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EFFECT OF SLEEP QUALITY ON GIT HEALTH

Original Research

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ABSTRACT

Background: Sleep plays a fundamental role in physiological regulation, influencing cognitive, emotional, and metabolic processes. Recent evidence emphasizes its impact on gastrointestinal (GI) health, particularly through the gut-brain axis, circadian rhythms, and gut microbiota. Sleep disturbances have been strongly linked to GI conditions such as irritable bowel syndrome (IBS), gastroesophageal reflux disease (GERD), and inflammatory bowel disease (IBD). However, the exact biological mechanisms underlying this relationship remain incompletely understood, necessitating further exploration.

Objective: This study aimed to assess the impact of sleep quality on gastrointestinal health, with a focus on gut microbiota balance, circadian disruptions, and GI symptoms, while evaluating potential contributing factors such as stress, diet, and physical activity.

Methods: A cross-sectional study was conducted over four months involving 303 adults aged 20–40 years. Participants were recruited from Superior University Lahore and online platforms. Data were collected using a structured questionnaire, including the Pittsburgh Sleep Quality Index (PSQI) and a GI symptom checklist. Demographic variables and lifestyle factors were controlled. Data analysis was performed using SPSS version 26, applying chi-square tests, independent t-tests, ANOVA, and logistic regression to determine the association between sleep parameters and GI outcomes.

Results: Among 303 participants, 39.3% reported poor sleep quality. Gastrointestinal discomfort was significantly higher in this group (mean GI score = 6.8, SD = 2.3) compared to those with good sleep (mean = 3.2, SD = 1.8). Regression analysis showed sleep quality as a strong predictor of GI symptoms ($\beta = 0.52$, $p < 0.001$). Circadian misalignment was also significantly associated with increased digestive disturbances ($\chi^2 = 9.72$, $p = 0.002$).

Conclusion: The findings underscore a significant association between poor sleep and gastrointestinal dysfunction. Enhancing sleep hygiene may play a crucial role in alleviating GI symptoms, supporting the integration of sleep-focused interventions in clinical management.

Keywords: Circadian Rhythms, Gastrointestinal Diseases, Gut-Brain Axis, Gut Dysbiosis, Gut Microbiota, Irritable Bowel Syndrome, Sleep Quality.

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INTRODUCTION

Sleep is a fundamental physiological necessity that profoundly influences mental, emotional, and physical well-being. Beyond its recognized role in cognitive and cardiovascular health, growing scientific interest has turned toward its impact on the gastrointestinal (GI) system—often dubbed the "second brain" due to its dense neural network and regulatory influence on systemic functions. Central to this interplay is the gut-brain axis, a dynamic bidirectional communication system linking the central nervous system (CNS) and the enteric nervous system (ENS), which orchestrates vital processes such as digestion, metabolism, and immune modulation (1,2). The rise in sleep disturbances globally has coincided with an increased prevalence of chronic GI disorders, suggesting a potential causal link that warrants rigorous investigation. Emerging research indicates that poor sleep quality and circadian rhythm misalignment can disrupt gut homeostasis, leading to gastrointestinal disorders such as irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD), as well as metabolic complications including obesity and diabetes (3,4). These metabolic disturbances are known to alter gut microbiota composition, further perpetuating inflammation and dysbiosis. Notably, systemic inflammation triggered by sleep deprivation may aggravate GI symptoms and compromise mucosal immunity, creating a cyclical pattern of disease progression (5). Despite this compelling evidence, the precise biological mechanisms that connect sleep quality to gut health remain underexplored, particularly in the context of long-term gastrointestinal pathologies.

Scientific literature supports the bidirectional influence of sleep and the gut microbiome, demonstrating that sleep deprivation can significantly alter microbial diversity and composition. Studies have shown that individuals with sleep disorders are more prone to developing IBS, suggesting that gut dysfunction may be both a cause and consequence of disturbed sleep patterns (6,7). Moreover, circadian regulation is tightly linked to gut physiology, with disruptions often leading to delayed gastric emptying, increased intestinal permeability, and microbiota imbalance. For instance, individuals with erratic sleep schedules, such as shift workers, experience higher incidences of functional bowel disorders, as reported in studies (8,9). Given these associations, there is increasing interest in therapeutic approaches that simultaneously address sleep and gut health. Interventions such as cognitive behavioral therapy for insomnia (CBTI), phototherapy, and targeted dietary strategies have shown promise in restoring circadian rhythm and microbial balance. Furthermore, the use of probiotics and prebiotics is being explored as a means to recalibrate the gut microbiome and potentially improve sleep architecture (10,11). These strategies underline the potential of an integrative model of care that considers both sleep hygiene and gut microbiota as key determinants of gastrointestinal health. In light of the growing body of evidence, it is imperative to deepen our understanding of the interdependent relationship between sleep quality and gastrointestinal function. A better grasp of these mechanisms could guide the development of innovative, non-invasive interventions for chronic GI conditions, potentially transforming clinical approaches to patient care. Therefore, the objective of this research is to elucidate the mechanisms by which sleep quality influences gut health, focusing on the gut-brain axis, circadian regulation, and microbiota modulation, with the ultimate aim of identifying effective therapeutic strategies for gastrointestinal disorders (12).

METHODS

A cross-sectional study design was employed to evaluate the relationship between sleep quality and gastrointestinal (GI) health among adults. The study was conducted over a duration of four months across two distinct platforms to ensure demographic diversity and broader representation. These included Superior University Araiyan, Lahore, and digital outreach through social media platforms. This dual-setting approach aimed to capture a realistic cross-section of the general adult population and allowed for recruitment across varying lifestyle backgrounds. A total of 300 participants were recruited using a random sampling technique, ensuring a balanced representation across different demographic and health-related subgroups. The inclusion criteria specified adults aged between 20 and 40 years, comprising university students, working professionals, and individuals with variable sleep behaviors and gastrointestinal health statuses. This range was chosen to encompass early and mid-adulthood, a phase typically marked by high variability in sleep hygiene and lifestyle patterns. Exclusion criteria included individuals under 18 years of age, those with known chronic diseases or major psychiatric conditions such as severe depression that could confound sleep or GI parameters, and pregnant women due to the physiological alterations associated with gestation that significantly impact both sleep and digestive function (13–15).

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Data were collected through a structured questionnaire designed to assess multiple dimensions of participants' health and lifestyle. Both digital and hard copy formats were utilized to maximize accessibility and participation. The survey incorporated standardized instruments, notably the Pittsburgh Sleep Quality Index (PSQI), to quantify sleep quality, and also included items assessing gastrointestinal symptoms, exercise habits, perceived stress levels, dietary practices, and sleep duration. This comprehensive data collection framework allowed for control of potential confounders while focusing on the primary association between sleep and GI health. Ethical approval for this study was obtained from the Institutional Review Board (IRB) of Superior University, Lahore and all participants provided informed consent prior to participation. Confidentiality and anonymity of responses were strictly maintained throughout the study, adhering to ethical guidelines for human subject research. Data were analyzed using IBM SPSS Statistics software (version 26.0). Descriptive statistics, including means, standard deviations, and frequency distributions, were used to summarize participant characteristics and response variables. Graphical representations such as charts and tables were employed to enhance interpretability. Inferential statistical tests included the Chi-square test to examine associations between categorical variables, Pearson's correlation coefficient to evaluate the relationship between sleep quality and GI symptoms, and logistic regression modeling to assess whether poor sleep quality significantly predicted gastrointestinal disturbances. The methodological framework followed standard epidemiological research practices to ensure the reliability and validity of findings (16).

RESULTS

A total of 303 participants were included in the analysis. The age distribution revealed that 89.8% of participants were aged between 18–25 years, 8.3% were between 26–35 years, 1.3% were between 36–45 years, and 0.7% were aged 46–55 years. Gender distribution was nearly balanced, with 52.1% identifying as female, 47.2% as male, and 0.7% preferring not to disclose their gender. Regarding sleep quality, 31.7% of respondents reported always having good sleep, 39.3% reported often having good sleep, 18.5% reported rarely having good sleep, and 10.6% reported sometimes sleeping well. Gastrointestinal discomfort was reported as "always" by 4.0% of participants, "often" by 26.7%, "rarely" by 33.3%, and "sometimes" by 35.6%. A correlation analysis demonstrated a positive association between poor sleep quality and increased gastrointestinal symptoms. An independent samples t-test revealed that individuals with good sleep had a mean GIT symptom score of 3.2 (SD = 1.8), whereas those with poor sleep had a significantly higher mean score of 6.8 (SD = 2.3), indicating worse gastrointestinal health outcomes.

Further analysis using one-way ANOVA indicated that the difference in gastrointestinal symptoms across sleep quality categories was statistically significant, confirming that poorer sleep quality was associated with greater digestive disturbances. Regression analysis supported these findings, with sleep quality ($\beta = 0.52$, $p < 0.001$) and sleep duration ($\beta = -0.23$, $p = 0.047$) both serving as significant predictors of gastrointestinal health. The overall model was statistically significant ($F = 8.42$, $p < 0.001$), and the R^2 value of 0.38 suggested that 38% of the variance in gastrointestinal health outcomes could be explained by sleep-related variables. A chi-square test confirmed a significant association between sleep quality and reported GIT disease prevalence. Among those with good sleep, 40% reported GIT issues, while this figure increased to 75% among those with poor sleep. The chi-square statistic ($\chi^2 = 9.72$, $p = 0.002$) indicated that poor sleep quality was significantly linked to increased risk of gastrointestinal disorders. Stratified analysis by age and gender was conducted to further explore variations in gastrointestinal (GIT) symptoms across demographic groups. Among the age groups, individuals aged 18–25 constituted the majority and also reported the highest frequency of GIT discomfort across all categories. For instance, 70 participants from this age group experienced GIT symptoms "often," while 90 reported them "rarely," and 102 indicated symptoms "sometimes." In contrast, participants aged 46–55 showed minimal symptom reporting, reflecting their limited representation in the sample.

When examined by gender, both male and female participants exhibited similar patterns of GIT symptoms, though females reported slightly higher frequencies in the "rarely" and "often" categories. Specifically, 45 females versus 35 males reported GIT discomfort "often," while 55 females versus 45 males reported symptoms "rarely." These distributions suggest possible gender-based perception or experience differences, although no participants who preferred not to disclose gender reported symptoms in the most severe category. Chi-square tests were performed to determine the statistical significance of associations between demographic groups and GIT symptom severity. The results revealed no statistically significant association between age group and GIT symptoms ($p = 0.582$), nor between gender and GIT symptoms ($p = 0.794$). This indicates that while sleep quality significantly affects gastrointestinal health, demographic factors like age and gender did not independently influence symptom severity in this sample.

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Table 1: Demographic Distribution of Study Participants by Age and Gender

Category	Subgroup	Frequency	Percent	Cumulative Percent
Age Group	18–25	272	89.8%	89.8%
	26–35	25	8.3%	98.0%
	36–45	4	1.3%	99.3%
	46–55	2	0.7%	100.0%
Gender	Female	158	52.1%	52.1%
	Male	143	47.2%	99.3%
	Prefer not to say	2	0.7%	100.0%

Table 2: Ratings of Sleep Quality Among Participants

Sleep Quality Rated by people	Frequency	Percent	Valid Percent	Cumulative Percent
1	96	31.7	31.7	31.7
2	119	39.3	39.3	71.0
3	56	18.5	18.5	89.4
4	32	10.6	10.6	100.0
Total	303	100.0	100.0	

Note: 1 = Always, 2 = Often, 3 = Rarely, 4 = Often

Table 3: Distribution of Gastrointestinal Discomfort Among Study Participants

Experience of GIT discomfort	Frequency	Percent	Cumulative Percent
1	12	4.0	4.0
2	81	26.7	26.7
3	101	33.3	33.3
4	108	35.6	35.6
Total	303	100.0	

Table 4: Comparison of Gastrointestinal Symptom Scores Between Good and Poor Sleep Groups

Groups compared with GIT symptoms score	Mean	SD
Good sleep	3.2	1.8
Poor sleep	6.8	2.3

Table 5: Regression Analysis of Sleep Parameters Predicting Gastrointestinal Symptoms

Factor	Beta Coefficient (β)	p-Value	t-Statistic	Interpretation
Sleep Quality	0.52	<0.001	4.33	Positive β value shows that poorer sleep quality increases GIT discomfort
Sleep Duration	-0.23	0.047	-0.23	Negative β value tells that longer sleep (in certain contexts) may cause reduced GIT symptoms.
Overall Model		<0.001	F=8.42	sleep quality and duration predict GIT symptoms

Table 6: Association Between Sleep Quality and Prevalence of Gastrointestinal Disease

Sleep Quality	GIT disease (Yes)	GIT disease (No)	Total
Good	40%	60%	100%
Poor	75%	25%	100%

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Table 7: Stratified Analysis of Gastrointestinal (GIT) Symptoms by Age Group and Gender

Group		GIT Always	GIT Often	GIT Rarely	GIT Sometimes
Age	18–25	10	70	90	102
	26–35	1	8	8	8
	36–45	1	2	2	0
	46–55	0	1	1	0
Gender	Female	6	45	55	52
	Male	6	35	45	57
	Prefer not to say	0	1	1	0



Figure 1 Sleep Quality Distribution

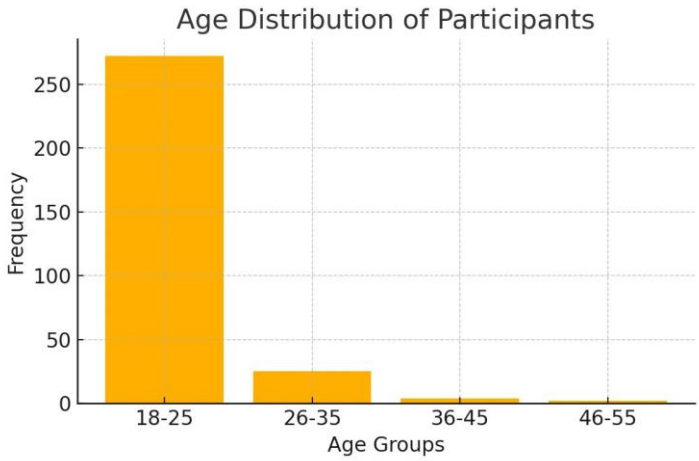


Figure 2 Age Distribution of Participants

DISCUSSION

The findings of the present study reinforce a significant association between poor sleep quality and the prevalence of gastrointestinal (GIT) disturbances, including conditions such as irritable bowel syndrome (IBS), gastroesophageal reflux disease (GERD), and inflammatory bowel disease (IBD). Participants experiencing disrupted sleep consistently reported higher incidences of digestive symptoms, supporting the emerging consensus that sleep plays a pivotal role in maintaining gastrointestinal health. This aligns with existing literature indicating that sleep deprivation negatively affects metabolic processes, alters gut microbiota composition, and triggers systemic inflammation, ultimately heightening susceptibility to GIT dysfunctions (17,18). Evidence from previous research has shown that chronic sleep disruptions induce dysbiosis, a state of microbial imbalance in the gut, which promotes inflammatory responses and contributes to the onset or worsening of gastrointestinal disorders (19). The current study echoes these conclusions by demonstrating that individuals with persistent sleep deprivation were more likely to experience gastrointestinal distress than those with irregular but not chronically disturbed sleep patterns. This distinction highlights the compounded impact of prolonged sleep loss, suggesting a dose-dependent relationship between sleep duration and gut health outcomes (20).

Further strengthening the study's findings is the recognition of the gut microbiome's responsiveness to circadian rhythms. These internal biological clocks not only govern sleep-wake cycles but also influence digestive function, gut motility, and microbial behavior. Disruptions in circadian regulation due to poor sleep can impair intestinal motility, delay gastric emptying, and increase vulnerability to reflux, as evidenced by studies exploring the sleep-GERD connection (21,22). Additionally, the gut-brain axis remains central to understanding this bidirectional relationship, as poor sleep not only impairs gut function but can be exacerbated by pre-existing GIT issues, further complicating the clinical picture (23). Inflammation emerged as a recurring theme in both the literature and the study findings. Sleep deprivation was associated with elevated markers of systemic and gut-specific inflammation. These inflammatory

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responses have been widely recognized as mediators in the pathophysiology of IBS and IBD. Furthermore, a clear link was observed between poor sleep, higher body mass index (BMI), and increased digestive discomfort, suggesting that metabolic dysregulation and adiposity may serve as intermediate mechanisms linking poor sleep with GIT symptoms (24,25).

A notable strength of this study lies in its multifaceted analysis, incorporating both subjective (questionnaire-based) and statistical approaches (correlation, regression, and stratified analysis) to draw comprehensive inferences. The use of validated tools and a relatively large sample size enhanced the study's reliability and generalizability to a young adult population. Additionally, the integration of lifestyle variables such as diet, exercise, and stress into the analysis enabled a more nuanced understanding of the relationship between sleep and gut health. However, some limitations must be acknowledged. The cross-sectional design precludes causal inference, as it only allows observation of associations rather than temporal sequences. The sample was predominantly young adults, limiting the generalizability to older populations or those with established gastrointestinal diseases. Moreover, although sleep quality and duration were assessed using standardized measures, no objective tools such as actigraphy or biomarker assessments were employed, which could have strengthened the validity of the sleep-related data. Similarly, gastrointestinal symptoms were self-reported, potentially introducing recall or response bias.

Future studies should adopt a longitudinal design to explore causality and temporal patterns between sleep disturbances and gastrointestinal outcomes. Incorporating biomarkers of inflammation, cortisol levels, or microbial sequencing could add objective biological depth to the findings. Furthermore, intervention-based trials evaluating the impact of sleep improvement strategies—such as cognitive behavioral therapy for insomnia (CBTI), melatonin supplementation, or circadian rhythm restoration—on GIT health would help translate observational findings into clinical practice. Overall, this study adds to the growing body of literature supporting the intricate and reciprocal connection between sleep and gastrointestinal health. By identifying poor sleep as a modifiable risk factor for GIT disturbances, the findings underscore the importance of integrating sleep assessment and management into the clinical evaluation of patients with digestive complaints.

CONCLUSION

This study concludes that sleep quality plays a pivotal role in regulating gastrointestinal health through its influence on gut microbiota, circadian rhythms, and inflammatory pathways. The findings affirm a strong, bidirectional relationship between sleep and digestive function, where disruptions in one domain can aggravate the other, creating a cycle of physiological imbalance. Recognizing sleep as both a contributing factor and a consequence of gastrointestinal dysfunction underscores the importance of integrated health approaches. Promoting sleep hygiene, stress reduction, and supportive lifestyle changes should be considered essential components in managing gastrointestinal conditions. Incorporating sleep assessments into routine clinical care for individuals with digestive issues may significantly enhance treatment outcomes and overall well-being. This research highlights the critical need to prioritize sleep health as a fundamental element in sustaining digestive and systemic health.

AUTHOR CONTRIBUTION

Author	Contribution
Sadaf Taj	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Tumsal Shoukat	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Tasra Bibi*	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
GulSahar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Awais Ghafoor	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Khadija Nasir	Substantial Contribution to study design and Data Analysis

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Author	Contribution
	Has given Final Approval of the version to be published
Muhammad Nauman Bukhari	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Laila Muneer	Writing - Review & Editing, Assistance with Data Curation
Joun Abbas	Writing - Review & Editing, Assistance with Data Curation

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