The dark side of light: light at night may raise the risk of type 2 diabetes

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Thanks to Thomas Edison (1847–1931), who invented practical incandescent light bulbs in 1879, light at night has become a ubiquitous feature of modern society.[1] Light at night, indoors and outdoors, enhances safety, productivity, and community engagement by providing visibility for navigation, security, and extended activities. However, the amplitude and timing of circadian rhythms in humans, which regulate the peak and trough activities of essential physiological processes within the body throughout the day (e.g., hormonal secretion or expression of metabolic genes in tissues), can be disrupted by exposure to light at night.[2]

The natural light–dark cycle serves as a fundamental zeitgeber, synchronising circadian rhythms with the 24-h solar day. Light reaching the retina triggers action potentials, transmitted by the optical nerves to the suprachiasmatic nuclei, the hypothalamic region housing the master clock that entrains peripheral and central clocks.[3] For example, upon awakening from night-time sleep, light exposure can elicit a strong transient rise in serum cortisol levels, also known as the cortisol awakening response.[4] Glucocorticoids such as cortisol reset circadian rhythms of peripheral circadian clocks, signalling the body the onset of the biological day.[5] At sunset, as daylight fades, the secretion of melatonin, a hormone primarily produced by the brain's pineal gland, begins to rise, signalling the onset of the biological night.[3]

Artificial light in the evening and night can disrupt physiological processes controlled by endogenous circadian rhythms, potentially leading to adverse health consequences. This is evidenced by suppressed secretion of the hormone melatonin,[6] as well as a higher prevalence of adverse health consequences such as obesity, type 2 diabetes, and hypertension under chronic conditions of light at night.[7] However, evidence from large-scale studies using objective measures of individual light exposure to investigate how 24-h light exposure characteristics are linked to metabolic health outcomes is lacking.

In this issue of *The Lancet Regional Health – Europe*,[8] Daniel Windred and colleagues present findings from an analysis conducted on the UK Biobank cohort. Their study utilised approximately 13 million hours of light sensor data gathered from 84.790 participants who wore light sensors for one week. Their primary finding was a positive association between light at night exposure and the risk of incident type 2 diabetes during a mean follow-up period of 7.9 years. For example, those in the highest percentile of light at night exposure (90–100th percentiles) exhibited a greater risk of developing type 2 diabetes compared to those with the lowest light at night exposure (0–50th percentiles, hazard ratio 1.53 [95% CI 1.32–1.77], $p < 0.0001$). This association persisted even when considering participants' genetic risk for type 2 diabetes. Furthermore, participants with less pronounced circadian amplitude, indicating that their light at night exposure levels were closer to those measured during daytime, and those with less stable day-to-day light exposure patterns, exhibited a greater risk of developing type 2 diabetes.

Windred and colleagues' findings suggest that minimising night-time light exposure, or increasing daylight exposure while simultaneously reducing light at night to widen the circadian amplitude, or promoting day-to-day regularity of light exposure patterns could all be meaningful strategies to lower the risk of type 2 diabetes. However, several points should be considered in the interpretation and generalisability of their findings. For instance, light sensitivity of the master clock can vary considerably between individuals,[9] which may also impact to what extent light at night may affect the risk of developing type 2 diabetes. Despite being a potential risk factor for type 2 diabetes, light at night serves crucial functions, such as facilitating night-time work in healthcare settings, assisting individuals in enhancing indoor visibility (e.g., aiding elderly subjects concerned about falling), and contributing to a sense of safety by alleviating feelings of anxiety and fear. Additionally, it remains unclear whether interventions such as wearing blue-light blocking glasses during the night or using a sleep mask in a bedroom illuminated by indoor light can effectively mitigate the risk of type 2 diabetes amidst exposure to light at night. Lastly, the observed association between light at night and type 2 diabetes may actually be mediated by nocturnal activities facilitated by light, such as night-time eating episodes.[10]

Notwithstanding these crucial considerations, the study by Windred and colleagues suggests that promoting light hygiene, including but not limited to low exposure to light at night, may hold some public health

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promise as an easily implementable strategy to lower the incidence of type 2 diabetes. Whether light-tailored strategies can aid the therapeutic outcomes of those who have already developed type 2 diabetes is also worth investigating in this context.

Contributors

CB and PX wrote the first draft. DAN critically reviewed the manuscript. All authors read and approved the final content of the paper.

Declaration of interests

No potential conflicts of interest relevant to this article were reported.

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