MELATONIN AND SLEEP: HORMONAL REGULATION OF THE SLEEP-WAKE CYCLE AND ITS IMPORTANCE FOR HUMAN HEALTH

Talatova Sohiba Nodirbek qizi
3rd-year student of the Faculty of Medical Pedagogy and General Medicine,
Tashkent State Medical University, Tashkent-2026

Sattarova Iroda Dilmurod qizi
3rd-year student of the Faculty of Medical Pedagogy and General Medicine,
Tashkent State Medical University, Tashkent-2026

R.F. Umarov
Academic Supervisor: Lecturer at the Department of Medical and
Biological Chemistry, Medical Biology,
Biophysics and Medical Informatics.
https://doi.org/10.5281/zenodo.22871664

Abstract. Melatonin is an important hormone involved in the regulation of the human sleep-wake cycle and plays a significant role in maintaining the body's circadian rhythm. It is primarily produced by the pineal gland in response to darkness, while exposure to light suppresses its production. The daily rhythm of melatonin secretion helps the body recognize periods of day and night and contributes to the regulation of sleep onset and sleep quality. This paper examines the role of melatonin in the hormonal regulation of the sleep-wake cycle and discusses its importance for human health. The study focuses on the relationship between melatonin secretion, circadian rhythms, sleep patterns, and environmental factors such as artificial light and irregular schedules.
Keywords: melatonin, sleep, sleep-wake cycle, circadian rhythm, hormones, pineal gland, human health, sleep quality.

INTRODUCTION

Sleep is a fundamental physiological process that is essential for physical recovery, cognitive functioning, emotional regulation, and overall health. The timing of sleep and wakefulness is strongly influenced by the circadian rhythm, an approximately 24-hour biological cycle that coordinates various physiological processes in accordance with the environmental light-dark cycle. Melatonin, a hormone mainly synthesized and released by the pineal gland, is one of the key biological signals involved in this process. Under normal conditions, melatonin secretion increases in the evening as environmental light decreases, reaches higher levels during the night, and declines toward morning. Through this pattern, melatonin provides the body with information about the time of day and facilitates the transition toward sleep. Modern lifestyles, however, are often characterized by prolonged exposure to artificial light, irregular working schedules, nighttime use of electronic devices, and insufficient sleep, all of which may interfere with normal circadian regulation. Therefore, understanding the role of melatonin in sleep regulation is important for explaining how biological rhythms influence human health. The purpose of this paper is to examine the hormonal regulation of the sleep-wake cycle through melatonin and to discuss its significance for maintaining healthy sleep and general well-being.

METHODS

This study is based on a review and analysis of scientific literature concerning melatonin, circadian rhythms, sleep physiology, and hormonal regulation of the sleep-wake cycle. Relevant scientific concepts and findings were examined using a descriptive and comparative approach. Particular attention was given to the physiological mechanisms of melatonin production, the relationship between light exposure and melatonin secretion, and the influence of circadian rhythm on sleep timing. The study also considered factors that can alter normal melatonin patterns, including artificial nighttime light, irregular sleep

schedules, shift work, and changes in daily routines. Information from scientific literature was synthesized to identify the main physiological functions of melatonin and its relationship with sleep quality and human health.

RESULTS

The analysis demonstrates that melatonin has a central role in communicating information about the light-dark cycle to the human body. Melatonin secretion is regulated by the circadian system and is strongly influenced by environmental light. In darkness, signals from the biological clock promote melatonin production by the pineal gland, resulting in increased hormone levels during the evening and night. This increase is associated with the physiological preparation of the body for sleep, while decreasing melatonin levels toward morning correspond with the transition to daytime wakefulness. The findings also indicate that exposure to bright light during the evening or nighttime can suppress melatonin production and potentially delay the timing of sleep. Irregular sleep schedules may further disturb the alignment between the internal biological clock and the external environment. Maintaining consistent sleep and wake times, receiving sufficient natural light during the daytime, and reducing excessive bright-light exposure before bedtime can therefore support normal circadian regulation.

DISCUSSION

The results emphasize that melatonin should be understood primarily as a biological timing signal that helps synchronize the sleep-wake cycle with the environmental day-night pattern. Its secretion is closely connected to the circadian system, making light exposure one of the most important external factors affecting its daily rhythm. Modern technological environments may create conditions in which individuals remain exposed to artificial light during periods when the body would normally be preparing for sleep. In addition, irregular working and sleeping schedules can contribute to a mismatch between internal circadian timing and social routines. These factors may make it more difficult for some individuals to maintain consistent and restorative sleep. However, melatonin is only one component of sleep regulation, and sleep quality is also influenced by sleep duration, behavioral habits, stress, age, health conditions, and other physiological processes. Therefore, maintaining a regular daily schedule, obtaining adequate daytime light exposure, creating a dark and comfortable sleeping environment, and limiting excessive light before bedtime can be considered practical approaches to supporting healthy circadian rhythms. Understanding the hormonal regulation of sleep can help individuals and health professionals recognize the importance of biological timing in maintaining healthy sleep patterns and overall health.

CONCLUSION

In conclusion, melatonin is an important hormone in the regulation of the human sleep-wake cycle and serves as a key signal connecting the body's internal circadian system with the environmental light-dark cycle. Its secretion normally increases during darkness and decreases in response to morning light, thereby contributing to the appropriate timing of sleep and wakefulness. Disruption of this natural rhythm through excessive nighttime light exposure, irregular schedules, or other lifestyle factors may interfere with normal sleep patterns. Maintaining regular sleep and wake times, obtaining adequate exposure to natural daylight, and reducing bright light before bedtime can support the normal functioning of the circadian system.

REFERENCES

1. Cajochen, C., Kräuchi, K., & Wirz-Justice, A. (2003). Role of melatonin in the regulation of human circadian rhythms and sleep. Journal of Neuroendocrinology.
2. Arendt, J. (2006). Melatonin and human rhythms. Chronobiology International.
3. Brzezinski, A. (1997). Melatonin in humans. New England Journal of Medicine.
4. Zisapel, N. (2018). New perspectives on the role of melatonin in human sleep, circadian rhythms and their regulation. British Journal of Pharmacology.
5. Czeisler, C. A., & Gooley, J. J. (2007). Sleep and circadian rhythms in humans. Cold Spring Harbor Symposia on Quantitative Biology.