

THE EFFECT OF SUNLIGHT ON THE HUMAN ORGANISM

Erkin Khojievich Bozorov¹

Chief Researcher at the Institute of
Nuclear Physics of the Academy of
Sciences of the Republic of Uzbekistan,
Professor of the Department of
Nuclear Physics and Astronomy of the
Faculty of Physics of NUUz,
Doctor of Physical and Mathematical Sciences,
e-mail: erkinbozorov789@mail.ru
Orcid id 0009-0002-0270-0054

Donakhon Abduvalieva²

Senior Lecturer at the Department
of Medicine, Faculty of Medicine,
Alfraganus University
e-mail: olimboevadonohon@gmail.com

Abstract. This article examines the positive and negative effects of sunlight on the human body based on research conducted by local and foreign scientists.

It synthesizes medical and hygienic recommendations for its rational use for both prophylactic and therapeutic purposes.

Keywords: sunlight, ultraviolet radiation, vitamin D, photocarcinogenesis, immunomodulation, photoaging.

INTRODUCTION

Sunlight serves as the foundation for all vital processes on Earth. The spectrum of solar radiation is non-homogeneous. At the Earth's surface, it consists of ultraviolet — UV (1%), visible (40%), and infrared — IR (59%) components. Visible light has been shown to increase cerebral cortex activity, positively influence the emotional state of the body, and affect photochemical processes, metabolism, and cardiovascular function. Infrared (IR) radiation is almost entirely absorbed by the stratum corneum (outer layer) of the skin and penetrates to a depth of approximately 20 mm into the body. The therapeutic effect of IR radiation is directly related to the temperature differential between the skin surface and its deeper layers, which activates the body's thermoregulation system.

Ultraviolet (UV) radiation, particularly long-wave UV rays within the UV spectrum of solar radiation, undoubtedly exerts the most potent influence on the

human organism [1]. From a hygienic perspective, among these spectra, ultraviolet rays possess the highest photochemical activity.

In recent decades, climate change and urbanization processes have radically altered the levels of solar exposure among the population. On one hand, a lack of sunlight causes vitamin D hypovitaminosis, weakening of the immune system, and seasonal depression. On the other hand, excessive exposure to ultraviolet radiation increases the risk of lip cancer, basal cell carcinoma, squamous cell carcinoma of the skin, and cutaneous melanoma, particularly in fair-skinned individuals. Furthermore, evidence indicates that solar UV radiation elevates the risk of several ocular diseases, including cortical cataracts, certain conjunctival tumors, and even ocular melanoma [2].

The territory of Uzbekistan is characterized by high insolation resources and an abundance of sunny days (2,800–3,000 hours per year). For this reason, protecting public health requires a deep and systematic analysis of the effects of sunlight on the body, as well as the establishment of hygienic standards that take local climatic conditions into account.

LITERATURE REVIEW

An extensive scientific database has been established regarding the effects of sunlight on the human organism. Research in this field can be broadly classified into two categories: beneficial metabolic and health-promoting effects, and pathological, destructive negative effects.

The role of sunlight in vitamin D synthesis and immunomodulation is of particular significance. For instance, M. Holick, through years of extensive research, demonstrated that ultraviolet radiation is responsible for vitamin D production. He noted that living at higher latitudes is associated with an increased risk of mortality from chronic conditions, including multiple sclerosis, type 1 diabetes, hypertension, and cardiovascular diseases. Conversely, visible and infrared radiation are utilized clinically for wound healing and improving skin health [3]. At the same time, he notes that chronic sun exposure causes non-melanoma skin cancer or sunburn-induced cutaneous melanoma, and that squamous cell carcinoma induced by UV radiation has even been included in the German Ordinance on Occupational

Diseases [4]. Another scientist fundamentally demonstrated the mechanism of pre-vitamin D₃ formation from 7-dehydrocholesterol in the skin under the influence of UV-B rays (wavelength 290–315 nm). He emphasized that a lack of sunlight increases the risk of skeletal diseases such as rickets and osteoporosis, as well as autoimmune pathologies and certain types of cancer [5].

Furthermore, [Cornelia Baldermann](#), in her research, stated that while ultraviolet radiation triggers the formation of vitamin D in the body, it is simultaneously the primary cause of skin cancer and can lead to other adverse consequences for eye and skin health [6, 7]. Ultraviolet radiation damages genetic material and is classified as a "human carcinogen" in the highest risk category, alongside asbestos and ionizing radiation [8]. Risks to eye and skin health associated with ultraviolet radiation can affect almost every individual [9].

Another crucial area in photobiology is the process of photoaging. A. Bernard demonstrated in his works that UV-A rays (315–400 nm) penetrate into the deeper layers of the skin, generating oxidative stress and activating matrix metalloproteinases that break down collagen fibers [10].

In hot climates, high doses of solar radiation adversely affect the body's thermoregulation (heat exchange) system and the cardiovascular system.

Despite the abundance of sunny days in Uzbekistan, the prevalence of vitamin D deficiency among children and pregnant women remains high. The primary reasons for this include national clothing culture (body coverage), the tendency to remain in the shade during the hot summer months, and inadequate dietary habits.

ANALYSIS AND RESULTS

An analysis of the reviewed scientific literature indicates that the effect of sunlight on the organism is dose-dependent. Sunlight is both vital for human health and potentially hazardous.

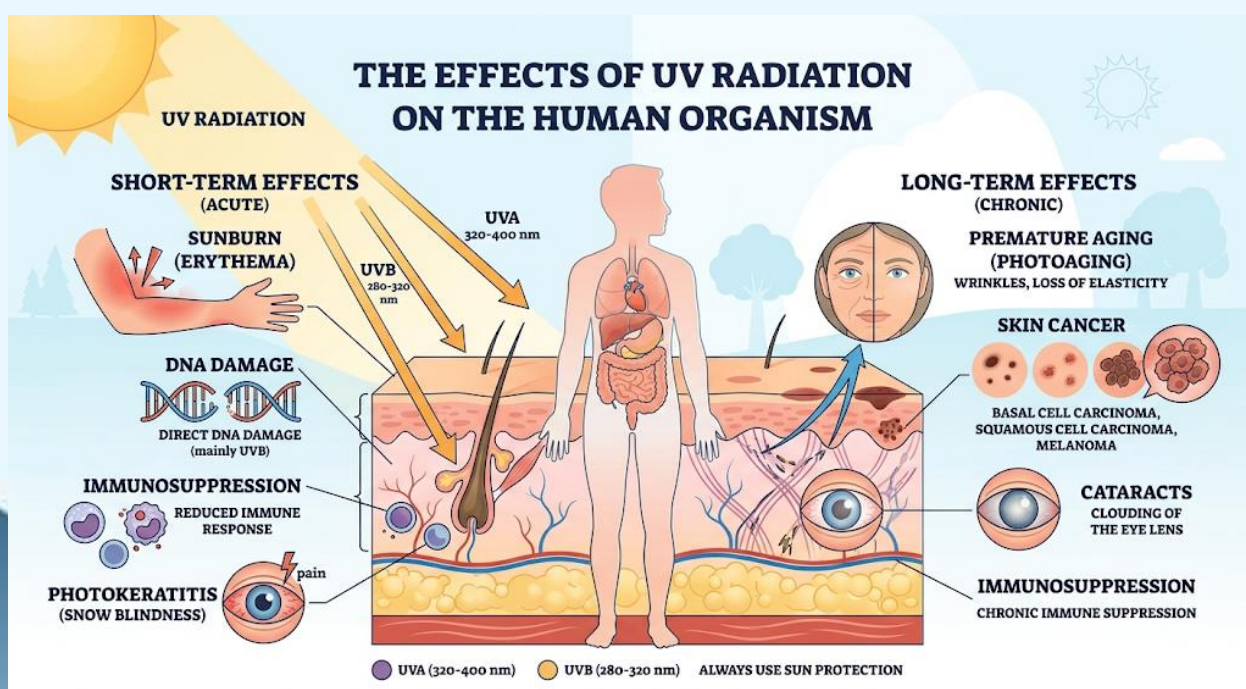
The positive effects of sunlight are associated with endothermal metabolism and the neuroendocrine system. Exposure to ultraviolet rays on the skin for 10–15 minutes a day covers up to 80–90% of the body's daily requirement for vitamin D. Visible light acts on the hypothalamus via the retina, regulating the release of

serotonin (the "happiness hormone") during the day and melatonin (the "sleep hormone") at night. This process governs the human biological clock.

Ultraviolet rays also transfer nitrates accumulated in the skin into the bloodstream, helping to dilate blood vessels and lower arterial blood pressure [10].

Additionally, the bactericidal function of ultraviolet rays deserves special mention. In medical institutions, the bactericidal property of UV rays is utilized to prevent healthcare-associated infections and ensure the sterility of operating rooms and dressing rooms. The direct effect of ultraviolet radiation on bacterial cells, specifically on their DNA molecules, induces destructive chemical reactions that lead to the destruction of microbial cells [11].

In studies conducted by T.B. Tilyavov and co-authors, among patients diagnosed with purulent soft tissue wounds, 77 individuals were treated with a water-soluble ointment, while 66 individuals were treated with UV rays. The results showed that UV radiation shortened the time required to clear the wound of various microflora and reduced the antibiotic resistance of the bacterial strains [12].



Sunlight possesses a dual nature, exerting negative effects alongside its beneficial properties. High doses of its ultraviolet spectrum induce destructive processes in the organism.

The following table summarizes the primary pathologies caused by different spectra of UV radiation:

Classification and Pathological Effects of UV Radiation Spectra

UV Radiation Type	Wavelength (nm)	Primary Target in the Organism	Resulting Pathological Conditions
UV-A (UVA)	315 – 400 nm	Dermal layer of the skin, collagen, and elastin fibers	Photoaging, elastosis, increased free radical production, deep pigmentation (melasma)
UV-B (UVB)	290 – 315 nm	Epidermis (outer layer), cellular DNA	Sunburn (erythema), DNA mutations, photocarcinogenesis (skin cancer, melanoma)
UV-C (UVC)	100 – 290 nm	Absorbed by the ozone layer	High mutagenic and bactericidal activity (barely reaches the Earth's surface)

An analysis of studies conducted under the climatic conditions of Uzbekistan confirms that remaining under direct sunlight during peak solar activity hours (from 11:00 AM to 4:00 PM) leads not only to localized skin damage but also to a decline in systemic immunity. The primary manifestations of excessive exposure include increased excitability of the nervous system, rapid fatigue, elevated body temperature, decreased appetite, frequent headaches, general malaise, sleep disturbances, memory impairment, and tachycardia [13].

The long-term adverse consequences of intense radiation exposure encompass hypercalcemia, growth retardation, hemolysis, immunosuppression, varying degrees of burns, and dermatological disorders.

Individuals who consistently perform outdoor labor, as well as personnel regularly operating equipment that emits artificial ultraviolet radiation, are primarily susceptible to the hazards of excessive exposure.

CONCLUSION

In conclusion, sunlight exerts a dual biological effect on the human organism. In optimal doses, it strengthens the skeletal and immune systems, whereas in excessive doses, it poses mutagenic and oncogenic risks.

Given the climatic and geographical peculiarities of our region, it is imperative to cultivate a culture of sun protection among the population. To eradicate vitamin D deficiency in our country, it is highly advisable to develop explicit regulations governing the prophylactic use of solar exposure.

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