UDC 61

# PHYSIOLOGICAL ASPECTS OF NIGHT LIGHT INFLUENCE ON MELATONIN SYNTHESIS CIRCADIAN RHYTHM

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**Abstract:** The effect of night light on the body can have negative consequences in the form of disruptions of the circadian rhythm of melatonin synthesis. Night light will be perceived by the retina (blue light of 446–477 nm wavelength was found to be the strongest input for melatonin regulation in healthy subjects), will be transmitted to the hypothalamic nuclei and then the inhibitory signal will go to the pineal gland and the synthesis of the hormone will be suppressed. In turn, melatonin deficiency can lead to mood disorders - anxiety, depression, in addition, cancer diseases may occur or progress.

**Keywords:** Circadian rhythms, night light, sleep, melatonin, photoreceptors, pineal gland , 6-sulfatoxymelatonin (aMT6s).

**Introduction.** Humans live in a 24-hour environment, in which light and darkness follow a diurnal pattern. Rhythmic variations in ambient illumination impact behaviours such as rest during sleep and activity during wakefulness as well as their underlying biological processes. Rather recently, the availability of artificial light has substantially changed the light environment, especially during evening and night hours. In humans, the known effects of light on circadian rhythms and sleep are all, without exception, mediated by the retina.The retina is a fine layer of nerve tissue at the back of our eyes, containing specialised photoreceptors [1]. Several epidemiological and experimental observations have shown that circadian rhythms regulate many physiological processes besides sleep, such as hormone production, immune activity, and cell proliferation and apoptosis. As a consequence, circadian coordination disruption increases the risk for a variety of pathologies, such as psychiatry disorders and metabolic alterations, and promotes cancer development and progression [2].

The effect of light has been widely studied in studies of the circadian period and human sleep, primarily the acute suppression of melatonin synthesis in response to light exposure [1].

The circadian rhythm of pineal melatonin is the best marker of internal time under low ambient light levels. The endogenous melatonin rhythm exhibits a close association with the endogenous circadian component of the sleep propensity rhythm. This has led to the idea that melatonin is an internal sleep "facilitator" in humans, and therefore useful in the treatment of insomnia and the readjustment of circadian rhythms [3].

It has been suspected for some time that different photoreceptors subserve sight and melatonin production. Thus, some blind people without pupil light reflexes have light-induced suppression of melatonin secretion; their eyes serve more than a cosmetic function as they do not report insomnia.Conversely, blind patients without light-induced suppression of melatonin do have sleep disorders.

A ‘non-rod’, ‘non-cone’ photoreceptor was suspected when transgenic mice lacking both rods and cones were nevertheless found to have light-responsive clocks. Furthermore, monochromatic blue light of 446–477 nm wavelength was found to be the strongest input for melatonin regulation in healthy subjects, suggesting that a photo pigment distinct from that of rods and cones was responsible for melatonin regulation. The mystery photoreceptor involved in melatonin regulation was identified a couple of years ago: it is the retinal ganglion cell. A total of 0.2% of retinal ganglion cells contain melanopsin and respond directly to light even when isolated pharmacologically or physically from other retinal neurons. They react slowly but tonically to luminance changes.

In mammals, the components of circadian melatonin rhythm production are distributed in three different areas, all in the diencephalon: the photoreceptors are in the retina, the endogenous oscillator (the ‘internal clock’ which sets the cycle length) in the suprachiasmatic nucleus of the hypothalamus, and the neuroendocrine effector in the pineal gland which produces melatonin in a rhythmic pattern [4].

Mechanism of action: Light influences melatonin secretion from the pineal gland via a multisynaptic indirect nervous system. Light enters the eye through the pupillary aperture, stimulates the retina, and sends its signal to the circadian pacemaker, the suprachiasmatic nuclei of the SCN, via the direct retinohypothalamic projection (RHT). There is also an additional connection between the integrating center in the thalamus, the intergonous lobe (IGL), and the SCN. The IGL provides a second neural pathway for light to influence the circadian pacemaker. From the SCN, impulses travel to the pineal gland, first synapsing in the paraventricular nucleus of the hypothalamus, descending to a synapse in the interomediolateral cell column (IMLCC) of the upper thoracic spinal cord, projecting to the superior cervical ganglion, and finally ascending along the cerebral vasculature to a terminal synapse in the pineal gland [5].

The current state of the literature includes evidence on how various durations and intensities of morning, midday, and evening bright light exposure, as well as whole-day light exposure interventions can improve specific aspects of sleep. Short-term bright light exposure in the morning, up to 2 hr of moderate (3,000–10,000 lux) morning exposures, up to 4 hr of moderate evening exposure, and whole-day exposures to lower illuminance levels (<3,000 lux) can improve sleep outcomes. Based on new findings on the mechanism through which light impacts sleep, future studies should be more specific about the spectral qualities of light sources [6].

A study was conducted to assess the impact of nocturnal behavior on melatonin levels in 100 adolescents who self-reported their sleep behavior and provided a first morning urine sample for analysis of urinary 6-sulfatoxymelatonin (aMT6s) levels.

Sleep duration, ambient light levels during sleep, and self-reported use of electronics after lights out contributed to changes in aMT6s levels. In particular, urinary aMT6 levels were significantly lower among participants who reported going to bed after midnight on weekends. Sleep interruption was also significantly associated with decreased urinary aMT6 levels, but only if the sleep interruption was accompanied by lights on [7].

**Conclusions.** With regard to the multiplicity of melatonin's actions, the consequences of melatonin deficiency extend to numerous physiological functions. This hormone is also known to interact with brain receptors responsible for regulating mood states. Adequate levels of melatonin can contribute to feelings of well-being and happiness, while an imbalance or deficiency may lead to mood disorders such as depression or anxiety [8]. Moreover, the suppression of melatonin production is associated with an increased incidence of cancer , which could be correlated with a loss in the regulation of the circadian machinery. Therefore, it is very important to follow a daily routine to maintain your health [9].

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