS, Nur H, Hidigow AMH, Gabow AA, et al. Restless nights, demanding days: assessment of the prevalence and associated factors of poor sleep quality among medical students in Mogadishu, Somalia. *BMC Med Educ* [Internet]. 2025;26(1):70. Available from: <https://doi.org/10.1186/s12909-025-08438-3>
12. Kalmbach DA, Cuamatzi-Castelan A, Tonnu C V., Tran KM, Anderson JR, Roth T, et al. Hyperarousal and sleep reactivity in insomnia: current insights. *Nat Sci Sleep* [Internet]. 2018;10:193–201. Available from: <https://doi.org/10.2147/NSS.S138823>
13. Teimouri A, Amra B. Association between Sleep Quality and Gastroesophageal Reflux in Medical Students. *Middle East J Dig Dis* [Internet]. 2021;13(2):139–44. Available from: <https://doi.org/10.34172/MEJDD.2021.217>
14. Shibli F, Skeans J, Yamasaki T, Fass R. Nocturnal Gastroesophageal Reflux Disease (GERD) and Sleep: An Important Relationship That Is Commonly Overlooked. *J Clin Gastroenterol* [Internet].

- 2020;54(8):663–74. Available from: <https://doi.org/10.1097/MCG.0000000000001382>
15. Setyowati A, Chung MH. Validity and reliability of the Indonesian version of the Pittsburgh Sleep Quality Index in adolescents. *Int J Nurs Pract* [Internet]. 2020;27(2). Available from: https://doi.org/10.1111/ijn.12856?urlappend=%3Futm_source%3Dresearchgate.net%26utm_medium%3Darticle
 16. Veauthier C. Poor versus good sleepers in patients under treatment for sleep-related breathing disorders: better is not good enough. *Neuropsychiatr Dis Treat* [Internet]. 2024;10:131–3. Available from: <https://doi.org/10.2147/NDT.S58970>
 17. Simadibrata M, Rani A, Pangestu AD, Djumhana A. The gastro-esophageal reflux disease questionnaire using Indonesian language: A language validation survey. *Med J Indones* [Internet]. 2011;20(2). Available from: <https://doi.org/10.13181/mji.v20i2.442>
 18. Yildirim S, Ekitli GB, Onder N, Avci AG. Examination of Sleep Quality and Factors Affecting Sleep Quality of a Group of University Students. *Int J Caring Sci* [Internet]. 2020;13(2):1431–1439. Available from: <https://doaj.org/article/29f5289de6114df189e36281eb945860>
 19. Vezenkov S. Sleep, the Nervous System, and the Gut: An Ancient Alliance With Modern Consequences. *Nootism* [Internet]. 2025;1(5):44–8. Available from: <https://doi.org/10.64441/nootism.1.5.4>
 20. Olivares MJ, Toledo C, Ortolani D, Ortiz FC, Díaz HS, Iturriaga R, et al. Sleep dysregulation in sympathetic-mediated diseases: implications for disease progression. *Sleep* [Internet]. 2022;45(11). Available from: <https://doi.org/10.1093/sleep/zsac166>
 21. Wright CD, Heaton B, Garcia RI, Leonard MM, Fasano A, McNeil DW. Gastrointestinal distress as a potential mediator between stress and periodontal inflammation. *Community Dent Oral Epidemiol* [Internet]. 2023;51(6):12501257. Available from: <https://doi.org/10.1111/cdoe.12889>
 22. Vernia F, Di Ruscio M, Ciccone A, Viscido A, Frieri G, Stefanelli G, et al. Sleep disorders related to nutrition and digestive diseases: a neglected clinical condition. *Int J Med Sci* [Internet]. 2021;18(3):593–603. Available from: <https://doi.org/10.7150/ijms.45512>
 23. Tan X, Wang S, Wu F, Zhu J. Bidirectional correlation between gastroesophageal reflux disease and sleep problems: a systematic review and meta-analysis. *PeerJ* [Internet]. 2024;12. Available from: <https://doi.org/10.7717/peerj.17202>
 24. Zielinski MR, McKenna JT, McCarley RW. Functions and Mechanisms of Sleep. *AIMS Neurosci* [Internet]. 2016;3(1):67–104. Available from: <https://doi.org/10.3934/Neuroscience.2016.1.67>
 25. Zhang L, Aierken A, Zhang M, Qiu Z. Pathogenesis and management of gastroesophageal reflux disease-associated cough: a narrative review. *J Thorac Dis* [Internet]. 2023;15(4):2314–23. Available from: <https://doi.org/10.21037/jtd-22-1757>
 26. Turab MS, Awan MA, Masroor L, Amir K, Khan M, Liaquat A. Stress and Gastroesophageal Reflux Disease: Are They Related? *Cureus* [Internet]. 2025;17(2):e79037. Available from: <https://doi.org/10.7759/cureus.79037>
 27. Karim YA, Dewanti L. The Complex Interplay of Pathophysiological, Metabolic, and Behavioral Risk Factors in Gastroesophageal Reflux Disease (GERD): A Literature Review. *Int J Sci Adv* [Internet]. 2025; Available from: <https://doi.org/10.51542/ijscia.v6i6.31>