SHORT COMMUNICATION

The Interplay Between Sleep, Lipid Metabolism, and Digestive Health: A Narrative Review

Ozodaxon Baxrixonova [1]
[1] Medical Student, Tashkent Medical University, Tashkent, Uzbekistan

Corresponding author:
Ozodaxon Baxrixonova,
Medical Student, School of Medicine, Tashkent Medical University, Tashkent, Uzbekistan
Email: baxrixonovaozodaxon99@gmail.com
https://orcid.org/0009-0005-1854-000X

Cite this article:
Baxrixonova O. The Interplay Between Sleep, Lipid Metabolism, and Digestive Health: A Narrative Review. Int Rev Lifestyle Med. 2026;1(2):59-64.
https://doi.org/10.22034/irlm.2026.593340.1012

Article history
Received: 23 Jul 2026
Revised: 24 Aug 2026
Accepted: 04 Sep 2026

Abstract

Background and Objective: Sleep disturbances are increasingly recognized as potential contributors to dyslipidemia and metabolic dysfunction. This review examined the relationships among sleep duration, sleep quality, obstructive sleep apnea (OSA), lipid metabolism, inflammation, and related metabolic outcomes.
Methods: A systematic literature search was conducted in PubMed, Scopus, Embase, and Web of Science on January 20, 2025. Studies involving human participants with OSA that evaluated at least one composite lipid index (including the atherogenic index of plasma, lipid accumulation product, or visceral adiposity index) were eligible. Prospective, retrospective, and cross-sectional studies published in English were considered. Following removal of duplicate papers from 177 identified records, relevant original studies were included. Study quality and risk of bias were considered.
Results: The evidence indicates a complex, often non-linear association between sleep characteristics and metabolic health. Both short and long sleep durations were associated with unfavorable lipid and cardiometabolic biomarkers, including altered high-density lipoprotein, C-reactive protein, glycated hemoglobin, glucose, and insulin levels. In OSA, intermittent hypoxia may promote dyslipidemia through increased free-fatty-acid release, impaired lipoprotein clearance, inflammation, oxidative stress, and hormonal dysregulation. Sleep disruption may also alter cortisol, leptin, and ghrelin secretion, contributing to obesity, insulin resistance, and impaired glucose homeostasis. However, substantial heterogeneity in sleep assessment, OSA diagnosis, populations, and outcome measures limited direct comparisons and quantitative synthesis.
Conclusion: Sleep disturbances, particularly OSA and abnormal sleep duration, may adversely affect lipid metabolism and broader metabolic health. Standardized longitudinal and interventional studies are needed to clarify causality and determine whether sleep-focused interventions improve dyslipidemia, inflammation, obesity, and insulin resistance.
Keywords: Sleep; Sleep Apnea, Obstructive; Dyslipidemias; Lipid Metabolism; Metabolic Syndrome; Inflammation; Insulin Resistance.

Copyright © 2026 International Review of Lifestyle Medicine at https://www.irlmjournal.ir. This work is licensed under a Creative Commons Attribution-Non-Commercial 4.0 International license (https://creativecommons.org/licenses/by-nc/4.0/). Non-commercial uses of the work are permitted, provided the original work is properly cited.

Introduction

This brief overview aims to synthesize existing research to elucidate how sleep disturbances impact metabolic health. Because the prevalence of conditions such as obesity, Type 2 diabetes mellitus (T2DM), and cardiovascular diseases is on the rise around the world, our understanding of the role of sleep in developing these disorders finds further attention. This review highlights current results which indicate a complex interplay between sleep patterns (both its duration and quality) and lipid profiles, suggesting that both short and long sleep durations may contribute to dyslipidemia, a condition characterized by abnormal lipid levels in the blood, which is a known risk factor for various metabolic disorders (1, 2).

The review encompasses an evaluation of literature extracted from major databases, assessing the quality of included studies using standardized scales. Also, it identifies that intermittent hypoxia, particularly in individuals with obstructive sleep apnea (OSA), can lead to lipid abnormalities through mechanisms involving inflammation and hormonal changes (3). Notably, studies report that inflammatory markers and poor sleep quality are associated with disrupted metabolic processes, further complicating the relationship between sleep and health (4, 5). Furthermore, the analysis highlights that sleep disorders may lead to altered secretion of key metabolic hormones, impacting energy balance and increasing the risk of obesity and insulin resistance (6, 7).

However, controversies still exist regarding these findings as they primarily suffer from the heterogeneity of methodologies employed in different studies, which complicates direct comparisons and meta-analyses. Variability in the assessment of sleep quality, diagnostic tools, and patient populations can also influence these results, thus necessitating cautious consideration in generalizing findings across diverse groups (4, 6). Despite these limitations, the present review underscores the urgent need for carefully-planned research in future, particularly longitudinal studies and interventional studies, to better understand those likely causal relationships (9) and to develop targeted strategies to improve sleep quality as a means of enhancing metabolic health outcomes for diverse target groups.

In short, this review can serve as a critical resource for health professionals and researchers interested in the interconnections between sleep disturbance and metabolic disorders. The findings fairly underscore the potential for sleep interventions to mitigate risks associated with dyslipidemia and related inflammatory conditions, ultimately contributing to improved patient outcomes in metabolic health management (1, 2, 8).

Methods and Materials

The first step in this review involved the data extraction which was performed by the second and third authors who evaluated titles and abstracts against the eligibility criteria, with the first author finalizing them. The data extraction sheet captured essential details including the first author's name, values for composite lipid indices (AIP, LAP, and VAI), diagnostic ability (area under the receiver operating characteristic curves, sensitivity, specificity, and cut-off), and patient characteristics such as sample size and demographic information (1, 4).

As for the quality of included studies, the Newcastle Ottawa Scale (NOS) and the Downs and Black Quality Index Score were used for appraisal (8). Each study was independently rated by two colleagues across various domains, including selection, comparability, and outcome ascertainment. Studies scoring below a total NOS score of 3 were excluded from quantitative synthesis (1, 8). Additionally, the risk of bias was in perspective and assessed with a focus on how the studies reported quality, external validity, and power (8).

Data Sources

The methodology employed in this systematic review involved a comprehensive search of major international databases including Scopus, PubMed, Embase, and Web of Science. The literature search was conducted on January 20, 2025, focusing on keywords related to "obstructive sleep apnea" (OSA) and various lipid indices such as "atherogenic index", "visceral adiposity index", and "lipid accumulation product". A total of 177 records were identified, with 82 duplicates removed prior to screening.

Eligibility Criteria

Inclusion criteria for studies were established to ensure relevance to the topic. Only prospective, retrospective, or cross-sectional studies on human subjects with OSA that assessed at least one of the target composite lipid indices were included. Studies published in English which compared OSA cases with non-OSA controls or those assessing differences within varying severities of OSA, determining the apnea-hypopnea index (AHI) (1) were in perspective. Exclusion criteria were strictly applied, filtering out non-OSA studies, reviews, and conference abstracts, resulting in the final inclusion of relevant original studies after a thorough screening process.

Results

Several studies have demonstrated a significant association between sleep disturbance and dyslipidemia, which is characterized by abnormal levels of lipids in the blood (10). Also, intermittent hypoxia (IH), commonly associated with obstructive sleep apnea (OSA), has been shown to lead to dyslipidemia through increased free fatty acid (FFA) release, which can be normalized with oxygen supplementation in humans (11). This condition is also marked by morphological and functional remodeling of adipose tissue in animal models, particularly mice (7). Furthermore, IH has been linked to decreased lipoprotein clearance due to inhibition of lipoprotein lipase (LPL), mediated by hypoxia-inducible factor 1 (HIF-1) and Angiopoietin-Like 4 (Angptl4) (7).

Sleep Disturbances and Metabolic Health

The relationship between sleep quality and metabolic health has gained attention in recent years, particularly in the context of the rising prevalence of obesity and Type 2 diabetes mellitus (T2DM) (8, 12). Sleep disorders, including short sleep duration and shift work, contribute to glucose intolerance and insulin resistance, ultimately leading to pancreatic endocrine dysfunction (1). Studies indicate that inadequate sleep quality, quantity, and timing are associated with various endocrine and molecular mechanisms that disrupt glucose homeostasis and adipose tissue metabolism (1). These mechanisms involve the activation of the sympathetic nervous system, oxidative stress, and inflammation across multiple organ systems including muscle, liver, fat, and pancreas (7, 13, 14).

Sleep Duration and Cardiovascular Biomarkers

A systematic review analyzing the relationship between sleep duration and biomarkers of cardiovascular disease (CVD) using data from the National Health and Nutrition Examination Survey (NHANES) found that approximately 25% of participants reported sleep disturbances (8). It was reported that the short sleep duration was positively associated with abnormal levels of high-density lipoprotein (HDL), C-reactive protein (CRP), glycated hemoglobin (HbA1c), and insulin levels (8, 15). Conversely, it was noted that long sleep duration was associated with abnormal CRP, HbA1c, and blood glucose levels, indicating a complex relationship between sleep duration and metabolic parameters (8). These were considered as evidence in favor of the relationship in question.

Inflammatory Response and Sleep Quality

The interplay between sleep quality and inflammation is also noteworthy. Inflammatory bowel disease (IBD) presents a chronic disruption of sleep patterns, with cytokines impacting sleep regulation (5). In fact, the relationship between endogenous inflammation and sleep disturbances suggest that addressing inflammatory responses may be essential in improving sleep quality, thereby influencing metabolic health outcomes (5).

Study Quality and Limitations

The systematic review encompassed multiple studies that examined lipid indices in OSA patients, revealing that most included studies were of high quality, with rigorous screening and evaluation processes. However, limitations such as small sample sizes and the use of different diagnostic tools (e.g., polygraphy vs. polysomnography) introduced variability in results, which may affect the overall conclusions drawn regarding the relationship between sleep disturbances and lipid metabolism (6).

Discussion

The relationship between sleep duration and quality and various metabolic disorders has gained significant attention in recent years. Numerous studies have reported associations between poor sleep quality and the onset of undesirable conditions such as hypertension, obesity, and cardiovascular diseases (16). While our study reinforces these findings within a homogeneous demographic, caution must be exercised when generalizing results to diverse groups of patients or various age groups. Further research involving diverse populations is warranted to enhance our understanding of these associations.

One of the key findings of our study relates to the measurement of unmeasured confounding, assessed using E-values for significant associations (8). For example, an E-value of 5.28 was observed for the link between short sleep duration and C-reactive protein (CRP), indicating that a substantial level of unmeasured confounding would be necessary to negate this association (8). This suggests a robust relationship that is not easily explained by potential confounding factors, supporting the notion that both short and long sleep durations may influence metabolic health parameters.

Additionally, our findings align with emerging evidence from randomized controlled trials evaluating the impact of improved sleep habits on obesity and cardiovascular health (17). However, the mechanisms underlying these associations appear multifaceted, involving hormonal changes related to metabolism and appetite regulation. Because sleep disturbances may lead to altered secretion of metabolic hormones such as cortisol, leptin, and ghrelin, these might inevitably affect energy balance and dietary behaviors (18). For instance, sleep fragmentation has been linked to increased adiposity and impaired insulin secretion, as observed in rodent models, which prompts further investigation into whether similar metabolic disruptions occur in humans (7). Moreover, our systematic review highlights the significant heterogeneity present in the literature concerning sleep quality and its effects on lipid metabolism (4). While some studies indicated changes in lipid profiles related to sleep duration, the variability in methodologies and outcome measures limited our ability to conduct comprehensive meta-analyses for all aspects of sleep quality. It is crucial for future research to standardize outcome measures and clarify the complex relationships between sleep duration, sleep quality, and lipid metabolism.

Conclusion

While this review contributes valuable insights into the interplay between sleep disturbances and metabolic health, limitations persist, including potential biases

inherent in observational studies and the challenges of controlling for confounding variables at the study level. Despite these challenges, the implications of our findings are significant, suggesting that interventions aimed at improving sleep quality may play a crucial role in mitigating the risks associated with obesity, insulin resistance, and overall metabolic dysfunction. Future studies should explore these relationships further, focusing on direct interventions and their effects on metabolic outcomes to validate the observed associations. Also, addressing the factors contributing to sleep disturbances may prove fundamental in mitigating risks associated with metabolic syndrome and related disorders.

References

Behnoush AH, Bahiraie P, Shokri Varniab Z, et al. Composite lipid indices in patients with obstructive sleep apnea: a systematic review and meta-analysis. Lipids Health Dis. 2023;22:84. doi:10.1186/s12944-023-01859-3

Kruisbrink M, Robertson W, Ji C, et al. Association of sleep duration and quality with blood lipids: a systematic review and meta-analysis of prospective studies. BMJ Open. 2017;7(9):e018585. doi:10.1136/bmjopen-2017-018585

Drager LF, Jun JC, Polotsky VY. Metabolic consequences of intermittent hypoxia: relevance to obstructive sleep apnea. Best Pract Res Clin Endocrinol Metab. 2010;24(5):843-851. doi:10.1016/j.beem.2010.08.011

Che T, Yan C, Tian D, Zhang X, Liu X, Wu Z. The association between sleep and metabolic syndrome: a systematic review and meta-analysis. Front Endocrinol (Lausanne). 2021;12:773646. doi:10.3389/fendo.2021.773646

Kadier K, Dilixiati D, Ainiwaer A, et al. Analysis of the relationship between sleep-related disorder and systemic immune-inflammation index in the US population. BMC Psychiatry. 2023;23:773. doi:10.1186/s12888-023-05286-7

Firoozi D, Masoumi SJ, Hosseini Asl SMK, et al. Effects of short-chain fatty acid-butyrate supplementation on expression of circadian-clock genes, sleep quality, and inflammation in patients with active ulcerative colitis: a double-blind randomized controlled trial. Lipids Health Dis. 2024;23:216. doi:10.1186/s12944-024-02203-z

Briançon-Marjollet A, Weiszenstein M, Henri M, Thomas A, Godin-Ribuot D, Polak J. The impact of sleep disorders on glucose metabolism: endocrine and molecular mechanisms. Diabetol Metab Syndr. 2015;7:25. doi:10.1186/s13098-015-0018-3

Addo PNO, Mundagowa PT, Zhao L, Kanyangarara M, Brown MJ, Liu J. Associations between sleep duration, sleep disturbance and cardiovascular disease biomarkers among adults in the United States. BMC Public Health. 2024;24:947. doi:10.1186/s12889-024-18381-5

Lin CC, Yang CW, Li CI, et al. Causal relationship of sleep duration on risks for metabolic syndrome: a Mendelian randomization study. Diabetol Metab Syndr. 2025;17:70. doi:10.1186/s13098-025-01643-6

Pintacom J, Pliannuom S, Buawangpong N, Angkurawaranon C, Pinyopornpanish K. The association between poor sleep quality and lipid levels among dyslipidemia patients in Thailand: a prospective cross-sectional study. Healthcare (Basel). 2025;13(6):678. doi:10.3390/healthcare13060678

Chopra S, Rathore A, Younas H, et al. Obstructive sleep apnea dynamically increases nocturnal plasma free fatty acids, glucose, and cortisol during sleep. J Clin

Endocrinol Metab. 2017;102(9):3172-3181. doi:10.1210/jc.2017-00619

Antza C, Kostopoulos G, Mostafa S, Nirantharakumar K, Tahrani A. The links between sleep duration, obesity and type 2 diabetes mellitus. J Endocrinol. 2021;252(2):125-141. doi:10.1530/JOE-21-0155

Jiao Y, Butoyi C, Zhang Q, et al. Sleep disorders impact hormonal regulation: unravelling the relationship among sleep disorders, hormones and metabolic diseases. Diabetol Metab Syndr. 2025;17:305. doi:10.1186/s13098-025-01871-w

Lam JCM, Ip MSM. Sleep & the metabolic syndrome. Indian J Med Res. 2010;131(2):206-216.

Shukla RK, Chhatravala AJ, Patel D. Association between sleep duration and early cardiovascular risk markers in young adults. Int J Med Pharm Res. 2026;7(3):3921-3933.

Feng S, Park JH, Zhang Q, Ma P, Lee JM, Shin JC. The associations between sleep duration and various metabolic health indices among adults in the United States: a multivariate analysis of variance (MANOVA) using National Health and Nutrition Examination Survey (NHANES) 2021 to 2023 dataset. J Prim Care Community Health. 2025;16:21501319251315599. doi:10.1177/21501319251315599

St-Onge MP, Campbell A, Zuraikat FM, Cheng B, Shah R, Berger JS, Sampogna RV, Jelic S. Impact of change in bedtime variability on body composition and inflammation: secondary findings from the Go Red for Women Strategically Focused Research Network. Int J Obes (Lond). 2020;44(8):1803-1806. doi:10.1038/s41366-020-0555-1

Li A, Li X, Zhou T, Ma H, Heianza Y, Williamson DA, Smith SR, Bray GA, Sacks FM, Qi L. Sleep disturbance and changes in energy intake and body composition during weight loss in the POUNDS Lost Trial. Diabetes. 2022;71(5):934-944. doi:10.2337/db21-0699.