



The Impact of Sleep: From Ancient Rituals to Modern Challenges

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Sleep Sci

Abstract

Keywords

- sleep
- sleep restriction
- population
- circadian rhythm
- health
- society

Although sleep is crucial for mental and physical health, insufficient sleep is a growing problem in our modern society. In general, adults need approximately eight hours of sleep per night, but this is often unfeasible nowadays. This sleep restriction has been observed, and it has worsened, throughout the past two centuries; therefore, it is more attributed to socioeconomic changes than to biological adaptations. The most important factors to contribute to this sleep restriction were the popularization of artificial light and industrialization. The present manuscript briefly overviews, from a socioanthropological perspective, the reasons why sleep has been impacted, disclosing its effects on individuals and on society.

Introduction

Sleep is crucial for mental and physical health, and it is essential for the homeostasis of body functions. Sleep restriction or poor sleep quality are associated with substantial health consequences, including cardiovascular diseases, diabetes, stroke, hypertension, obesity, and immune system dysfunction, which may increase the risks of inflammation, some types of cancer, and even death.^{1,2} Sleep should not only be considered a vulnerable state that persisted in evolutionary terms.^{3,4} Indeed, sleep is an adaptive state that enables the efficient use of finite energy.³⁻⁵

Despite the diverse philosophical approaches concerning sleep and regardless of any technical definition, sleep happens in all cultures. Sleep patterns differ in distinct parts of the world and have changed over the course time, but the fact that sleep has been present throughout time and across cultures is undisputable. In some cultures, sleep is a mystical and transcendental condition, described as prophetic or influencing important decisions. In ancient Greece, philosophers considered dreams to be divine and wrote manuals

for their interpretation.⁶ Traditions and environmental conditions can also influence sleep habits and practices.

The social sleep hypothesis explains how the early *Homo* genus overcame the risks arising from the transition to terrestrial segmented sleep: the idea is that early humans committed themselves to a kind of social niche. It is known that the controlled use of fire was also essential to ensure terrestrial sleep, and it enabled the practice of short periods of flexible, but quality sleep.^{7,8} Coolidge and Wynn (2016)⁹ suggested that when hominids became fully terrestrial, they gained the advantage of having greater stability than when they slept in trees. Thus, they could achieve sleep with longer duration and better quality, which would have improved the waking cognition and survival. However, in the last two centuries, much more pronounced alterations in sleep have occurred which are not simply explained by evolution.

Sleep in Modern Society

Insufficient sleep is a growing problem in our modern society.^{10,11} In general, adults need approximately seven to

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eight hours of sleep per night, but this is often unfeasible nowadays.² Data from the United States^{12,13} show that up to 40% of the population sleep no more than 7 hours per night, while 30% sleep less than 6 hours per night. Over the last 5 decades, a reduction of approximately 2 hours of sleep per night has been observed, and the proportion of individuals sleeping less than 6 hours has increased ~ 6% since 1985.¹² Similar data have been observed in São Paulo, Brazil, where epidemiological surveys¹⁴ report an average total sleep duration of 6.1 hours per night among individuals aged between 20 and 50 years. Such alterations are largely attributed to socio-cultural changes, the most important of them being the popularization of artificial light and industrialization.

A major cultural transformation in sleep patterns has occurred with the introduction and widespread availability of artificial light.^{15,16} Electric light was only developed a little over 140 years ago, which is a short period compared with the emergence of *H. sapiens* and the structure of our circadian system, but enough to restructure the priorities of society. One can imagine the impact of artificial light on sleep by considering life before the electric light was invented or widely available. The sources of light after sunset were basically fire, candles and lamps. As few human activities are performed in the absence of light, sleep becomes a natural behavior that helps the organism to recover and the individual pass the time, for it is a period of preconditioned interruption of most activities. Electric light is a factor that powerfully affects our circadian rhythm and is often overlooked when it comes to sleep disturbance. Without it, only a few people would stay awake at night.¹⁷

Obviously, our sleeping habits have changed drastically since then. Industrialization has led to major changes in sleep patterns since its introduction in the mid-eighteenth century, and when the light bulb was invented by Thomas Edison toward the end of the nineteenth century, life inside and outside the home changed forever. This invention made nighttime activities easier and safer and turned sleep into an inconvenient necessity that could be sacrificed in favor of work or engagement in social activities. Thus, polyphasic sleep became less prevalent and was gradually replaced by late-onset, single sleep, although some rural populations still had a biphasic sleep pattern (mostly composed by a larger nocturnal sleep period and a smaller midday *siesta*). The nineteenth and twentieth centuries were marked by major technological advances, the introduction of shift work, and a new understanding of the circadian rhythm. These major changes resulted in a decrease in sleep duration and, as a consequence, an increase in sleep-related diseases. This period was also marked by the wider availability of technological distractions and barriers to an adequate healthy sleep, a process that persists to date.^{18,19}

Under these circumstances, currently sleep restriction has become a relevant health issue. A variety of social and environmental factors affect both sleep duration and quality. Longer working hours and technological entertainment activities act as contemporary lifestyle stressors and contribute to sleep insufficiency. Chronic reduction in sleep is frequently associated with the impositions of modern life, such as

domestic and educational responsibilities and pressure from employers arising from a capitalist perspective. Although it is essential, sleep reduces the amount of time that can be devoted to other activities, such as work. The world has entered a frenetic functioning rhythm (24/7) with an increasing amount of time dedicated to work. If one is to fit leisure time into this routine, even less time is reserved for rest and sleep.²

The main question is: how does the reduction in sleep time affect us on an individual and societal level? As aforementioned, we now understand sleep beyond its purely behavioral aspects. It is known that electrophysiological activity in the brain during sleep produces two distinct and easily identifiable stages, namely rapid eye movement (REM) sleep and non-REM sleep.²⁰ Physiologically, during sleep, we experience alterations in the cardiovascular and respiratory systems and oscillations in the production of hormones and neurotransmitters. Thus, any disease that affects the quality, timing, or duration of sleep and impacts a person's ability to properly function while awake is understood as a sleep disorder. Given the importance of sleep for our physical and mental health, scientists around the world are dedicated to understanding the causes of sleep disorders and finding treatments for them. The combined effect of reduced sleep time and the emergence of sleep disorders has been categorically associated with the emergence of several diseases. Significant changes in hormone levels have been found²¹ in individuals exposed to few hours of sleep per day, and they include elevated levels of cortisol and ghrelin (an appetite-stimulating peptide), which contribute to a considerable increase in appetite, leading to a higher risk of developing metabolic disorders, such as diabetes or obesity.²² In terms of cardiovascular diseases, workers who sleep less than six hours per day have a four-fold increased risk of stroke.²³ There are also consequences at the level of the immune system, with an increase in hypo- and hyperactivity of the immune system, simultaneously promoting autoimmune phenomena with detrimental effects on acquired immunity, resulting in an ineffective response to immunization and increased susceptibility to infectious diseases.²⁴ Therefore, studies in this field are crucial for public health, especially as there is a bidirectional relationship between sleep and illness. Changing sleep patterns have renewed the focus of research on this issue, and it is now widely agreed that good sleep is a necessity to maintain a healthy body and mind.

The longer the duration of sleep restriction, the worse the signs and symptoms. Sleepiness increases as sleep curtailment continues, but it does not always grow in proportion to the persistence of chronic sleep restriction. Thus, the physiological response to sleep loss may depend, to some degree, on the form of sleep restriction (acute or chronic). The control related to sleep pressure (adenosine and the hypothalamic system) mediates the level of attention impairment depending on the amount of sleep loss. Sleep restriction exacerbates preexisting mood disorders such as anger, depression, and anxiety. Sleep restriction leads to mental confusion, temporal and spatial disorientation, and fatigue.

Authors²⁵ studying physical and verbal aggression, anger, and hostility in a group of young adult males found that these individuals reported aggression and anger after sleep restriction. Sleep restriction increases anxiety levels and significantly affects the restriction of emotional reactivity as it promotes persistent hyperadrenergic activity during wakefulness, reducing the amount and quality of subsequent nighttime sleep, creating a vicious circle. Symptoms of posttraumatic stress disorder have been induced through selective REM sleep restriction in healthy individuals, with increased autonomic sensitivity to conditioned stimuli that no longer exist.²⁶

The effects of the prevalence of sleep disorders on the individual and society have gradually become more apparent and have been correlated to the emergence of various diseases. The literature is scarce about the reasons why some individuals cannot sleep, particularly from an anthropological perspective, considering the potential impact on sleep of factors, such as social isolation and difficulties in maintaining relationships. Healthy contact with spouses, friends or relatives contributes to a feeling of safety and protection in humans, and disruptions in these relationships can lead to increased feelings of loneliness and vulnerability that reduce sleep quality.²⁷

Sleep should not be considered a purely biological event, but also a sociocultural phenomenon. After all, the way we sleep is a construction of the society in which we live. An example of this are the changes in the sleep cycle induced by catastrophic events such as accidents, natural disasters, and pandemics. As a recent instance, we can consider the coronavirus 2019 (COVID-19) pandemic, which had a range of direct and indirect effects on many aspects of sleep.²⁸ Therefore, social isolation, financial worries, and concerns about the consequences of this disease significantly increased anxiety, depression, stress, and insomnia, causing a greater reduction in sleep quality.^{29,30} Moreover, sleep can be affected not only by disruptions in social relationships as aforementioned, but also by hunger, lack of temperature regulators (heaters, blankets, fans or air conditioners), stress, and a broad range of other factors.³¹

Evidence suggests that, in addition to basal temperature, climate can influence sleep patterns: a study by Mattingly et al.³² reported that in spring and summer, when the days get longer, the time dedicated to sleep tends to be shorter. This may be a consequence of the milder weather and the opportunity to enjoy more outdoor activities, increased light, and higher temperatures, which affect the circadian rhythm. This is reflected in the fact that the sleep structure of people living in countries with colder climates and longer winters with shorter days is different from that of those living in the tropics.³² This opens the possibility to discuss whether global warming and climate change could affect sleep in a societal and global level.³³

The relationship between the structure of society and sleep does not operate in one direction, as poor sleep can have an impact on several areas, including work and interpersonal interactions, which have wider societal implications. The social impact of sleep cannot be underestimated. A

lack of quality sleep can lead to irritability, decreased cognitive functioning, and impaired social interactions. Sleep-deprived individuals often find it challenging to concentrate, communicate effectively, and regulate their emotions, which can strain personal relationships and hinder social dynamics within communities.

Among the many mechanisms that contribute to poor health, stress is a factor that is often ignored, as it is a part of life, but excessive stress can have devastating consequences. The body's ability to return to normalcy, or the so-called "resilience," is the key to preventing stress from becoming deleterious. In this respect, sleep is vital, as good sleep reduces stress and promotes greater emotional resilience. Recent studies^{34,35} suggest that sleep contributes to the development of the system of interactions in the central nervous system that defines who we are and what information we process, making sleep an important element in our ability to control emotional stress. The neurobehavioral consequences of sleep restriction are responsible for the increase in the incidence of human errors in the workplace, traffic accidents, personal conflicts, and drug abuse.^{26,36}

Modern humans sleep less than their ancestors and are more likely to experience sleep restriction. Modern society fosters a lifestyle that disregards biological circadian rhythms. The prevalence of early-morning work schedules has made commonplace the use of alarms that interrupt sleep early. The adoption of artificial light, particularly at night, as well as the use of electronic devices emitting light have interfered with the endogenous secretion of melatonin, leading to a restriction in total sleep time.³⁷ Observational studies³⁸ have corroborated these suspicions, with populations in the Amazon rainforest without access to electrical light exhibiting longer daily sleep durations (> 30 minutes) than their counterparts with electricity in their homes. In addition, beliefs and cultural and environmental factors play a role in determining sleep schedules in different regions. In an increasingly technological, globalized, nocturnal, and competitive world, it is theorized that sleep schedules have become subservient to work productivity. This hypothesis takes on particular relevance in countries that have experienced technological growth after World War II, such as South Korea and Japan. South Korea is a highly-competitive country in terms of academics and work, where sleep time is shortened by economic circumstances, being inversely correlated with the time spent at work and with salary.^{39–41} Therefore, it is not difficult to understand why South Korea is considered the country with the lowest average daily sleep duration among the member countries of the Organization for Economic Co-operation and Development (OECD), with only approximately six hours allocated for sleep.⁴² However, these almost century-old trends exhibit mixed patterns in many countries, with published studies within the same country revealing contrasting conclusions regarding the possibility of a gradual decrease in total sleep time between 1960 and 2000.^{43,44} Sleep disorders are increasingly common worldwide; they affect health and well-being, and have a wide range of consequences, including decreased work productivity and an increase in accidents, meaning that

these rapid changes in sleep patterns and quality should be of great concern.

Efforts are needed to provide the opportunity and the right environment for people of all ages to obtain regular restful sleep that contributes to health maintenance and improved productivity. We need to develop a better understanding of why sleep restriction is detrimental to our health as well as the neurological and physiological mechanisms underlying this. It is necessary to consider this problem from a broader perspective, considering anthropological and societal aspects that have frequently been ignored. It is important to note that improving the quality of sleep is not an obstacle to the modernization and functioning of society, nor does it solve the evident social issues we face, but it can be a relief from one of their consequences. Modern society faces a significant number of challenges and social problems, and addressing the issue of sleep quality, although clearly not a universal panacea, could result in a significant range of benefits regarding physical and mental health, work, relationships, and overall quality of life. To foster a healthy modern society, it is crucial to promote optimal sleep and well-being through the establishment of healthy sleep routines, the management of sleep disorders, and the incorporation of relaxation techniques into daily life.

Conflict of Interests

The authors have no conflict of interests to declare.

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References

- Itani O, Jike M, Watanabe N, Kaneita Y. Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression. *Sleep Med* 2017;32:246–256. Doi: 10.1016/j.sleep.2016.08.006
- Andersen ML, Tufik S. Sleep and the modern society. *J Sleep Disord Ther* 2015;04(05):. Doi: 10.4172/2167-0277.1000e131
- Siegel JM. Sleep viewed as a state of adaptive inactivity. *Nat Rev Neurosci* 2009;10(10):747–753. Doi: 10.1038/nrn2697
- Siegel JM. Sleep function: an evolutionary perspective. *Lancet Neurol* 2022;21(10):937–946. Doi: 10.1016/S1474-4422(22)00210-1
- Field JM, Bonsall MB. The evolution of sleep is inevitable in a periodic world. *PLoS One* 2018;13(08):e0201615. Doi: 10.1371/journal.pone.0201615
- Barbera J. Sleep and dreaming in Greek and Roman philosophy. *Sleep Med* 2008;9(08):906–910. Doi: 10.1016/j.sleep.2007.10.010
- Nunn CL, Samson DR, Krystal AD. Shining evolutionary light on human sleep and sleep disorders. *Evol Med Public Health* 2016;2016(01):227–243. Doi: 10.1093/emph/eow018
- Samson DR. The Human Sleep Paradox: The unexpected sleeping habits of Homo sapiens. *Annu Rev Anthropol* 2021;50(01):259–274. Doi: 10.1146/annurev-anthro-010220-075523
- Coolidge FL, Wynn T. An introduction to cognitive archaeology. *Research-article*. 2016;25(06):386–392. Doi: 10.1177_0963721416657085
- Tufik S, Andersen ML, Bittencourt LR, Mello MT. Paradoxical sleep deprivation: neurochemical, hormonal and behavioral alterations. Evidence from 30 years of research. *An Acad Bras Cienc* 2009;81(03):521–538
- Grandner MA. Sleep, Health, and Society. *Sleep Med Clin* 2022;17(02):117–139. Doi: 10.1016/j.jsmc.2022.03.001
- National Center for Health Statistics. Percentage of adults who reported an average of ≤ 6 hours of sleep per 24-hour period, by sex and age group - United States, 1985 and 2004. *MMWR Morb Mortal Wkly Rep* 2005;54(37):933
- National Sleep Foundation. 2002 sleep in America Pool. National Sleep Foundation; 2002
- Moraes W, Piovezan R, Poyares D, Bittencourt LR, Santos-Silva R, Tufik S. Effects of aging on sleep structure throughout adulthood: a population-based study. *Sleep Med* 2014;15(04):401–409. Doi: 10.1016/j.sleep.2013.11.791
- Flaskerud JH. The Cultures of Sleep. *Issues Ment Health Nurs* 2015;36(12):1013–1016. Doi: 10.3109/01612840.2014.978960
- Casiraghi LP, Plano SA, Fernández-Duque E, Valeggia C, Golombek DA, de la Iglesia HO. Access to electric light is associated with delays of the dim-light melatonin onset in a traditionally hunter-gatherer Toba/Qom community. *J Pineal Res* 2020;69(04):e12689. Doi: 10.1111/jpi.12689
- Czeisler CA. Perspective: casting light on sleep deficiency. *Nature* 2013;497(7450):S13. Doi: 10.1038/497S13a
- Ekirch AR. Sleep we have lost: pre-industrial slumber in the British Isles. *Am Hist Rev* 2001;106(02):343–386
- Samson DR, Crittenden AN, Mabulla IA, Mabulla AZP. The evolution of human sleep: Technological and cultural innovation associated with sleep-wake regulation among Hadza hunter-gatherers. *J Hum Evol* 2017;113:91–102. Doi: 10.1016/j.jhevol.2017.08.005
- Dement W, Kleitman N. The relation of eye movements during sleep to dream activity: an objective method for the study of dreaming. *J Exp Psychol* 1957;53(05):339–346
- Andersen ML, Alvarenga TF, Mazaro-Costa R, Hachul HC, Tufik S. The association of testosterone, sleep, and sexual function in men and women. *Brain Res* 2011;1416:80–104. Doi: 10.1016/j.brainres.2011.07.060
- Orzeł-Gryglewska J. Consequences of sleep deprivation. *Int J Occup Med Environ Health* 2010;23(01):95–114. Doi: 10.2478/v10001-010-0004-9
- Covassin N, Singh P. Sleep duration and cardiovascular disease risk: epidemiologic and experimental evidence. *Sleep Med Clin* 2016;11(01):81–89. Doi: 10.1016/j.jsmc.2015.10.007
- Besedovsky L, Lange T, Haack M. The sleep-immune crosstalk in health and disease. *Physiol Rev* 2019;99(03):1325–1380. Doi: 10.1152/physrev.00010.2018
- Tempesta D, Soccì V, De Gennaro L, Ferrara M. Sleep and emotional processing. *Sleep Med Rev* 2018;40:183–195. Doi: 10.1016/j.smrv.2017.12.005
- Pires GN, Bezerra AG, Tufik S, Andersen ML. Effects of acute sleep deprivation on state anxiety levels: a systematic review and meta-analysis. *Sleep Med* 2016;24:109–118. Doi: 10.1016/j.sleep.2016.07.019
- Ellis EM. Watchers in the night: an anthropological look at sleep disorders. *Am J Psychother* 1991;45(02):211–220. Doi: 10.1176/appi.psychotherapy.1991.45.2.211
- Bhat S, Chokroverty S. Sleep disorders and COVID-19. *Sleep Med* 2022;91:253–261. Doi: 10.1016/j.sleep.2021.07.021
- AlRasheed MM, Fekih-Romdhane F, Jahrami H, et al; COMITY investigators. The prevalence and severity of insomnia symptoms during COVID-19: A global systematic review and individual participant data meta-analysis. *Sleep Med* 2022;100:7–23. Doi: 10.1016/j.sleep.2022.06.020
- Mello MT, Silva A, Guerreiro RC, et al. Sleep and COVID-19: considerations about immunity, pathophysiology, and treatment. *Sleep Sci* 2020;13(03):199–209. Doi: 10.5935/1984-0063.20200062

- 31 Slopen N, Lewis TT, Williams DR. Discrimination and sleep: a systematic review. *Sleep Med* 2016;18:88–95. Doi: 10.1016/j.sleep.2015.01.012
- 32 Mattingly SM, Grover T, Martinez GJ, et al. The effects of seasons and weather on sleep patterns measured through longitudinal multimodal sensing. *NPJ Digit Med* 2021;4(01):76. Doi: 10.1038/s41746-021-00435-2
- 33 Rifkin DI, Long MW, Perry MJ. Climate change and sleep: A systematic review of the literature and conceptual framework. *Sleep Med Rev* 2018;42:3–9. Doi: 10.1016/j.smr.2018.07.007
- 34 Lerner I, Lupkin SM, Sinha N, Tsai A, Gluck MA. Baseline levels of rapid eye movement sleep may protect against excessive activity in fear-related neural circuitry. *J Neurosci* 2017;37(46):11233–11244. Doi: 10.1523/JNEUROSCI.0578-17.2017
- 35 Whalley K. Sleep to forget. *Nat Rev Neurosci* 2019;20(12):716–717. Doi: 10.1038/s41583-019-0232-3
- 36 de Mello MT, Narciso FV, Tufik S, et al. Sleep disorders as a cause of motor vehicle collisions. *Int J Prev Med* 2013;4(03):246–257
- 37 Reiter RJ, Tan DX, Korkmaz A, et al. Light at night, chronodisruption, melatonin suppression, and cancer risk: a review. *Crit Rev Oncog* 2007;13(04):303–328. Doi: 10.1615/critrevoncog.v13.i4.30
- 38 Moreno CR, Vasconcelos S, Marqueze EC, et al. Sleep patterns in Amazon rubber tappers with and without electric light at home. *Sci Rep* 2015;5:14074. Doi: 10.1038/srep14074
- 39 Lee M. Korean adolescents' "examination hell" and their use of free time. *New Dir Child Adolesc Dev* 2003;(99):9–21. Doi: 10.1002/cd.63
- 40 Peng I. The good, the bad and the confusing: the political economy of social care expansion in South Korea. *Dev Change* 2011;42(04):905–923. Doi: 10.1111/j.1467-7660.2011.01724.x
- 41 Massar SAA, Lim J, Huettel SA. Sleep deprivation, effort allocation and performance. *Prog Brain Res* 2019;246:1–26. Doi: 10.1016/bs.pbr.2019.03.007
- 42 OECD. Special focus: measuring leisure in OECD countries. 2009. Doi: 10.1787/soc_glance-2008-3-en
- 43 Bin YS, Marshall NS, Glozier N. Secular trends in adult sleep duration: a systematic review. *Sleep Med Rev* 2012;16(03):223–230. Doi: 10.1016/j.smr.2011.07.003
- 44 Bin YS, Marshall NS, Glozier N. Sleeping at the limits: the changing prevalence of short and long sleep durations in 10 countries. *Am J Epidemiol* 2013;177(08):826–833. Doi: 10.1093/aje/kws308