

Exploring the Connection between Sleep Quality and Digestive Function in Young Women: Insights from Ayurveda's Perspective on *Agni* - A Comprehensive Study

Research Article

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Abstract

Introduction: This cross-sectional analytical study delves into the intricate connection between sleep quality and digestive function among female volunteers aged 20-30 years, focusing on Ayurvedic principles, particularly the concept of Agni. The research, conducted at our institute and its surroundings, involved 186 female participants. **Methods:** Employing a cross-sectional survey, the study assessed sleep quality, digestive symptoms, and Agni status among female participants. Statistical analysis was conducted to explore associations between variables. Sleep patterns were evaluated using the Pittsburgh Sleep Quality Index (PSQI), while digestive function was assessed using a modified Gastrointestinal Symptom Rating Scale (GSRs) questionnaire. Agni types were determined following the MUHS proforma for Agni assessment. **Results:** The data highlights a significant association between disturbed sleep and heightened gastrointestinal symptoms. Individuals experiencing disrupted sleep predominantly exhibited *Tikshna Agni*, in alignment with Ayurvedic principles correlating irregular sleep with digestive imbalances. Notably, *Vishmagni*, characterised by irregular digestive fire, was prominently observed in individuals with disturbed sleep. **Conclusion:** This study underscores the intricate relationship between sleep quality and digestive harmony, particularly emphasising the role of Agni. Addressing irregular sleep patterns and their impact on Agni status is vital for maintaining optimal digestive health. The findings advocate for integrating interventions targeting sleep quality into healthcare practices. Future research should explore specific sleep improvement strategies and consider additional lifestyle factors to promote holistic health and well-being.

Keywords: Sleep, Digestive Function, *Ayurveda*, *Agni*.

Introduction

In today's fast-paced world, characterised by demanding work schedules, educational pursuits, and lifestyle choices, a surge in sleep disorders has emerged, contributing to a pervasive health crisis. These disorders, often fuelled by night awakenings due to study commitments, work patterns, and other factors, pose a significant threat to both physical and psychological well-being. The increasing prevalence of irregular and inadequate sleep habits has given rise to various health issues, making sleep-related disorders a pressing concern in society.

Lifestyle changes in recent times have led to a profusion of disorders such as obesity, diabetes, hypertension, PCOD (Polycystic Ovary Syndrome), depression, metabolic syndromes, cirrhosis, and other liver diseases, with sleep deprivation playing a

significant role in their manifestation (1). According to Ayurveda, maintaining equilibrium in the tripod of life—*Ahara* (food), *Nidra* (sleep), and *Bramhacharya* (celibacy)—is essential for complete health. Disturbed sleep can lead to various health issues, as highlighted by Acharya Vagbhata, who emphasised the adverse effects of sleep at improper times on physical and mental well-being (2)(3).

In Ayurveda, the concept of *Nidra* holds paramount importance, as it helps to maintain the equilibrium state of *Dosha*, *Dhatu*, and *Mala*. The early part of the night is characterised by the predominance of kapha dosha, and disruptions in sleep patterns can lead to imbalances in *Vata* and *Pitta doshas*, ultimately resulting in symptoms of diseases associated with these *doshas* (4).

The concept of *Agni*, described as the transformative fire within the body, plays a crucial role in digestion, absorption, and assimilation of food (5). Ayurveda emphasises various determinants of Agni, including dosha influence, age, season, work patterns, and diet quality. Deviations from recommended practices, such as irregularities in diet, sleep, and emotional factors, can lead to deficiencies in digestive

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fire (*Mandagni*), disrupting normal sleep patterns and potentially causing various diseases and psychological disturbances (6).

Modern research has shed light on the impact of sleep on digestive health. Circadian rhythms regulate gastrointestinal physiology, and disruptions in these rhythms can exacerbate gastrointestinal disorders and diseases (7). Stress hormones like cortisol, affected by sleep quality, can contribute to inflammation in the gastrointestinal tract, leading to digestive discomforts (8,9). Emerging research also suggests a bidirectional relationship between gut microbiota and sleep, highlighting the importance of maintaining a symbiotic relationship for overall digestive health (10).

Furthermore, sleep influences hormones related to appetite regulation, potentially leading to overeating or cravings for unhealthy foods, which can negatively impact digestive health (11). In light of these insights, this study aims to explore the intricate connection between sleep quality and digestive health, emphasising the importance of proper sleep and daily regimens in mitigating the prevalence of disorders.

The study aims to elucidate the crucial link between sleep quality and digestive system function, focusing particularly on *Agni* according to Ayurveda. As *Asamyak Nidra* (improper sleep) is identified as a primary causative factor for various diseases, understanding the significance of sleep and its impact on digestion is imperative. By investigating this association, the study seeks to uncover potential health implications, particularly among young females, and pave the way for targeted interventions to mitigate lifestyle disorders. Ultimately, the research aims to underscore the importance of adopting a holistic approach to health, emphasising the adherence to daily regimens and the prioritisation of sufficient, quality sleep.

Materials and Methods

- **Study design:** A descriptive cross-sectional survey was conducted among female individuals from our institute and surrounding areas.
- **Duration of the study:** The duration of study was 18 months.
- **Criteria for participants:** Female volunteers aged between 20 to 30 years, deemed healthy, and willing to participate were included in the study. Individuals with depressive disorders under medication were excluded. Participants were matched based on age and gender using group matching.
- **Sampling technique:** Purposive sampling method was employed to select participants from the population. Participants were collected based on specific demographic characteristics, such as age, gender, education level.
- **Data collection:**
 1. Sample Selection: Participants were screened based on the inclusion and exclusion criteria and divided into two groups by using PSQI scale:
 - Group 'A': Participants with normal sleep (93 individuals).

- Group 'B': Participants with disturbed sleep (93 individuals).

The Pittsburgh Sleep Quality Index (PSQI) is a self-reported questionnaire used to assess sleep quality and disturbances. It consists of 7 components:

1. Sleep Quality (1 question, rated 0-3)
2. Sleep Latency (1 question, rated 0-3)
3. Sleep Duration (1 question, rated 0-3)
4. Sleep Efficiency (1 question, rated 0-3)
5. Sleep Disturbances (9 questions, rated 0-3)
6. Use of Sleep Medication (1 question, rated 0-3)
7. Daytime Dysfunction (2 questions, rated 0-3)

The assessment method involves:

1. Self-reported questionnaire completed by participants
 2. Rating scale: 0-3, where 0 = no difficulty and 3 = severe difficulty
 3. Scoring: Total score ranges from 0 to 21
 4. Interpretation: Total score > 4 indicates poor sleep quality.
2. Assessment of Agni: Agni was evaluated using a questionnaire and proforma provided by MUHS, Nashik, for both groups to determine the type of Agni.

3. Evaluation of Digestive Function: Modified GSRS questionnaire, a 4-point graded Likert-type scale, was utilised to assess the function of the digestive system.

The questions from an existing scale were used without modifying them and have created a simple scoring to simplify the process for respondents. Some modifications in options and scores were done and it was validated. As Cronbach's alpha value is 0.804 after testing, which indicates its good reliability.

The GSRS (Gastrointestinal Symptom Rating Scale) comprises 15 questions, grouped into 5 dimensions: abdominal pain, reflux, diarrhoea, constipation, and indigestion each offering four response options: "no discomfort at all" (scored as 1), "mild discomfort" (scored as 2), "moderate discomfort" (scored as 3), and "severe discomfort" (scored as 4). Thus, the total score ranges from 15 to 60.

The level of discomfort was assessed using a 3-point scale, where:

- Mild discomfort referred to symptoms that were slightly bothersome
- Moderate discomfort referred to symptoms that were noticeably uncomfortable
- Severe discomfort referred to symptoms that were extremely distressing

This scale was used to quantify the degree of discomfort experienced by participants due to gastrointestinal symptoms.

A score exceeding 15 suggests disturbed digestive function. Score falling between 16 and 30 indicate participant is having mild digestive problems. Score ranging from 31 to 45 suggest moderate digestive issues or within the range of 46 to 60 indicate severe digestive issues (12).

4. Association Analysis: The association between sleep quality and digestive function was analysed concerning Agni.

5. Observation and Analysis: Data obtained from the study were observed, analysed, and discussed to draw conclusions.

Statistical analysis

Statistical analysis was performed to assess the association between sleep quality, digestive function, and Agni using appropriate methods. Data was analysed using STATA 14.0. Continuous variables (e.g., Age, PSQI score) were presented as mean ± SD, median, and range, and compared using Wilcoxon rank-sum test (non-normal) or independent t-test (normal). Categorical variables (e.g., Demographics, GSRs category) were compared using chi-squared or Fisher's exact test. Spearman Correlation coefficient assessed correlation between PSQI and GSRE scores. Statistical significance was set at P < 0.05. Result was interpreted to draw meaningful conclusions regarding the study objectives.

Observation & Results

Age distribution: The study comprised a total of 186 individuals, categorised into two age groups: 20-25 years and 26-30 years. Notably, 68.81% were in the younger age group, with 31.18% in the older category. Disturbed sleep quality was more prevalent in the younger age group, with 72.04% experiencing sleep disturbances, possibly attributed to lifestyle factors, stress, and work-related pressures.

Distribution of individuals according to Agni

Examining the participant's Agni status revealed interesting patterns. *Tikshna Agni* was most prevalent in both groups, with 45.16% in the normal sleep group (Group A) and 54.84% in the disturbed sleep group (Group B). [Table 1].

Table 1: Distribution of individuals according to Agni

Agni	Group-A		Group-B		Total	
	N	%	N	%	N	%
Manda	5	5.38	8	8.60	13	6.98
Sama	27	29.03	10	10.75	37	19.99
Tikshna	42	45.16	51	54.84	93	50
Visham	19	20.43	24	25.81	43	23.11
p-value	<0.01, Significant					

N=no. of individuals

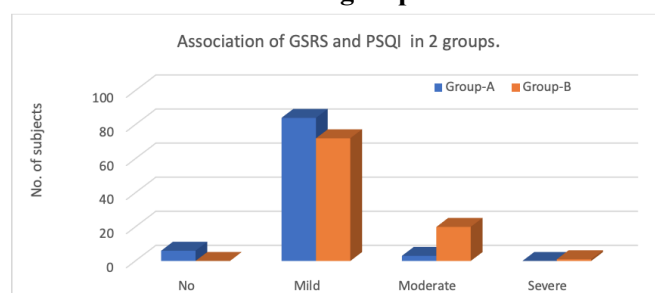
Distribution of individuals according to GSRs in both groups: Group A, characterized by normal sleep quality, exhibited a lower prevalence of digestive symptoms (3.23% with moderate symptoms). In contrast, Group B, experiencing disturbed sleep, demonstrated a higher incidence of symptoms, with 21.51% reporting moderate digestive issues. The statistical significance (p-value <0.0001) underscores the potential impact of sleep quality on digestive well-being. [Table2].

Table 2: Distribution of individuals according to GSRs in both groups

Category of GSRs	Group-A		Group-B	
	N	%	N	%
No	6	6.45	0	0
Mild	84	90.32	72	77.42
Moderate	3	3.23	20	21.51
Severe	0	0	1	1.08
Chi2-value	20.4883			
p-value	<0.0001, Highly significant.			

N=number of individuals.

Graph 1: Distribution of individuals according to GSRs in both group A and B



- Application of Chi-square: The Chi-square test examined the association between Group A (normal sleep) and Group B and GSRs symptom categories.
- Type of Analysis: Inter-group comparison between two independent groups.
- Significance: Chi-square value: 20.4883, p-value <0.0001 (highly significant). Highly significant difference in GSRs symptoms between Group A and Group B. Group A has better digestive health (6.45% no symptoms, 90.32% mild symptoms).
- Group B has poorer digestive health (21.51% moderate, 1.08% severe symptoms). Association between sleep quality and digestive health suggested.

Comparison of Mean GSRs Scores between 2 groups

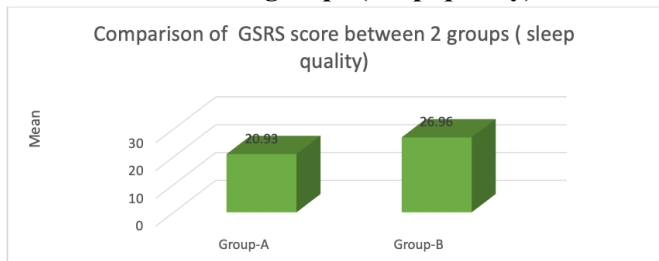
Comparing GSRs scores between the two groups revealed a significantly higher mean score in Group B (26.96 ± 5.89) than in Group A (20.93 ± 4.42). This disparity suggests that disturbed sleep may contribute to increased stress levels, hormonal imbalances, and alterations in gut microbiota, collectively leading to heightened digestive discomfort. [Table 3]

Table 3: Comparison of Mean GSRs Scores between 2 groups

GSRs Score	Sleep quality	
	Group-A	Group-B
Mean	20.93	26.96
SD	4.42	5.89
t-value	5.6559	
p-value	<0.0001, Highly significant	

Above table shows that Mean of GSRs was 20.93 ± 4.42 of Group-A and 26.96 ± 5.89 of Group-B individuals with p value < 0.0001, which is highly significant.

Graph 2: Showing comparison of GSRs score between 2 groups (sleep quality)



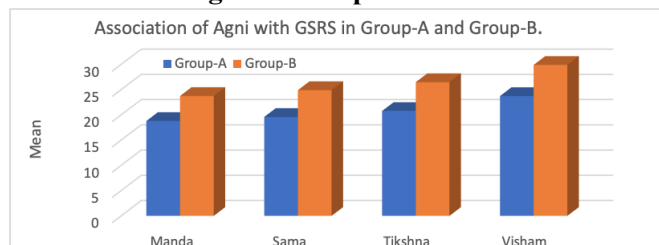
Association between GSRs and Agni in Group-A and Group B.

Table 4: Association between GSRs and Agni in Group-A and Group-B

Agni	Group-A (Good sleep)			Group-B (Poor sleep)			p-value
	Mean	SD	Median	Mean	SD	Median	
Manda	18.8	1.92	19	23.75	5.82	23	0.0972, NS
Sama	19.59	3.57	19	24.9	6.67	23	0.0035, HS
Tikshna	20.78	3.55	20	26.49	4.95	27	<0.0001, HS
Visham	23.73	6.37	22	29.91	6.67	30.5	0.0038, HS

Individuals having *mandagni* had mean of 18.8 ± 1.92 in Group-A and 23.75 ± 5.82 in Group-B with p-value 0.0972 which is non-significant. Individuals with *Samagni* had mean of 19.59 ± 3.57 in Group-A and 24.9 ± 6.67 in Group-B with p-value 0.0035 which is highly significant. Individuals with *tikshnagni* had 20.78 ± 3.55 in Group-A and 26.49 ± 4.95 in Group-B with p-value of < 0.0001 that is highly significant and individuals with *Vishamagni* had mean 23.73 ± 6.37 in group-A and 29.91 ± 6.67 in group-B with p-value 0.0038 which is highly significant. [Table 4]

Graph 3: Showing association between GSRs and Agni in Group-A and B



- There is no significant difference in GSRs scores for Manda Agni between Group A and Group B.
- There is a highly significant differences in GSRs scores for Sama, Tikshna, and Visham Agni between Group A and Group B, indicating poorer digestive health in Group B.
- Some of the patients in Group A do have score less than 15 but above no. is the mean of the GSRs scores.

Distribution of PSQI Score in the individuals

a) PSQI score in group A

Table 5: Distribution of subjects according to PSQI score in Group-A

PSQI Score	No. of subjects	Percentage
0	4	4.30
1	8	8.60
2	14	15.05
3	29	31.18
4	38	40.86
Total	93	100
Mean PSQI score	$2.95 \pm 14.14 (0 - 4)$	

Out of 93 individuals in group A had minimum 4 (4.30%) had score "0", 8 subjects had score "1", 14 subjects had score "2", 29 subjects were having 3 score and maximum 38 (40.86%) individuals had score "4".

b) PSQI Score in group B

Out of 93 individuals in group "B", 28 (30.10%) individuals had minimum score "5", 25 subjects had score "6", 17 subjects had score "7", 9 subjects had score "8", 7 subjects had score "9", 1 individual had 10 score, 3 individuals had score 11, 2 subjects had 13 score and 1(1.07%) individual had maximum score 14.

Table 6: Distribution of subjects according to PSQI score in Group-B

PSQI Score	No. of subjects	Percentage
5	28	30.11
6	25	26.88
7	17	18.28
8	9	9.68
9	7	7.53
10	1	1.08
11	3	3.23
13	2	2.15
14	1	1.08
Total	93	100
Mean PSQI score	$6.74 \pm 1.93 (5 - 14)$	

Table 7: Comparison of Mean of PSQI Score between Group-A and Group B

	Group-A	Group-B
Mean	2.95	6.74
SD	1.14	1.93
Median	3	6
Z-value	11.896	
p-value	<0.0001, HS	

Above table shows that Mean of PSQI score was 2.95 ± 1.14 of Group-A and 6.74 ± 1.93 of Group-B individuals with p value < 0.0001 , Highly significant. [Table 6]

Comparison of Mean GSRs Score between Group-A and Group-B.

Table 8: Comparison of Mean GSRs Score between Group-A and Group-B

	Group-A	Group-B
Mean	20.93	25.36
SD	4.44	6.10
Median	20	25
Z-value	5.6559	
p-value	<0.0001, HS	

Mean of GSRs was 20.93 ± 25.36 of Group-A and ± 6.10 of Group-B individuals with p value < 0.0001, Highly significant.[Table 7]

Correlation between PSQI and GSRs in both the groups: The correlation analysis between the Pittsburgh Sleep Quality Index (PSQI) and GSRs scores further reinforced the interconnection of sleep quality and digestive symptoms. Both groups exhibited significant correlations (p-value <0.05), indicating a potential relationship between poor sleep quality and raised digestive discomfort.

Table 9: Correlation between PSQI score and GSRs in Group-A and Group-B

	PSQI Score			
	Group-A		Group-B	
	rho-value	p-value	rho-value	p-value
GSRs score	0.2260	0.0294, Significant	0.2561	0.0132, Significant

The correlation between PSQI and GSRs scores was calculated using Spearman's rank correlation coefficient (rho-value).

Calculation steps: Scores were ranked separately for each group.rank differences and sum of squared differences calculated and by using formula:

$$rho = 1 - (6 * \sum d^2) / (n * (n^2 - 1))$$

rho calculated.

Here, Group A: rho = 0.2260, p = 0.0294 (Significant) and Group B: rho = 0.2561, p = 0.0132 which is significant.

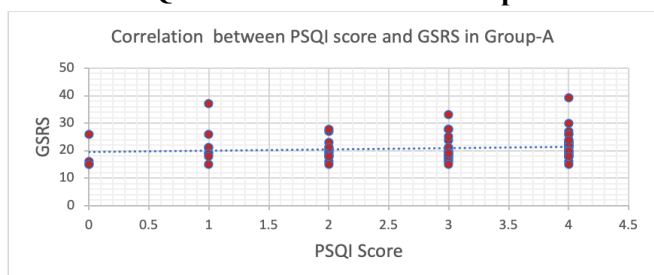
Indicates positive correlation between PSQI and GSRs scores in both group.

Significance of rho can also be determined by its absolute value:

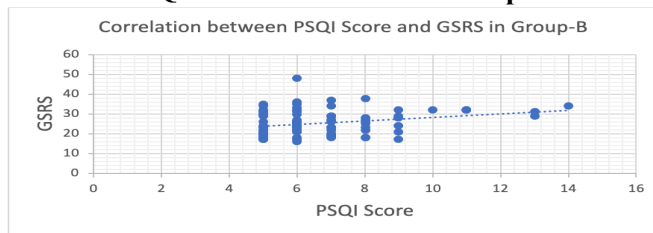
- 0.00-0.30: Very weak correlation
- 0.30-0.50: Weak correlation
- 0.50-0.70: Moderate correlation
- 0.70-0.90: Strong correlation
- 0.90-1.00: Very strong correlation

Here, In Group A: rho = 0.2260 and Group B: rho = 0.2561 (weak correlation).

Graph 4 Correlation between PSQI score and GSRs in Group-A



Graph 5: Correlation between PSQI score and GSRs in Group-B



Correlation between PSQI score and GSRs in Group-A having p-value 0.0294 is significant and in Group-B having p-value 0.0132 is significant. [Table 8]

Discussion

Ayurveda, an ancient system of medicine, accentuates three pillars of health: *Ahara* (diet), *Nidra* (sleep), and *Brahmacharya* (celibacy). Among these, *Nidra*, or proper sleep, is paramount for good health, while disrupted sleep can lead to various diseases, impacting circadian rhythms and physiological functions like digestion. Circadian rhythms and sleep play crucial roles in regulating physiological functions, including those of the digestive system. Disruptions in sleep patterns, particularly induced by shift work, have been extensively studied and linked to negative impacts on health, such as impaired glucose and lipid homeostasis, disturbances in hormone secretion patterns, and heightened risk of metabolic syndrome. Circadian disruption from shift work harms health by affecting glucose and lipid balance, disrupting melatonin and cortisol patterns, and messing with hormones like leptin and ghrelin, leading to metabolic syndrome risk. It also messes with digestion by altering hormone secretion affecting stomach acid, pancreatic enzymes, and bile production, impacting nutrient absorption(13)(14).

Observations indicate that improved sleep quality correlates with alleviation of gastrointestinal (GI) symptoms, suggesting a direct influence of sleep patterns on digestive function. Sleep disturbances may affect gastrointestinal motility, gastric secretion, and mucosal secretion, impacting *Agni* (digestive fire) and overall digestive health(15). In this study, a significant concentration of individuals aged 20-25, with Group B (experiencing disturbed sleep) is observed. This aligns with existing literature suggesting a connection between disrupted sleep and lifestyle factors, stress, and commitments in early adulthood(16).

This study reveal a higher prevalence of disturbed sleep quality among young females, correlating with increased digestive symptoms, particularly *Tikshna Agni* linked to raised *Pitta Dosha*. Disrupted sleep can lead to intestinal dysfunction and dysbiosis, exacerbating digestive issues. This study involves 186 individuals shows a predominant occurrence of *Tikshna Agni*, especially in those with disturbed sleep, may be attributed to the dominance of *Pitta Dosha* during the middle stage of life, as per Ayurvedic principles (17). Disturbed sleep elevates *Pitta dosha*, intensifying *Tikshna Agni* and causing excessive heat and digestive imbalances. Individuals with disturbed sleep exhibit a significantly higher mean GSRs score compared to those with normal sleep, indicating

increased digestive discomfort possibly due to elevated stress, hormonal imbalances and changes in gut microbiota (18)(19).

Association of GSRs with various types of Agni shows significant connections, particularly with *Vishamagni* prevalent in poor sleep quality individuals. This aligns with Ayurvedic principles linking Vata dominance with disrupted sleep, leading to digestive imbalances(20). Ayurvedic concepts emphasise the impact of disrupted sleep on Agni, leading to digestive issues. This aligns with observations in the study where poor sleep quality affects *Agnibala*, contributing to heightened digestive concerns. The correlation analysis between sleep quality and GSRs score underscores the connection between poor sleep and increased digestive symptoms, emphasising the importance of sleep quality for optimal digestive function.

This study's findings align with previous research, supporting the notion that disturbed sleep affects digestive health. It contributes to understanding the relationship between sleep quality and digestive efficiency, integrating traditional medical systems with modern scientific research.

Conclusion

This research illuminates a significant link between sleep quality and digestive function in females aged 20-30, focusing on Ayurvedic concept of *Agni*. Disturbed sleep prevalence may be influenced by lifestyle factors, affecting digestive health, especially *Tikshna Agni* dominance indicating a connection to Pitta Dosha. Additionally, disturbed sleep, particularly *Vishamagni*, correlates with heightened digestive discomfort, reinforcing Ayurvedic principles linking Vata dominance with disrupted sleep patterns and digestive issues. Integrating Ayurvedic principles with scientific evidence emphasises the importance of holistic healthcare, recommending healthy sleep habits for digestive health management in this demographic. This study underscores the necessity for holistic interventions addressing both sleep quality and Agni regulation for optimal gastrointestinal health, supported by findings aligning with ancient texts, highlighting Ayurvedic wisdom's enduring relevance in healthcare.

Conflict of interest: None

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