

Can environmental changes modify the manifestations of cutaneous diseases and via what mechanism?

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ABSTRACT

The environment exerts a profound influence on both skin health and overall human well-being. As the body's primary protective barrier, the skin safeguards against harmful chemicals, ultraviolet radiation, and repeated exposure to water. Understanding how environmental factors interact with cutaneous biology is essential for effective prevention, diagnosis, and management of skin disorders. The skin also acts as a visible indicator of systemic and external changes, reflecting alterations that may arise through epigenetic mechanisms. These mechanisms can modify gene expression, trigger new dermatologic conditions, impair immune responses, and contribute to resistance to treatment. Hence, dermatologists must remain attentive to environmental shifts, recognizing their impact on skin function and disease patterns to promote comprehensive patient care.

Key words: Environment, Skin health, Epigenetic mechanisms, Vaccine

It has long been proven that the surrounding environment plays an important role in the appearance of the skin and general health. The main function of the skin is to preserve the human body and protect from harmful substances, whether they are noxious chemicals, ultraviolet light, or continued/frequent exposure to water [1]. Understanding the interaction between the environment and the skin and its diseases is vital to reach effective prevention and management. In order to encourage skin health within these environmental stresses, medical doctors must keep in mind the following 16 ideal issues to support human well-being (Fig. 1):

- Pathogens: In a special community media, friendly kissing is considered to have an important role in molluscum contagiosum skin infection [2]. During the COVID-19 pandemic, numerous skin manifestations were reported, such as hair loss, diffuse petechiae, chilblain-like lesions, acneiform rash, pyoderma gangrenosum, and unusual skin hypersensitivity to drugs [3,4].
- Vaccine: Vaccination strategies are linked to adverse effects, including a variety of skin lesions ranging from pruritus, tenderness, erythema, and edema, to erosions, papules, and pigmentation [5]. All over the world, several autoimmunological skin reactions may happen after COVID-19 vaccination. For example, urticaria and angioedema represent type-I hypersensitivity responses, whereas erythema multiforme-like rashes, leukocytoclastic vasculitis, systemic lupus erythematosus, and thrombocytopenia represent type-IV hypersensitivity responses [6].
- Insect bite: Mites such as scabies and head lice are the main infestations in children. Bite reactions caused by fleas and bed bugs are common sources that present with chronic and recurrent papular urticaria [7].
- Pollution (industrial): Similar to ultraviolet radiation, airborne pollutants cause skin pigmentation. Eumelanin has an antioxidative effect, and it is

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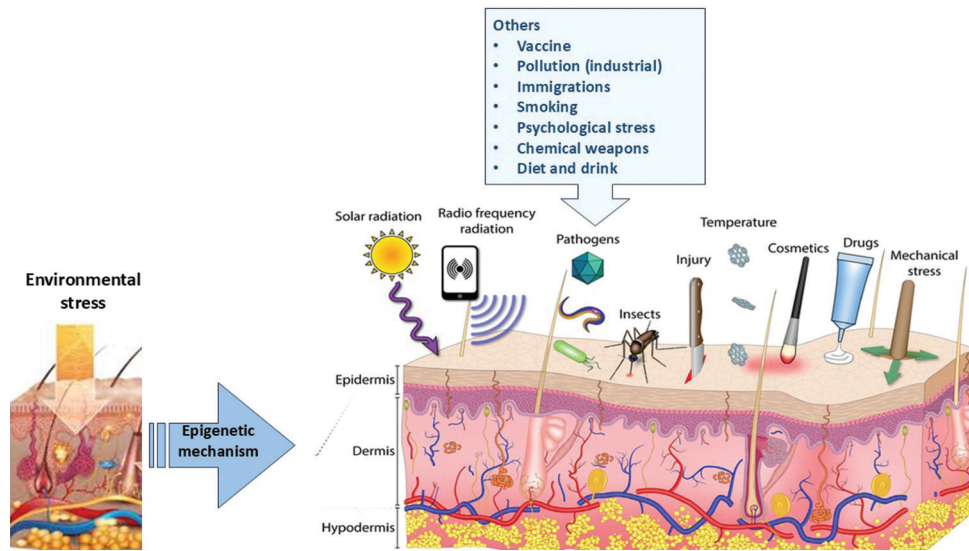


Figure 1: The environmental factors that might harm the human skin (modified; medical video).

anticipated that this response acts as a protective strategy against oxidative stress caused by air pollution [8]. The study revealed an epidemic of acne vulgaris caused by air pollutants, such as sulfur dioxide and nitric dioxide, which may increase the concentration of cutaneous oxidative stress, which leads to acne flares. Furthermore, the raised humidity contributing to keratinocyte swelling and hair follicle obstruction can, thus, intensify the growth of *Cutibacterium acnes* [9]. On the other hand, current epidemiological studies show that the black carbon elements and polycyclic aromatic hydrocarbons increase the incidence of cutaneous cancer [9].

- Solar radiation: Sun exposure and the increased risk of skin tumors, particularly for fair-skinned people, remains a matter of debate. Additional cutaneous disorders associated with ultraviolet radiation are sunburn, phototoxic and photoallergic reactions, solar UV damage, long-lasting pigmentation, melasma, and others [10].
- Extreme temperature changes: The important role of the skin is thermoregulation or homeostasis. Frostbite might happen in a very cold situation. Moderate degrees of cold may produce cold urticaria, chilblains, acrocyanosis, cold panniculitis, Raynaud's syndrome, and cryoglobulinemia [11]. Prolonged exposure to an elevated temperature and humidity increases the prevalence of miliaria, types of physical urticarias, and erythema ab igne. Moreover, it can disturb sebum production and skin hydration. This can encourage the growth of *Cutibacterium acnes* and be responsible for

the epidemic of acne vulgaris in hot climate countries [9,11]. An association between irritant skin changes and low temperatures or humidity has been well-known. Dry and cold weather upsurges the risk of flares of atopic dermatitis [12].

- Diet: In recent years, the role of nutritional alterations as a means to treat or prevent dermatological diseases has received special consideration. Eating habits, chiefly the eating of dairy products and highly glycemic foods, have been associated with the severity of acne, through the exacerbation of sebum production and local irritation [9]. Numerous dietary issues such as spicy foods, hot beverages, caffeine, vanilla, alcohol, and cinnamon have been considered triggers for seborrheic dermatitis or rosacea [13]. Some possible mechanisms of acne involve spicy foods. The idea that this might trigger the disease is a matter of controversy, and there are limited studies. The probiotics showed excessive potential in stopping and managing cutaneous disorders, including acne, atopic dermatitis, urticaria, solar skin damage, wound protection, and cosmetic substances [14]. Moreover, the ketogenic diet is used in treating skin diseases, such as psoriasis, acne, and hidradenitis suppurativa. Conversely, this regimen could produce prurigo pigmentosa and nutritional deficiencies as an abnormal cutaneous reaction [15].
- Chemical weapons: Previous studies from Iraq anticipated the dramatic upsurge in the frequency and severity of mycosis fungoides, Kaposi sarcoma, Paget's disease, squamous cell carcinoma, and dermatofibrosarcoma protuberans that were

significantly influenced by war crimes [16]. Skin disorders have been an imperative health alarm in military employees throughout times past. The spectrum of cutaneous diseases in the Gulf War's military was eczema (seborrheic dermatitis), and infections (bacterial, viral, or fungal), which accounted significantly for the majority of referrals. During World War II, up to 75% of all clinical presentations were skin complaints. These were attributed principally to the different types of used weapons [17].

- Immigration: Immigrants showed an increased hazard for many skin diseases, especially for scabies and bacterial infections. Recently, the incidence of resistant fungal infections of the skin has increased. The exact causes behind this are still obscure, but it is generally prevalent among immigrants [18,19].
- Radiofrequency: Ablative and non-ablative radiofrequency was used to improve and rejuvenate damaged skin. The described drawback reactions include swelling, edema, erythema, crusting, hyperpigmentation, and acne [20].
- Injury, detergents, chemical and mechanical stress: Daily use of detergents by housewives, as well as mechanical stress by farmers, is frequently associated with irritant hand dermatitis. Likewise, the Pacha boil (Orf) affected the injured hands of housewives [21].
- Smoking: Cigarette smoking leads to increased skin changes, including cancer, and accelerates the natural course of skin aging [22].
- Hair dyes and cosmetics: Black color hair dyeing may be associated with several dermatological diseases, ranging from allergic contact dermatitis to facial melanosis and erythema multiforme-like eruption [23]. The common adverse skin reactions to facial cosmetics or perfumes are erythema, xerosis, and pruritus. Cosmetic acne is a known induced disease variant [9].
- Psychological stress: Psychoneuroimmunology provides locally expressed complex stress-induced reactions that have been established as active in many cutaneous diseases such as chronic urticaria, psoriasis, atopic dermatitis, warts, hair loss, and acne. Psychological stress might induce numerous cutaneous diseases such as dermatitis and hair loss. A previous study proposed a significant association between psychological stress and the severity of acne. Stress leads to hormonal variations that raise sebum production, which has been linked to the development of acne vulgaris [9].

- Drugs and herbal effects: There were various reported cutaneous side effects caused by many injectable, oral, or topical drugs, as well as an excessive intake of antibiotics, tonics, and herbals for certain reasons, whether by doctors or non-doctors. In certain circumstances, this might influence the behavior of numerous skin diseases by affecting gene functions or expression (epigenetic mechanism). In addition, this impact on the host immunological influence leads to the reappearance of many autoimmune or genetic diseases such as benign bullous disease of childhood and lipoid proteinosis, as it happened in Iraq since these diseases were common diseases before the 1990s, then completely disappeared, and now, they are returning [24].
- During outbreaks of infections and epidemics: There will be changes in the cutaneous manifestations of these diseases as they become more widespread, with new cutaneous features and more resistance to therapies as observed during outbreaks of scabies, cutaneous tuberculosis, and dermatophytosis. The frequency of autoimmune diseases such as vitiligo and alopecia areata increased during the COVID-19 epidemic [4,25].

In conclusion, the skin may be considered a mirror that reflects what is happening inside or outside of the body. Accordingly, any environmental change that affects the body will be reflected in the function and behavior of the skin. This could be explained by the epigenetic mechanism through which there are changes in the expression and functions of genes, hence the emergence of new cutaneous manifestations, new skin diseases, and impaired immunological reactions with the appearance of resistance to drug therapy. Therefore, dermatologists should be aware of what happens in their surrounding environment and what will be reflected in the human skin function and behavior.

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