

INFLUENCE OF ENVIRONMENTAL PHYSICAL FACTORS ON HUMAN HEALTH

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ABSTRACT	KEYWORDS
<p>The article examines the main physical factors of the environment: noise, lighting, vibration, and electromagnetic fields, their effects on the human body, and the role of these factors in shaping favorable or adverse living conditions. An analytical review of modern national and international studies was carried out to assess the influence of these factors on physiological and psychological functions. The approaches of different authors to evaluating permissible exposure levels are compared, and ways to prevent negative impacts are discussed.</p>	<p>Physical factors, noise, light, vibration, electromagnetic fields, health, environment, hygiene, living conditions.</p>

Introduction

A person in the modern world is exposed to many physical environmental factors on a daily basis [6, 7, 8]. This includes noise, light levels, vibrations, electromagnetic fields of various origins, temperature fluctuations, and others. At moderate values, these factors provide comfortable living conditions, but if they exceed acceptable levels, they become a source of chronic stress, functional disorders and diseases [8, 9, 10, 13, 15].

According to the article "Physical factors of the living environment and their significance in shaping human living conditions", noise and light conditions have the most pronounced effect on the body, especially during prolonged stay in unfavorable conditions. Similar conclusions are presented in the article "The influence of physical factors on public health", which emphasizes that chronic exposure to physical stimuli leads to a violation of neurohumoral regulation and a decrease in performance.

At the same time, as the report notes, physical factors are not always exclusively negative. Optimal levels of light and sound are necessary for the normal regulation of biorhythms and psychoemotional state. Thus, the hygienic assessment of these impacts should be aimed not only at reducing their intensity, but also at creating a balanced environment [11, 14].

The aim of the study is to analyze scientific sources devoted to the study of the influence of physical environmental factors on human health, conduct a comparative analysis of data from domestic and foreign authors, and determine the main directions for the prevention of adverse effects.

Research Methods

The work was performed using an analytical method that includes the study of scientific publications and regulatory materials on the topic.

We also applied a comparative method (to analyze differences in approaches to assessing factors in different countries) and a review method, which involves systematizing existing data on the physiological mechanisms of the influence of noise, light, vibration, and electromagnetic fields.

General provisions on the influence of physical factors on the human body.

Physical environmental factors are a set of non-biological influences that affect the physiological, mental, and social functions of a person. These include noise, light, vibration, temperature, and electromagnetic and radiation fields. Their effects can be either beneficial or harmful, depending on the intensity, duration, and nature of the contact.

Chronic exposure to physical stimuli leads to functional disorders of the central and autonomic nervous systems, sleep disorders, and increased fatigue. Researchers note that it is the long-term, weak, but constant exposure to such factors that is most dangerous, since the body does not have time to adapt [6].

Noise and light pollution in modern cities is increasingly seen as a significant factor affecting public health. Noise levels in densely populated areas often exceed acceptable sanitary standards, which leads to an increase in cardiovascular and psychosomatic diseases. Improper lighting, both excessive and insufficient, contributes to disruption of circadian rhythms and a decrease in human cognitive functions [11].

Thus, physical factors not only shape the quality of life, but also have a systemic effect on all levels of the body, from cellular to behavioral. For a complete hygienic assessment, it is necessary to take into account not only the strength of the stimulus, but also its combination with other influences.

Noise as a health risk factor

Noise is one of the most common adverse physical factors in the modern environment. According to the WHO definition, noise is an undesirable or harmful sound that affects human health and well-being. Noise sources can include transport, industrial facilities, household appliances, and even communication devices [1].

Numerous studies support the link between chronic noise exposure and increased levels of stress hormones such as cortisol and epinephrine. Prolonged acoustic exposure activates the hypothalamic-pituitary-adrenal system, which causes vasoconstriction, increased blood pressure and the development of vascular dysfunction. These processes contribute to the formation of hypertension, coronary heart disease, and sleep disorders [5].

In addition to physiological effects, noise has a noticeable effect on the psycho-emotional state of a person. Prolonged exposure to noise levels above 60 dB contributes to the development of anxiety, reduced concentration and increased irritability, even in healthy people. Children's audiences are particularly sensitive to noise: a constant high sound level can slow down speech development and reduce academic performance [2].

European countries are actively implementing measures to reduce the level of traffic noise: noise screens are being installed, special noise-absorbing road surfaces are being applied, and acoustic

comfort standards are being introduced in the design of residential buildings. Similar approaches are gradually being developed in our countries, but there is still a need to tighten control over compliance with sanitary standards and noise requirements in the residential environment [4].

Therefore, noise is not just an inconvenience, but a serious risk factor affecting the human cardiovascular, nervous and endocrine systems.

Electromagnetic fields and their influence on the human body.

The impact of electromagnetic fields on human health remains a subject of scientific debate. Although most studies do not reveal a direct carcinogenic effect, more and more evidence points to the ability of EMF to cause functional disorders of the nervous system, sleep disorders, and headaches with prolonged exposure [8].

Low-intensity electromagnetic fields emitted by household devices can affect the bioelectric activity of the brain and cause a decrease in concentration. The degree of risk is determined by the distance to the radiation source and the duration of contact [2].

Chronic exposure to electromagnetic fields in employees of energy companies often leads to the development of vegetative disorders, heart rhythm disorders and increased fatigue. To reduce the risk, it is recommended to maintain a safe distance between radiation sources and workplaces, as well as to use protective screens and personal protective equipment [7].

In general, despite the lack of unambiguous evidence of severe pathologies, prevention of EMF exposure is an important area of modern hygiene, especially in the context of digitalization and urbanization.

Lighting and light environment as an element of hygienic assessment of the living environment.

Lighting is one of the most significant factors that determine the comfort and safety of human living conditions. Light not only enables visual perception, but also plays a key role in regulating the body's biological rhythms, psychoemotional state, and metabolic processes.

Insufficient illumination of the premises leads to visual fatigue, headaches, irritability and a decrease in emotional state. At the same time, excessively bright or uneven lighting causes blinding, overexertion of the eye muscles and dizziness. To maintain visual and psychoemotional comfort, it is important to ensure optimal parameters of the light environment [7].

In recent years, special attention has been paid to the effects of artificial lighting at night. Excessive light levels, especially when the blue spectrum prevails, inhibit the production of melatonin, the sleep hormone that regulates circadian rhythms. Impaired melatonin secretion leads to sleep disorders, a weakened immune system, and increases the risk of developing metabolic diseases, including obesity and type 2 diabetes [2].

Artificial lighting at night is increasingly regarded as one of the new types of environmental pollution. Constant exposure to bright light sources, such as street lamps, advertising screens, and household appliances, has a long-term negative effect on the human nervous and endocrine systems, disrupting the natural mechanisms of biorhythm regulation [8].

Foreign hygiene standards recommend the use of dynamic lighting systems that adapt the intensity and spectrum of light depending on the time of day. This solution helps maintain the body's natural biorhythms and reduces the risk of overwork. Russian and Uzbek sanitary standards similarly set

requirements for the level of illumination of residential and educational premises (from 100 to 500 lux, depending on the type of activity), but the issues of light pollution are not yet sufficiently reflected in hygiene documents.

As a result, the light environment is not just an element of comfort, but the most important hygienic factor that requires strict regulation and a conscious approach when designing residential and public spaces.

Vibration as a physical and professional impact factor

Vibration is an oscillatory motion of solid bodies transmitted through supporting surfaces to the human body. It is a characteristic factor of both the industrial and urban environment. Its sources are traffic flows, construction equipment, building engineering systems, and household appliances.

Prolonged exposure to vibration causes the development of occupational pathology—a vibration disease characterized by impaired microcirculation, pain in the extremities, numbness of the fingers and a decrease in tactile sensitivity [6].

The impact of vibration is manifested not only in physical discomfort, but also in a decrease in cognitive functions and the ability to concentrate. When the vibration level exceeds 1.15 m/s^2 , there are disturbances in equilibrium, slowing down the reaction, and increasing the probability of errors during operation [3].

Domestic sanitary standards set maximum permissible levels of general vibration: up to 0.63 m/s^2 when exposed to the entire body and up to 2.0 m/s^2 when exposed to local vibration (for example, when working with a hand tool). If these values are exceeded, contact time should be reduced, shock absorbers should be applied, and preventive medical examinations should be performed.

It can be noted that vibration, like noise, is a factor with a multi-level impact: from functional disorders to organic changes in the vascular and nervous systems. Its hygienic assessment should take into account not only the intensity, but also the duration of exposure, as well as the nature of transmission through surfaces and building structures.

Combined effect of physical factors

In real conditions, a person is rarely exposed to only one of the factors. Much more often, they act in a complex, mutually reinforcing the unfavorable influence of each other.

Combined exposure to noise and artificial lighting at night causes more pronounced sleep disturbances and increased levels of stress hormones compared to the influence of each of these factors separately. Similar results are observed with the combined effect of noise and vibration, which is manifested by increased vascular spasm, increased blood pressure, and decreased cognitive performance [2, 10].

The combination of physical and psychoemotional stress forms the so-called total load effect, in which even moderate levels of factors that are safe separately become harmful when combined.

Particular importance is attached to the need to take into account the combined impact of all physical environmental factors in health protection programs. Modern approaches assume the concept of "total exposure", aimed at assessing the overall level of physical activity per person during the day [11].

In Russian practice, such a methodology is still being developed, but hygiene science is gradually moving from an isolated analysis of factors to a systematic approach that takes into account the interaction of light, noise, vibration, microclimate and electromagnetic fields.

Consequently, environmental hygiene assessment should consider not only each factor separately, but also their combined impact, which will allow for more accurate health forecasting and the development of effective preventive measures.

Comparative analysis of domestic and foreign approaches

The analysis of Russian and English sources shows that the approaches to assessing physical factors are generally similar, but there are differences in the level of regulatory rigor and emphasis.

The Russian School of Hygiene traditionally pays great attention to sanitary standards and medical control (for example, sanitary standards for light, vibration, and noise levels). Russian articles focus on the physiological consequences and the need for prevention in the workplace.

In foreign studies, more and more attention is paid to the psychological and behavioral aspects of the impact of physical environmental factors. Of particular interest are data on the impact of environmental conditions on the level of stress, performance and cognitive abilities of a person [2].

In international practice, much attention is paid to reducing the impact of physical factors on human health. In the UK, standards require the participation of ergonomics specialists in the design of workplaces, and in the US, educational campaigns are being implemented to raise awareness about the dangers of noise and light pollution. Projects to reduce vibration loads and control the acoustic climate are being actively implemented at the international level, and there are trends towards the development of similar approaches in other countries [4].

Thus, the national approach can be characterized as medical and regulatory, while the foreign approach can be described as comprehensive, taking into account social and psychological components.

Conclusions.

1. Physical environmental factors have a multifaceted impact on human health, affecting both physiological and mental functions. The most significant ones are noise, illumination, vibration, and electromagnetic fields, which are affected at various levels, from cellular to systemic.
2. Current research, including data from the Environmental Health Project, UK Parliament, and Kowalska-Koczwarra et al., confirms that the problem is interdisciplinary in nature. To solve this problem, we need to combine the efforts of medicine, engineering, urban studies, and social policy.
3. The main difficulties of prevention are insufficient standardization of standards, lack of a comprehensive assessment of combined impacts, and poor public awareness of the risks associated with physical environmental factors.
4. Effective prevention should include constant monitoring of environmental parameters, rational organization of lighting and acoustics, use of protective equipment, optimization of vibration isolation and development of environmental education among the population.
5. The development prospects are to improve hygiene regulation systems, introduce smart building technologies, and develop cross-industry programs that combine healthcare, ecology, and industrial safety.

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