The “Realities” of our Modern Light-Dark Cycle

Commentary on Piosczyk et al. Prolonged sleep under Stone Age conditions. *J Clin Sleep Med* 2014;10:719-722.

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The advent of artificial light and its widespread use beginning in the 19th century changed the fundamentals of human existence and has had profound effects on human behavior including where and when we work and sleep. Electric light has allowed us to extend our work and leisure hours past natural sunset and has resulted in 24-hour work schedules. The invention of electric light—and the Industrial Revolution that preceded artificial light’s arrival—also moved a significant segment of the daytime workforce indoors, which limited exposure to light levels as bright as natural outdoor daylight. Night shift work is associated with a host of health risks including cardiovascular disease, obesity, fertility problems, mood disorders, accidents, and cancer. Indeed, shift work has now been classified as a probable carcinogen. The alterations in physiology produced by artificial lights could occur through a host of (interacting) physiologic pathways including shifts in circadian rhythms, alteration of melatonin (and other hormonal) secretion patterns, and changes in sleep timing, quality, and duration.¹ Most of our understanding of human sleep and circadian biology comes from studying humans who live in environments where natural light is supplemented by artificial light or where subjects are brought into the laboratory and exposed to dim light levels to uncouple the sleep and circadian systems. In contrast, much less is known about sleep and circadian physiology in conditions lacking artificial light.

In this issue, Piosczyk et al.² describe the sleep of 5 adults who participated in a German reality television program where they lived in a stone-age like settlement for 2.5 months. This “natural experiment” provided a unique opportunity to examine sleep behavior in an environment that depended only on natural light. The participants exhibited average phase advances in estimated sleep onset of about 2 hours and advances in wake time of about 0.5 hours, resulting in increases in estimated sleep time of 1.5 hours—from 342 minutes at baseline to 432 minutes in Stone Age conditions. Putative mechanisms for these changes in sleep timing and duration include lack of evening artificial light and prolonged daytime light exposure beginning at dawn that would be expected to phase advance circadian rhythms and thus sleep patterns.

Piosczyk’s data are complementary to a recent study by Wright and colleagues³ where eight young adults had their

circadian rhythms measured before and after a 2-week camping trip in the Colorado Rocky Mountains. Objective measures of light levels showed that the participants were exposed to 4.5-fold increase in daytime light exposure compared to usual light exposure. Campers exhibited an average phase advance in the endogenous melatonin rhythm of ~2 hours but did not show a change in sleep duration; participants obtained just over 400 minutes of sleep in both conditions.

Although many factors varied between the two investigations—including study duration (~7 weeks vs. 2 weeks), daily routine, work load, housing, etc.—taken together these observational studies highlight the profound differences in how human sleep behavior and circadian physiology is expressed under natural conditions compared to living situations that are supplemented with artificial light. Much attention is given to the role that evening light both from indoor lighting and exposure to televisions, computers, and hand-held devices may play in sleep and circadian disruption. Relatively little attention, however, has been devoted to understanding the effects of low levels of daytime lighting. We speculate that exposure to lower light levels during the day and little natural daylight may play a role in sleep difficulties, mood disturbances, and vitamin D deficiency. Demonstrated sex differences in circadian period length⁴ and phase angle⁵ may point to differential vulnerability to alterations in light intensity and exposure patterns between women and men. Whether more daytime light exposure could counteract the effects of increased evening and nighttime light exposure is an empiric question. This Stone Age experiment highlights the reality that our sleep and circadian patterns and perhaps sleep quality are affected by light exposure. We anticipate that future developments in our ability to deliver light with specific spectral properties in a real world setting will enhance our ability to influence sleep and circadian physiology with artificial light. Forthcoming work should continue to examine the role of light levels and exposure patterns as potent, biologically active agents in human health and disease.

CITATION

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DISCLOSURE STATEMENT

The authors have indicated no financial conflicts of interest.