ISSN: 2320-2831

International Journal of Pharmacy and Analytical Research (IJPAR)

IJPAR | Vol.15 | Issue 1 | Jan - Mar -2026

www.ijpar.com

DOI: https://doi.org/10.61096/ijpar.v15.iss1.2026.73-79

Linking Sleep Patterns to Health Outcomes- A Systematic Review

Dr. K. Bhanu Teja[1]*, Kasireddy Swapna[2], Dev Prateek Patel[2], R. Yaswanth Kumar Reddy[2], Syed Hameed uddin[2], Chelmilla Pooja[2], Dr. Suthakaran Raj[3]

[1.]Assistant Professor, Department of Pharmacy Practice, Vijaya college of Pharmacy, Munaganoor (V), Hayathnagar (M), Hyderabad, Rangareddy (Dt), Telangana (St), India, 501505

[2.]Under Graduate Scholar, Vijaya College of Pharmacy, Munaganoor (V), Hayathnagar (M), Hyderabad, Rangareddy (Dt), Telangana (St), India, 501505

[3.]Professor & Principal, Vijaya college of pharmacy, Munaganoor (V), Hayathnagar (M), Hyderabad, Rangareddy (Dt), Telangana (St), India, 501505

*Corresponding Author: Dr. K. Bhanu Teja

bhanuteja220702@gmail.com

Published by: 13.02.2026

Futuristic Publications

Abstract: Sleep is a fundamental physiological process that plays a critical role in maintaining overall health and well-being. Emerging evidence suggests that both sleep duration and sleep quality significantly influence metabolic regulation, psychological wellness, and endocrine balance. Disturbances in sleep are associated with alterations in hormonal regulation, particularly insulin and other appetite-regulating hormones, which can disrupt energy homeostasis, impair glucose metabolism, and contribute to body weight gain. Inadequate or poor-quality sleep has also been linked to increased risk of metabolic dysregulation, emphasizing its role in body weight regulation. Beyond metabolic effects, sleep is essential for the proper functioning of the endocrine system involved in reproductive health. Disruptions in sleep patterns and circadian rhythms can adversely affect the hypothalamic–pituitary–gonadal axis, leading to hormonal imbalances that may manifest as irregular menstrual cycles, altered menstrual duration, or changes in menstrual flow. These effects may be further intensified by chronic psychological stress, which elevates cortisol levels and interferes with reproductive and metabolic hormone balance. The relationship between sleep and stress is bidirectional, wherein psychological distress negatively affects sleep quality, while inadequate sleep heightens stress sensitivity and emotional dysregulation. Lifestyle factors play a crucial role in shaping sleep behaviors. Unhealthy lifestyle practices, including poor dietary habits, physical inactivity, irregular daily routines, and sedentary behavior, are commonly associated with sleep disturbances and hormonal imbalance. Conversely, healthy lifestyle practices promote adequate sleep and hormonal stability. Overall, sleep emerges as a modifiable determinant influencing metabolism, reproductive health, stress, and lifestyle-related health outcomes. Targeted lifestyle interventions and stress management strategies aimed at improving sleep may serve as effective approaches to enhance metabolic health, reproductive function, and quality of life.

Keywords: Sleep quality; Sleep duration; Body weight regulation; Hormonal imbalance; Stress; Lifestyle factors; Reproductive health; Metabolic health

INTRODUCTION

Sleep is a vital biological process essential for the maintenance of physical health, mental functioning, emotional stability, and metabolic regulation. It is a naturally recurring state characterized by reduced consciousness, decreased responsiveness to external stimuli, and distinct physiological changes in brain activity, hormone secretion, and autonomic functions. Adequate sleep is necessary for tissue repair, memory consolidation, immune function, and overall homeostasis. In contrast, insufficient or disturbed sleep has emerged as a major public health concern due to its strong association with lifestyle-related disorders and impaired quality of life.

In recent decades, rapid modernization, academic pressure, occupational demands, excessive use of electronic devices, irregular work schedules, and sedentary lifestyles have contributed to a progressive decline in sleep duration and quality across all age groups. Epidemiological studies consistently demonstrate that inadequate sleep is associated with increased body mass index (BMI), weight gain, obesity, type 2 diabetes mellitus, cardiovascular disease, metabolic syndrome, menstrual irregularities, and psychological stress. Sleep deprivation disrupts hormonal balance, alters glucose metabolism, and impairs cognitive and emotional regulation, thereby influencing both physical and mental health outcomes.

Given the rising prevalence of sleep disturbances globally, understanding the biological mechanisms, stages, importance, and consequences of sleep deprivation is crucial for developing preventive and therapeutic strategies. This section provides a comprehensive overview of sleep, its stages, and the effects of sleep deprivation on health.

Definition of Sleep

Sleep is defined as a reversible state of reduced consciousness during which responsiveness to environmental stimuli is diminished, yet the individual can be awakened by appropriate sensory stimulation. Unlike coma or unconsciousness, sleep is an active and dynamic physiological process regulated by complex interactions between neural networks, neurotransmitters, and circadian rhythms.

During sleep, several physiological functions such as heart rate, blood pressure, respiratory rate, and body temperature decrease, allowing the body to conserve energy. At the same time, critical restorative processes occur, including protein synthesis, cellular repair, immune modulation, and hormonal regulation. Brain activity during sleep is highly organized and follows predictable patterns, reflecting the active role of sleep in maintaining cognitive and emotional health.

Sleep is regulated by two major biological systems: the circadian rhythm, which controls the timing of sleep and wakefulness, and the homeostatic sleep drive, which increases the pressure to sleep with prolonged wakefulness. Neurotransmitters such as gamma-aminobutyric acid (GABA), serotonin, dopamine, norepinephrine, acetylcholine, and melatonin play a central role in initiating and maintaining sleep by acting on different regions of the brain, particularly the hypothalamus and brainstem.

Stages and Types of Sleep

Scientific research has established that sleep is not a uniform state but consists of distinct stages that cycle throughout the night. Sleep is broadly classified into two major types: Non-Rapid Eye Movement (NREM) sleep and Rapid Eye Movement (REM) sleep. A typical night's sleep consists of multiple cycles, each lasting approximately 90 to 110 minutes.

Non-Rapid Eye Movement (NREM) Sleep

NREM sleep accounts for approximately 75–80% of total sleep time and is further divided into four stages:

- Stage 1 (NREM 1):
  This is the lightest stage of sleep and represents the transition from wakefulness to sleep. Muscle activity slows, eye movements become sluggish, and the individual can be easily awakened.
- Stage 2 (NREM 2):
  This stage constitutes the largest proportion of total sleep time. Eye movements stop, heart rate and body temperature decrease, and brain wave activity slows, indicating deeper relaxation.
- Stage 3 and Stage 4 (Slow-Wave Sleep):
  These stages represent deep sleep and are characterized by slow, synchronized brain waves. Blood pressure, heart rate,

and respiratory rate reach their lowest levels. Slow-wave sleep is essential for physical restoration, immune function, tissue repair, and the release of growth hormone.

Rapid Eye Movement (REM) Sleep

REM sleep is characterized by rapid eye movements, increased brain activity, irregular breathing, and temporary paralysis of major skeletal muscles. Brain wave patterns during REM sleep resemble those observed during wakefulness, which is why this stage is often referred to as paradoxical sleep. REM sleep is strongly associated with vivid dreaming and plays a crucial role in memory consolidation, emotional processing, learning, and brain development.

Infants spend a significantly higher proportion of sleep time in REM sleep compared to adults, highlighting its importance in brain maturation. With increasing age, total sleep duration and REM sleep gradually decline.

Importance of Sleep

Sleep is essential for optimal functioning of nearly every system in the human body. Several theories have been proposed to explain the biological importance of sleep, among which the Repair and Restoration Theory and the Evolutionary Theory are widely accepted.

Repair and Restoration Theory

According to this theory, sleep allows the body and brain to recover from physical and mental exertion experienced during wakefulness. During sleep, cellular repair, protein synthesis, and tissue regeneration are enhanced. Growth hormone secretion during deep NREM sleep promotes physical growth, muscle repair, and metabolic regulation, while REM sleep contributes to neural restoration, synaptic plasticity, and cognitive functioning.

Evolutionary Theory

The evolutionary theory suggests that sleep evolved as a protective mechanism to conserve energy and reduce exposure to environmental threats. Variations in sleep duration among species reflect adaptive responses to ecological demands and predator risk. This theory highlights the survival value of sleep and its role in energy conservation.

Definition of Sleep Deprivation

Sleep deprivation refers to a condition resulting from insufficient quantity or poor quality of sleep over a sustained period, leading to impaired physical, cognitive, and emotional functioning. It may be acute or chronic and can occur due to voluntary sleep restriction, lifestyle factors, medical conditions, or environmental disturbances.

Sleep deprivation differs from insomnia, as it often arises from behavioral or situational factors rather than an inability to initiate or maintain sleep.

Causes of Sleep Deprivation

Sleep deprivation is commonly observed among adolescents and young adults due to academic demands, examination stress, irregular schedules, and increased exposure to electronic media. Psychological stress, poor time management, excessive caffeine consumption, and prolonged screen time significantly interfere with normal sleep patterns.

Modern technology plays a major role in delaying bedtime and increasing nighttime arousal. Excessive use of smartphones, computers, and gaming devices stimulates dopamine release, reinforcing addictive behaviors that further reduce sleep duration. Social and academic pressures also contribute to chronic sleep restriction.

Effects of Sleep Deprivation

Sleep deprivation adversely affects metabolic, cardiovascular, immune, cognitive, and emotional health. It reduces insulin sensitivity, increases cortisol levels, and promotes weight gain and obesity. Chronic sleep loss impairs immune function, increasing susceptibility to infections and delaying recovery.

Cognitive consequences include impaired attention, memory deficits, reduced reaction time, and poor academic or occupational performance. Emotional effects include mood disturbances, irritability, anxiety, depression, and increased stress sensitivity. Prolonged sleep deprivation has been associated with increased risk of cardiovascular disease, mental health disorders, and reduced life expectancy.

Rationale for the Study

Given the increasing prevalence of sleep deprivation and its wide-ranging health

consequences, particularly among young adults, understanding sleep patterns and their association with body weight, stress, menstrual health, and lifestyle behaviors is of significant public health importance. Identifying modifiable factors related to sleep can aid in designing effective interventions aimed at improving health outcomes and quality of life.

AIMS AND OBJECTIVES

Aim of the Study

The aim of the present study is to assess the impact of sleep duration and sleep quality on body weight, perceived stress levels, and lifestyle-related behaviors among adults.

Objectives of the Study

Primary Objective

The primary objective of this study is to evaluate the association between sleep duration and sleep quality with body mass index (BMI) and total body weight among adults.

Secondary Objectives

To assess the relationship between sleep quality and perceived stress levels among adults.

1. To identify lifestyle factors, including dietary habits, physical activity, and daily routines, that are associated with inadequate or irregular sleep patterns.
2. To determine the prevalence of sleep-related problems and sleep disorders within the study population.
3. To provide evidence-based recommendations for improving sleep practices in order to promote healthy body weight, reduce stress, and support positive lifestyle modifications.

Materials and Methods

Study Design

This study was conducted as a narrative review to examine the impact of sleep duration and sleep quality on body weight, stress, menstrual irregularities, and lifestyle-related factors among adults. The review was based entirely on secondary data obtained from previously published scientific literature.

Data Sources and Literature Search

Data were collected from peer-reviewed research articles published in academic journals and reliable scientific sources. Electronic databases including Google Scholar, PubMed, Science Direct, and Research Gate were systematically searched to identify relevant studies. Only articles published in English and related to human health were considered.

The literature search employed predefined keywords associated with sleep duration, sleep quality, body mass index, body weight, stress, menstrual cycle irregularities, and lifestyle factors. Retrieved articles were screened by title and abstract for relevance, and duplicate records were removed.

Eligibility Criteria

Studies were included if they investigated the relationship between sleep and health outcomes such as body weight regulation, stress levels, or menstrual cycle characteristics. Original research articles, observational studies, experimental studies, and review papers were considered for inclusion.

Articles were excluded if they were non–peer-reviewed, opinion-based, editorials, case reports, or unrelated to sleep and health outcomes. Studies conducted on animals or those focusing exclusively on paediatric or narrowly defined clinical populations without generalizable findings were also excluded. Articles addressing sleep disorders without linking them to body weight, stress, or menstrual health were not included.

Data Extraction and Organization

Full-text articles meeting the inclusion criteria were reviewed in detail. Relevant data—including author name, year of publication, study design, study population, and major findings—were extracted. The extracted information was organized into thematic categories based on outcome measures: impact of sleep on body weight, impact of sleep on menstrual cycle, and impact of sleep on stress.

Data Analysis and Synthesis

A qualitative descriptive approach was used for data analysis. Findings from the selected studies were summarized, compared, and synthesized to identify consistent patterns, associations, and variations across the literature. The integrated analysis enabled a comprehensive understanding of the physiological and psychological effects of sleep on health outcomes.

Limitations

This review was limited to available published literature and did not involve primary data collection. Differences in study design, population characteristics, and methods used to assess sleep and health outcomes may influence the interpretation and generalizability of the findings.

RESULTS

A comprehensive literature search identified several studies examining the relationship between sleep duration, sleep quality, and various physical and psychological health outcomes. After screening titles, abstracts, and full texts, studies meeting the inclusion criteria were included in this review. The results consistently demonstrated significant associations between altered sleep patterns and stress, body weight, metabolic health, menstrual function, and lifestyle behaviours.

Sleep Duration and Stress

Population-based evidence demonstrated a strong inverse relationship between sleep duration and perceived stress. Individuals sleeping less than six hours per night exhibited significantly higher stress levels compared with those sleeping eight hours or more, with a clear dose–response pattern observed. Women showed a stronger association between short sleep and stress than men, and young adults aged 20–39 years were particularly vulnerable to the psychological effects of sleep loss. These findings were derived from large-scale community data and adjusted for sociodemographic and lifestyle confounders (Hyun-Joo Kim & Young-Eun Kim).

Sleep Duration, Body Weight, and Obesity

Across paediatric populations, short sleep duration was consistently associated with increased odds of overweight and obesity. Meta-analytic findings indicated that children and adolescents with shorter sleep durations had approximately 1.6–1.9 times higher odds of obesity, with stronger associations observed in younger children and males. A dose–response relationship was evident, with each additional hour of sleep reducing obesity risk (Chen, Beydoun & Wang).

In adults, both cross-sectional and longitudinal studies showed that habitual short sleep was associated with increased body weight and future weight gain, although the strength of association diminished with advancing age. Longitudinal evidence consistently supported short sleep as a predictor of subsequent obesity rather than a consequence of it (Patel & Frank).

Sleep Duration and Cardiometabolic Outcomes

Large-scale systematic reviews involving more than five million participants demonstrated that short sleep duration was significantly associated with increased risks of obesity, type 2 diabetes mellitus, hypertension, cardiovascular disease, coronary heart disease, and all-cause mortality. The strongest associations were observed when sleep duration was less than six hours per night, indicating a threshold effect for adverse health outcomes (Itani, Jike, Watanabe & Kaneita).

Hormonal and Metabolic Effects of Sleep Loss

Experimental sleep restriction studies revealed rapid and significant metabolic disturbances. Reduced sleep duration led to impaired glucose tolerance, decreased insulin sensitivity, and dysregulation of appetite-regulating hormones, including reduced leptin and increased ghrelin levels. Selective suppression of slow-wave sleep alone was sufficient to impair glucose metabolism, highlighting the importance of sleep quality independent of sleep duration. These physiological mechanisms provide a biological basis for the observed associations between short sleep and obesity (Van Cauter & Spiegel).

Sleep Quality, Central Obesity, and Lifestyle Behaviours

Poor sleep quality was independently associated with higher body mass index, increased central obesity, and poorer outcomes in weight-loss interventions. These associations were more pronounced in females than males. Irregular sleep timing and inconsistency between weekday and weekend sleep schedules were also linked to higher obesity risk, emphasizing the role of sleep regularity in weight regulation (Abdullah; Kohanmoo et al.).

Sleep deprivation was further associated with impaired cognitive performance, reduced vigilance, diminished executive function, and altered risk-taking behaviour. These cognitive deficits contribute to unhealthy lifestyle

behaviours, including poor dietary choices, reduced physical activity, and impaired decision-making (Lim & Dinges).

Sleep and Menstrual Health

Evidence regarding the relationship between sleep and menstrual health indicated a complex interaction influenced by psychosocial factors. While no consistent direct association was observed between menstrual phase and sleep quality, perceived stress and emotional well-being significantly mediated sleep disturbances across the menstrual cycle. These findings suggest that sleep problems reported during menstruation are more closely related to stress, mood, and pain rather than hormonal changes alone (Romans et al.).

DISCUSSION

This review provides robust evidence that disrupted sleep—characterized by short duration, poor quality, fragmentation, or irregular timing—is strongly associated with adverse cardiometabolic, psychological, and reproductive health outcomes. The consistency of findings across experimental, observational, and meta-analytic studies supports a causal pathway linking sleep disturbance to metabolic dysregulation, obesity, stress vulnerability, and impaired cognitive functioning.

Biological mechanisms include circadian misalignment, sympathetic overactivity, dysregulation of appetite hormones (leptin–ghrelin imbalance), insulin resistance, and hypothalamic–pituitary–adrenal axis activation. Vulnerability varies by age and sex, with children, adolescents, women, and shift workers demonstrating greater susceptibility.

Although long sleep duration was associated with increased mortality in some studies, this relationship is likely influenced by reverse causation and underlying disease. Obstructive sleep apnea emerged as a key mediator linking sleep disruption to metabolic disease, with evidence suggesting partial reversibility through treatment.

Strengths of this review include synthesis across diverse study designs and large populations. Limitations include reliance on self-reported sleep measures, heterogeneity among studies, and limited data from underserved populations.

CONCLUSION

This review highlights sleep as a critical, modifiable determinant of health. Short and poor-quality sleep are consistently associated with obesity, metabolic disorders, stress dysregulation, cognitive impairment, and menstrual health disturbances. The findings underscore the importance of integrating sleep assessment and sleep-focused interventions into public health strategies and clinical practice.

Promoting adequate sleep duration (7–9 hours), regular sleep schedules, and good sleep quality through lifestyle modification, behavioural therapy, and health education may significantly reduce the burden of non-communicable diseases. Future research should prioritize longitudinal and interventional studies using objective sleep measures to establish causality and guide evidence-based sleep interventions.

ACKNOWLEDGEMENT

The authors are grateful to the management of Vijaya college of pharmacy, Hyderabad for providing the facilities to carry out the present work.

CONSENT AND ETHICAL APPROVAL

It is not applicable

COMPETING INTERESTS

Authors have declared that no competing interests exist.

BIBILOGRAPHY

1. Cleveland Clinic. Causes and effects of sleep deprivation [Internet]. Cleveland (OH): Cleveland Clinic; c2023 [cited 2026 Jan 28]. Available from: https://my.clevelandclinic.org/health/diseases/23970-sleep-deprivation Sleep Foundation. Sleep deprivation [Internet]. Washington (DC): Sleep Foundation; c2023 [cited 2026 Jan 28]. Available from: https://www.sleepfoundation.org/sleep-deprivation
2. Kim HJ, Kim YE. The relationship between sleep duration and perceived stress: findings from the 2017 Community Health Survey in Korea. Int J Environ Res Public Health. 2019;16(17):3208. Available from: https://www.researchgate.net/publication/335588662

3. Patel SR, Hu FB. Short sleep duration and weight gain: a systematic review. Obesity (Silver Spring). 2008;16(3):643–653. Available from: https://pubmed.ncbi.nlm.nih.gov/18239586/
4. Chen X, Beydoun MA, Wang Y. Is sleep duration associated with childhood obesity? A systematic review and meta-analysis. Obesity (Silver Spring). 2008;16(2):265–274. Available from: https://pubmed.ncbi.nlm.nih.gov/18239632/
5. Itani O, Jike M, Watanabe N, Kaneita Y. Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression. Sleep Med. 2017;32:246–256. Available from: https://pubmed.ncbi.nlm.nih.gov/27743803/
6. Léger D, Bayon V, de Sanctis A. The role of sleep in the regulation of body weight. Mol Cell Endocrinol. 2015;418(Pt 2):101–107. Available from: https://pubmed.ncbi.nlm.nih.gov/26123586/
7. Romans SE, Kreindler D, Einstein G, Laredo S, Petrovic MJ, Stanley J. Sleep quality and the menstrual cycle. Sleep Med. 2015;16(4):489–495. Available from: https://pubmed.ncbi.nlm.nih.gov/25747332/
8. Kohanmoo A, Akhlaghi M, Sasani N, Nouripour F, Lombardo C, Kazemi A. Short sleep duration is associated with higher risk of central obesity in adults: a systematic review and meta-analysis. 2024. Available from**:** https://in.docworkspace.com/d/sICyDhpuhAuOpg8sG
9. Lim J, Dinges DF. A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. Psychol Bull. 2010;136(3):375–389. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC3564638/
10. Bacaro V, Ballesio A, Cerolini S, et al. Sleep duration and obesity in adulthood: an updated systematic review and meta-analysis. Obes Res Clin Pract. 2020;14(4):301–309.doi:10.1016/j.orcp.2020.03.004
11. Garvey WT. Clinical definition of overweight and obesity. Bariatr Endocrinol. 2019:121–143.
12. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;6(7):e1000097.doi:10.1371/journal.pmed.1000097
13. Jean-Louis G, Zizi F, Nunes J. Mood states and sleepiness in college students: influence of age, sex, habitual sleep, and substance use. Percept Mot Skills. 2006;103(1):27–39.
14. Deng HB, Tam T, Zee BCY, et al. Short sleep duration increases metabolic impact in healthy adults: a population-based cohort study. Sleep. 2017;40(10):zsx130. doi:10.1093/sleep/zsx130
15. Kim JY, Yadav D, Ahn SV, et al. A prospective study of total sleep duration and incident metabolic syndrome: the ARIRANG study. Sleep Med. 2015;16(12):1511–1515.doi:10.1016/j.sleep.2015.09.008
16. Santhosh Illendula**,** Suthakaran raj, A. Srujana & N. Meghanath ; a novel analytical method development and validation for the estimation of cabotegravir by uv spectroscopic method, WJPPS June 2025 14(6), 916-926 DOI:10.20959/wjpps20256-29916
17. Theorell-Haglöw J, Berglund L, Berne C, Lindberg E. Both habitual short sleepers and long sleepers are at greater risk of obesity: a population-based 10-year follow-up in women. Sleep Med. 2014;15(10):1204–1211. doi:10.1016/j.sleep.2014.06.002
18. Driver HS, Baker FC. Menstrual factors in sleep. Sleep Med Rev. 1998;2(4):213–229.
19. Santhosh Illendula, Pavan M, Sai Latha G, Nikhila R, Roopa, KNV Rao ; A new analytical method Development and validation of estimation of Sofosbuvir by UV Spectroscopic method , *IJBPAS May 2024 13(5) ,2388-2395. https://doi.org/10.31032/IJBPAS/2024/13.5.8033*
20. Wei S, Schmidt MD, Dwyer T, Norman RJ, Venn AJ. Obesity and menstrual irregularity: associations with SHBG, testosterone, and insulin. Obesity (Silver Spring). 2009;17(5):1070–1076.
21. Wiknjosastro H, Saifuddin AB, Rachimhadhi T, editors. Gynaecology. 2nd ed. Jakarta: Bina Pustaka Sarwono Prawirohardjo Foundation; 2005. p. 103–127, 204–229**.**