LETTER TO THE EDITOR

Exploring the Link between Artificial Light at Night and Metabolic Syndrome

Eeman Salam[1] and Mubashir Raza[1*]

[1]*Department of Medicine, Baqai Medical University, Karachi, Pakistan*

Dear Editor,

Artificial light at night (ALAN) has become an inseparable feature of modern life, driving 24-hour productivity by supporting economic growth, continuous healthcare, transportation, and global connectivity. However, this advancement carries hidden costs, particularly to human health. Emerging evidence underscores that long-term nocturnal light exposure is not merely a nuisance but a serious public health issue, with profound consequences for metabolic health [1].

Metabolic syndrome (MetS): a cluster of risk factors including hypertension, central obesity, insulin resistance, glucose intolerance, and dyslipidemia, is a growing global epidemic, affecting an estimated 20-25% of adults worldwide [2]. While traditionally attributed to lifestyle factors such as diet and physical inactivity, ALAN has now emerged as a modifiable risk factor. MetS dramatically increases the risk of type 2 diabetes and cardiovascular disease. Populations most at risk from ALAN include urban dwellers exposed to pervasive light pollution, shift workers, and individuals using smartphones or computers late into the night. ALAN contributes to MetS by activating the autonomic system and disrupting the circadian rhythm, which depends on the natural light-dark cycle to synchronize vital processes such as hormone secretion, thermoregulation, and metabolism [3]. ALAN, particularly short-wavelength blue light, suppresses melatonin, the "hormone of darkness", thereby impairing glucose metabolism, reducing insulin sensitivity, and promoting weight gain [4]. Epidemiological data strengthen this connection. For instance, an extensive study including over 1.6 million individuals demonstrated that higher ALAN exposure correlated with obesity, hypertension, insulin resistance, type 2 diabetes, and cardiovascular disease [5]. Another cohort analysis reported associations between ALAN and hypertension, obesity, and incident hypercholesterolemia [6]. Additionally, Wang *et al*. (2023) found that ALAN exposure accounted for 26.80% of metabolic disease cases in Ningxia, China, with risk exceptionally high in men [7]. Together, these findings suggest that chronic nighttime light exposure acts as an obesogenic factor, reinforcing the pathogenesis of MetS.

The implications of ALAN with MetS extend beyond individual behaviour into the realm of public health and policy. Widespread light pollution requires systemic solutions: urban planning reforms such as shielded street lighting, stricter regulations on outdoor lighting, and workplace strategies such as circadian-friendly lighting, scheduled rest breaks, and education on sleep hygiene to mitigate circadian disruption for night-shift workers. For clinicians, counselling of MetS should move beyond the usual modifiable risk parameters (diet and exercise) to also include 'light hygiene' such as avoiding bright light exposure before bedtime, using blackout curtains or masks, and adopting warmer, dimmer lighting in the evening. Ultimately, the link between ALAN and metabolic dysfunction is no longer speculative but supported by growing clinical and epidemiological evidence. Yet research remains limited in nationwide epidemiological and retrospective cohort studies, especially in diverse and high-risk populations. Future studies should prioritize these populations to clarify causal pathways and guide effective public health interventions.

In conclusion, ALAN is a pervasive and modifiable contributor to metabolic syndrome. Addressing this requires a multipronged approach: patient education on light hygiene, incorporating circadian health into lifestyle counselling, and public health policies to reduce light pollution. Recognizing light at night as an environmental risk factor is essential to curb the growing burden of metabolic disease.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

Declared none.

AUTHORS' CONTRIBUTION

ES conceptualized the study and wrote the original draft, while MR contributed to writing, reviewing, and submission of the final draft of the manuscript.

The final version of this manuscript has been read and approved by the authors.

**Corresponding author: Mubashir Raza, Department of Medicine, Baqai Medical University, Karachi, Pakistan, Email: mubashir19raza@gmail.com*
Received: June 19, 2025; Revised: September 14, 2025; Accepted: October 03, 2025
DOI: https://doi.org/10.37184/jlnh.2959-1805.4.9

GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work the authors limitedly used ChatGPT (GPT-4, OpenAI) to get language suggestions and do minor proofreading in some parts of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the published article.

REFERENCES

1. Zabuliene L, Milionis C, Koukkou E, Ilias I. Exposure to artificial lighting at night: from an ecological challenge to a risk factor for glucose dysmetabolism and gestational diabetes? Narrative review. Ann Med 2025; 57(1): 2477304.
DOI: https://doi.org/10.1080/07853890.2025.2477304 PMID: 40065696
2. Benedito-Silva AA, Evans S, Mendes JV, Castro J, da Silva B Gonçalves B, Ruiz FS, *et al*. Association between light exposure and metabolic syndrome in a rural Brazilian town. PLoS One 2020; 15(9): e0238772.
DOI: https://doi.org/10.1371/journal.pone.0238772 PMID: 32946454
3. Mason IC, Grimaldi D, Reid KJ, Warlick CD, Malkani RG, Abbott SM, *et al*. Light exposure during sleep impairs cardiometabolic function. Proc Natl Acad Sci USA 2022; 119(12): e2113290119.
DOI: https://doi.org/10.1073/pnas.2113290119 PMID: 35286195
4. Gooley JJ, Chamberlain K, Smith KA, Khalsa SBS, Rajaratnam SMW, Van Reen E, *et al*. Exposure to room light before bedtime suppresses melatonin onset and shortens melatonin duration in humans. J Clin Endocrinol Metab 2011; 96(3): E463-72.
DOI: https://doi.org/10.1210/jc.2010-2098 PMID: 21193540
5. Jiménez D, Arenas LN, Rincón EHH, Céspedes MJG, Peñuela CLJ. Luminous threats: the health impacts of artificial nighttime light on metabolic and mental health: a scoping review. Wellbeing, Space Soci 2025; 8: 100260.
DOI: https://doi.org/10.1016/j.wss.2025.100260
6. Palomar-Cros A, Espinosa A, Bará S, Sánchez A, Valentín A, Cirach M, *et al*. Outdoor artificial light-at-night and cardiometabolic disease risk: an urban perspective from the Catalan GCAT cohort study. Am J Epidemiol 2025; 194(4): 963-74.
DOI: https://doi.org/10.1093/aje/kwae269 PMID: 39160449
7. Wang H, Ma X, Yu Z, Hu N, Du Y, He X, *et al*. Exposure to outdoor artificial light at night increases risk and burden of metabolic disease in Ningxia, China. Environ Sci Pollut Res Int 2023; 30(37): 87517-26.
DOI: https://doi.org/10.1007/s11356-023-28684-6 PMID: 37428317