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THE IMPACT OF INTERIOR LIGHTING ON HEALTH AND VISUAL COMFORT

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ABSTRACT

Light is being increasingly utilized as a therapeutic intervention, with numerous studies documenting specific cases of its application. Despite its potential benefits, it is crucial to acknowledge the risks associated with adverse side effects. Interior lighting not only defines the aesthetic perception of a space but also plays a fundamental role in shaping human physiological and psychological well-being.

Scientific research has demonstrated that light stimulation can contribute to the improvement of various physiological and psychological conditions, including depressive disorders and sleep disturbances such as insomnia. Conversely, inadequate lighting may lead to headaches, visual fatigue, general exhaustion, and even disruptions in vitamin D synthesis.

This study examines the impact of lighting on human health and explores strategies for optimizing lighting design to enhance visual comfort and boost productivity. The color temperature of light is a critical factor in this context: warm-toned lighting fosters a sense of comfort and relaxation, whereas cooler light enhances concentration and cognitive performance.

To minimize the adverse effects of lighting, it is advisable to use luminaires with adjustable brightness and color temperature, as well as to maximize the integration of natural light into interior spaces. Additionally, reducing glare, ensuring the appropriate placement of light sources, and minimizing flicker in fluorescent lighting are essential measures for improving visual comfort.

Interior lighting should not be regarded solely as an aesthetic element but rather as a crucial determinant of human health and efficiency. An optimized lighting design can significantly enhance quality of life and prevent a range of health issues associated with poor lighting conditions.

KEYWORDS

Interior Lighting, Visual Comfort, Physiological Impact, Health, Melatonin

CITATION

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Introduction

The development of lighting technologies and design approaches in interior architecture should be guided not only by aesthetic principles but also by considerations of users' health and comfort. Light is a primary regulator of biological rhythms and influences productivity, cognitive functions, and mental well-being. Exposure to appropriate lighting improves concentration and mood, while insufficient or excessive lighting can lead to visual discomfort, chronic fatigue, and even neurological disorders. With a proper approach to interior lighting, it is possible to prevent various physiological and cognitive issues associated with prolonged exposure to inappropriate lighting.

2. Physiological and Psychological Effects of Lighting

One of the most apparent aspects of indoor lighting is its effect on mental states. It is believed that lighting can influence mood and even productivity, especially when combined with the color scheme of a given space. Although such claims are often encountered, empirical evidence from rigorously controlled studies remains limited. The main challenge lies in distinguishing direct physiological effects from cultural and cognitive factors.

A widely held belief is that "more light is better," which has led to a trend of increasing illumination levels in workplaces, commercial areas, and other public zones. However, this raises concerns about potential negative consequences, primarily related to increased exposure to ultraviolet (UV) radiation. Light in the UVA (315–400 nm) and UVB (280–315 nm) ranges can cause serious damage to the eyes and skin. In this context, Patak's research analyzes the mechanisms through which UV rays can trigger harmful effects, including the development of malignant diseases.

Outside the domestic environment, most indoor lighting fixtures are fluorescent lamps, which can emit significant amounts of UV radiation, especially newer high-intensity models. Laboratory and field studies conducted by Urbach and his team have shown that individuals spending extended periods under such lighting are at a considerably higher risk of cumulative skin damage, particularly those with fair skin and heightened UV sensitivity.

This underscores the necessity of monitoring the lighting environment not only with photometric measurements but also with radiometric analysis that encompasses the full spectrum of light emissions. Unfortunately, measuring UV radiation—especially in the most hazardous ranges—is not an easy task. This issue may lead to the introduction of stricter safety standards.

Furthermore, some individuals may develop increased photosensitivity due to certain medications or cosmetic products. Research presented by Harber and his team indicates that specific compounds, such as musk ambrette, can make the skin more sensitive to UVA radiation commonly emitted by fluorescent lighting.

2.1 Headaches and Eye Strain

Inadequate lighting—including excessive brightness, flickering from fluorescent lamps, improper color temperature, and insufficient natural light—can lead to visual discomfort. Symptoms may include eye redness, blurred vision, headaches, facial muscle tension, and general fatigue. Prolonged exposure to such lighting can impair visual acuity and increase the risk of degenerative eye conditions.

2.2 Impact on Circadian Rhythms

Circadian rhythms are internal biological clocks that regulate sleep-wake cycles, body temperature, and hormone levels. In 2002, a new class of retinal cells—melanopsin-containing ganglion cells—was discovered. These cells are responsible for synchronizing circadian rhythms and are most sensitive to blue light with a wavelength of around 480 nm.

Artificial lighting, especially with high intensity at night, can suppress melatonin secretion—the hormone responsible for sleep. This leads to disruptions in circadian rhythms, increased risk of insomnia, and long-term health problems such as cardiovascular disease and cognitive impairment.

Studies in hospitals and workplace environments have shown that adapting lighting to align with natural circadian rhythms improves sleep quality, reduces stress, and increases productivity. For instance, dynamic lighting that mimics the natural daylight cycle has proven effective in treating Seasonal Affective Disorder (SAD).

Circadian Rhythms and Sleep Quality: Lighting design that takes human circadian rhythms into account is vital for promoting better sleep quality and overall physiological health. Ladopoulos (2020) emphasizes that human-centric lighting, which focuses on balancing visual, emotional, and biological benefits, can significantly influence circadian rhythms, thereby affecting sleep quality and alertness (Ladopoulos, 2020).

The significance of lighting in indoor environments is multifaceted, affecting emotional health, psychological perception, and physiological responses. From setting mood and atmosphere to influencing behavior and perception, and from alleviating eye strain to maintaining circadian rhythms, the role of lighting is integral to creating environments that foster emotional well-being and a comfortable user experience.

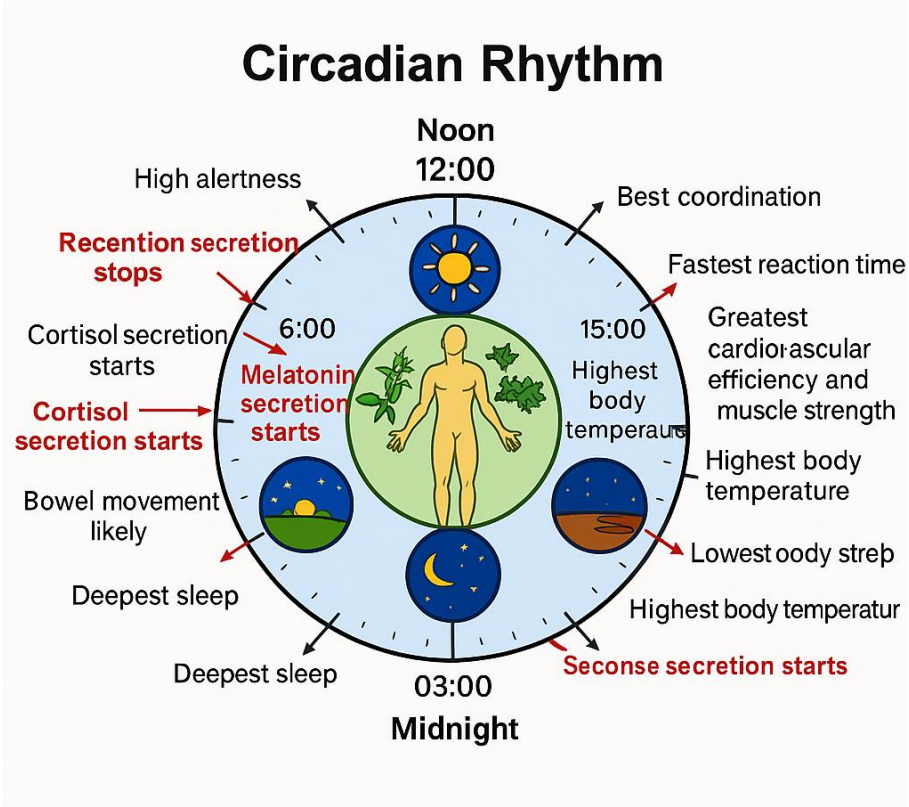

Fig. 1. *Conceptual model showing body clock*

2.3 Psychological Effects

Lighting has a significant impact on people's mood and mental state. Insufficient light—particularly during the winter months—can contribute to the development of Seasonal Affective Disorder (SAD), a type of depression linked to the lack of sunlight. On the other hand, overly bright or uneven lighting can provoke anxiety and irritability. Research shows that properly balancing natural and artificial light can enhance emotional well-being and cognitive performance.

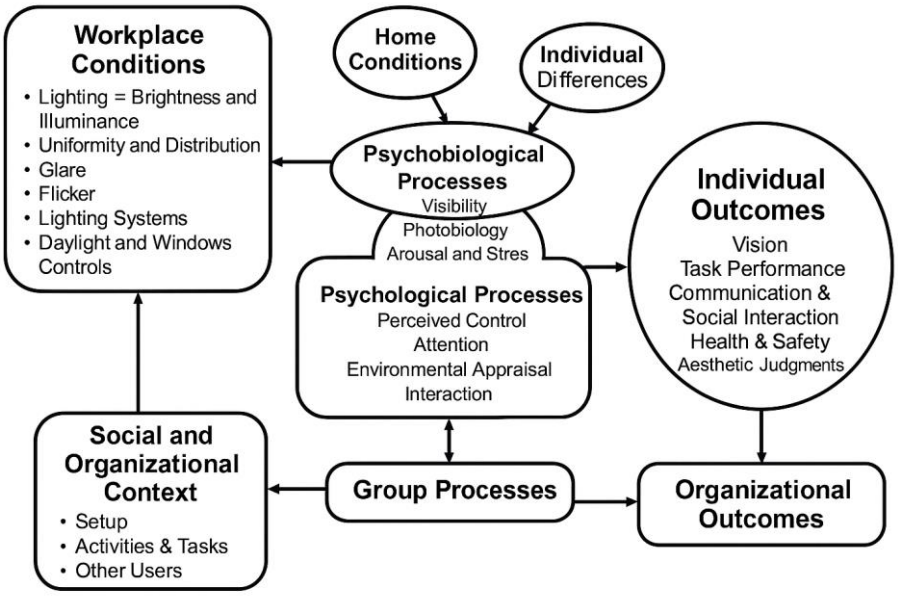

Fig. 2. *The relationship between lighting conditions, individual processes, and outcomes*

2.4 Therapeutic Applications of Light

Light therapy is effectively used in the treatment of depressive disorders, sleep disturbances, and Seasonal Affective Disorder. Studies have shown that exposure to bright white or blue light in the morning can accelerate the restoration of circadian rhythm and improve mood.
In medical practice, light is also used to treat skin conditions such as psoriasis and eczema through UV phototherapy. Additionally, infrared light has applications in relieving muscle pain and improving blood circulation.

3. Optimizing Interior Lighting

3.1 Selecting Appropriate Lighting Fixtures

Energy-efficient lighting fixtures such as LED lamps offer the possibility to control both the intensity and spectral composition of light. Suitable color temperature (2700K–6500K) and a high color rendering index (CRI >80) are key factors in improving visual comfort. Lighting technologies that allow for adjustment of both brightness and color temperature can be tailored to different activities and times of day.

3.2 Adjusting Light Intensity

The intensity of light should be adapted to the needs of the specific environment. For example, workplaces typically require illumination levels of 500–1000 lux, whereas in residential settings optimal levels range from 200 to 500 lux. Excessively bright lighting may lead to visual discomfort, while insufficient lighting can result in eye strain and decreased productivity.

3.3 Reducing the Negative Effects of Artificial Lighting

Implementing dynamic lighting technologies that adjust light spectrum and intensity according to the time of day can reduce the adverse effects on biological rhythms. The use of anti-glare filters, diffuse lighting, and proper placement of luminaires also helps minimize visual discomfort.

3.4 Lighting Beliefs Questionnaire (LBQ)

The indicators in the LBQ were evaluated using a five-point Likert scale ranging from 0 to 4. Half of the items were negatively worded; their scores were reverse-coded so that higher values consistently reflected a stronger belief that lighting causes a certain effect. The questionnaire also included an "I don't know" option, which was frequently used by participants from the research lab but rarely by the student samples. Interviews with randomly selected respondents from this group revealed that they chose “I don’t know” when they were unsure whether they agreed or disagreed with a given statement. Therefore, all "I don't know" responses were recoded as a value of 2 (neutral) to increase the number of cases included in the analysis.

The scale score was calculated as the average of non-missing responses for each participant. The overall mean score of 2.26 (SD = 0.33) on a 0–4 scale indicates that beliefs about lighting are moderately strong overall.

Frequency data for responses to each statement are provided in the Appendix. Some statements received high agreement: 65% of respondents reported that light quality is important to their well-being. A significant majority (80.5%) agreed or strongly agreed that natural light is better than artificial light. There was also broad support for the idea that lighting affects mood—72% of participants agreed or strongly agreed with this statement.

Fewer participants, however, believed that lighting could affect health (49%) or work performance (43%). Some statements received lower agreement levels; for example, only 30% believed that dim lighting could lead to depression.

These results suggest that while general belief in the effects of lighting on people is moderately strong, specific beliefs about certain effects (such as impact on health or performance) are less pronounced and vary depending on the type of effect.

TABLE 1

Descriptive Statistics: Full Scales

Scale	*Limits*	M	SD	N	*Hams*	*alpha*
LBQ	0-4	2.26	0.33	302	32	.79
Lighting Knowledge Test	0—10	5.10	3.07	318	10	.83
Actual Control	0—4	2.97	0.71	175	21	.91
Desired Control	0-4	1.B6	0.69	176	21	.91
PSS	0—6	3.58	0.62	312	18	.63
Free Will-Determinism	0—4	2.66	0.61	222	11	.77
LoC	0—23	12.30	4.51	68	23	.79

NOTE: PSS » Person-Surroundings Scale; LSQ a Lighting Beliefs Questionnaire; LoC = Locus of Control. For LBQ and PSS, higher values indicate stronger beliefs In physical environmental effects on people. Higher Lighting Knowledge Test scores Indicate greater knowledge. Higher scores on Actual Control Scale. Desired Control Scale, and LoC Scale reflect control external to the Individual. Higher Free Wifl-DeteimInIsm Scale scores Indicate greater belief In free will.

4. Conclusions

The advancement of research on light and its impact on human health highlights that optimal lighting plays a critical role in visual comfort and overall well-being. Through proper design of lighting systems, the risks associated with artificial lighting can be minimized, and quality of life can be improved in both work and home environments. In the future, the integration of smart lighting systems based on biological and cognitive principles may lead to significant improvements in human health and productivity.

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