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Editorial

Night Light Pollution and Ocular Fatigue

Choul Yong Park

Department of Ophthalmology, Dongguk University, Ilsan Hospital, Goyang, Korea

▸ See the article "Effect of Ambient Light Exposure on Ocular Fatigue during Sleep" in volume 33, e248.

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Address for Correspondence:
Choul Yong Park, MD, PhD
Department of Ophthalmology, Dongguk University, Ilsan Hospital, Donggukro 27, Ilsan-dong-gu, Goyang 10326, Republic of Korea.
E-mail: oph0112@gmail.com

ORCID iDs
Choul Yong Park
https://orcid.org/0000-0002-3041-658X

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Environmental brightness is an important factor in synchronizing human circadian rhythms to solar light-dark cycles. Therefore, disruption of the environmental light-dark cycle can cause abnormal circadian rhythm and may result in various psychological or physiological human dysfunctions. It is a fact that civilization makes the night brighter; in addition to streetlights and car lights, smart pads, cell phones, computers, and TVs further increase urban night illumination. As a result, undesired environmental alteration called 'light pollution' spreads widely across the world with the constant growth of human civilization.[1] In contrast to natural solar light, artificial light sources emit more blue light (a short wavelength of light with a range of 460–500 nm). Notably, constant or excessive exposure to blue light can cause inadvertent retinal damage by oxidative stress.[2]

Intolerance of the human eyes to excess light exposure can manifest as ocular fatigue. Ocular fatigue is more aggravated after exposure to blue light.[3] Whereas physical or mental fatigue is known to explain the decreased performance of physical (muscular) or cognitive (mental) function, ocular fatigue, also known as 'eye strain,' specifically manifests as a combination of eye discomfort and visual impairment. Typical symptoms of ocular fatigue include tired eye, blurry eye, heavy eye, itchy eye, burning eye, increased tearing, and conjunctival hyperemia. Ocular fatigue may also aggravate dry eye symptoms and cause rapid break up of tear film.

In this issue, Suh et al.[4] investigated the effect of ambient light exposure during sleep on ocular fatigue in the morning. They found that continuous exposure to relatively low ambient luminance (5 or 10 lux) during sleep significantly increased morning ocular fatigue. The value of this study is a clear demonstration of the assumption that has long been made based on individual experience, and especially valuable are this study's strengths. First, it is one of the rare prospective studies to investigate the effect of nighttime exposure to excessive illumination on morning ocular fatigue. Second, they chose the stimulating light intensities of 5 or 10 lux in accordance with the street night light intensity of an average city. Thus, the participants were exposed to settings of full levels of nighttime urban light pollution. Third, the authors investigated both the objective and subjective parameters to measure ocular fatigue. Subjective responses to questionnaire are highly dependent upon responders' daily physical and mental condition. Therefore, combining the objective parameters better potentiate the authors' findings and conclusions.

However, the study by Suh et al.[4] possesses some limitations. As for now, there has been no direct method to clearly measure ocular fatigue. Although the questionnaires and tear break up time can be useful indicators of ocular fatigue, many of these parameters overlap with the signs and symptoms of dry eye syndrome. The study would have been improved with the measurement of critical flicker frequency (CFF). Many studies measure CFF to objectively quantify ocular fatigue.[3] Human eyes have both spatial and temporal resolutions to interpret visual stimulus; spatial resolution of human vision can be measured using a visual acuity chart, which we are familiar with. On the other hand, CFF is the threshold frequency of light flicker, which can be recognized as flashing light. Increased CFF means the eye can distinguish higher frequencies of flashing light. Tired eyes generally have lower CFF and recognize flickering light as continuous. In addition, indicated by the authors as one of the possible mechanisms of their findings, excessive nighttime illumination could potentially interrupt the normal sleep of the participants. In another study, exposure to 5 and 10 lux of dim light during sleep disrupted normal sleep patterns, decreasing total sleep time and sleep efficiency and increased REM sleep.[5] Sleep deprivation can meaningfully change all parameters that are investigated to measure ocular fatigue. The measurement of participants' sleep quality therefore might have excluded the sleep deprivation effect on ocular fatigue. Finally, the chronic effects of ambient light exposure during sleep are still unknown and pose an interesting topic for future studies. Interestingly, a mouse study reported a significant recovery of sleep quality after chronic exposure to dim light during sleep.[6]

Modern people are constantly exposed to new environmental health risks that they have never experienced before. Light pollution is one such risk. The study of light pollution and ocular health is now beginning to receive global attention. This concern is not limited to nighttime light pollution, but also includes the overall light hazard. Future studies and results will suggest pertinent solutions to protect our eyes from ever-increasing light pollution.

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