Holistic dermatology: An evidence-based review of modifiable lifestyle factor associations with dermatologic disorders

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Background: Holistic dermatology focuses on treating the human body as a whole and implementing lifestyle changes to enhance the treatment and prognosis of skin disease. Understanding the interplay between modifiable lifestyle factors and patients' dermatologic health will help physicians better inform patients on self-care methods to mitigate the burden of their skin disease(s).

Objective: To review the current scientific literature on the relationship between modifiable lifestyle factors and the dermatologic outcome of skin disorders.

Methods: A systematic literature search on PubMed, Cochrane, and Web of Science was conducted to identify research articles examining the relationship between dermatology and 6 major categories of modifiable lifestyle factors: diet, sleep, exercise, stress, alcohol, and smoking.

Results: A substantial amount of evidence supports the relationship between modifiable lifestyle factors and dermatologic outcomes. There were the most studies on diet, stress, alcohol, and smoking, but all lifestyle factors were supported by some degree of scientific evidence.

Conclusion: All modifiable lifestyle factors explored in this review play a critical role in modulating the onset and progression of skin disease. We anticipate more research studies in the future and an increasing integration of holistic dermatology into patient care. (J Am Acad Dermatol 2022;86:868-77.)

Key words: alcohol; alternative medicine; diet; exercise; holistic dermatology; integrative dermatology; lifestyle factors; modifiable lifestyle factors; sleep; stress; smoking; traditional medicine.

Mainstream dermatologic medicine focuses on the treatment of symptoms and diseases with drugs (topical, oral, injectables), radiation, surgery, lasers, and phototherapy. Holistic or integrative dermatology is dedicated to treating the human body as a whole to promote better overall health with the expectation that a dermatologic condition will benefit in conjunction.[1] The premise is that skin is a reflection of general health and that treating conditions from the inside out will address the underlying cause of the condition and prevent its recurrence. Holistic medicine has been used in many cultures around the world for centuries and predominates in Asian societies to this

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day. From herbal therapies to acupuncture, holistic medicine focuses on environmental factors, nutritional factors, the gut microbiome, history of exposures, stress, and improving the function of the immune system. Integrative medicine is still underappreciated and met with resistance in Western societies because of its potential adverse effects and, sometimes, lack of scientific research. Furthermore, a holistic lifestyle can be costly and difficult to implement, because it is not often covered by insurance, and healthful foods may not be easily accessible or financially practical. Advocating for appropriate holistic medical treatments may be an important task for physicians to help their patients promote an overall healthy lifestyle. Many dermatologic conditions can be prevented or mitigated by modifiable lifestyle factors such as diet, sleep, exercise, stress, alcohol, and smoking. Understanding the role of these factors in modulating skin disease will help physicians better educate patients on self-care approaches, enhance the effects of treatments, and promote good health.

CAPSULE SUMMARY

- Many dermatologic conditions can be prevented or mitigated by modifiable lifestyle factors such as diet, sleep, exercise, stress, alcohol, and smoking.
- Well-controlled studies evaluating the relationship between lifestyle factors and dermatology are continuing to evolve; alcohol, diet, stress, smoking, and illicit drug use had the most clinical evidence to date.

METHODS

A systematic literature search was conducted to examine the relationship between dermatology and 6 major categories of modifiable lifestyle factors on the PubMed (US National Library of Medicine), Web of Science, and Cochrane databases. The search terms *diet*, *exercise*, *sleep*, *stress*, *alcohol*, and *smoking*, were used to identify all relevant articles. Both in vitro and in vivo studies were included up to August 2019. Non—English language articles were excluded. A total of 128 studies were included for this study. Evidence supporting each lifestyle factor is summarized in Table 1.

ALCOHOL

There is a strong relationship between alcohol abuse and skin pathology. Studies have suggested a dose-dependent relationship between alcohol consumption and both melanoma[2-5] and basal cell carcinoma.[6,7] However, the underlying mechanism is poorly understood. Some studies suggest a link between heavy drinking and higher rates of sunburn, which may, in turn, lead to skin cancer.[8] Other studies show that alcohol consumption may cause an increase in skin permeability and a decrease in carotenoid antioxidant substances, causing more rapid and intense erythema after ultraviolet (UV) irradiation.[9] In addition to skin cancer, binge and heavy consumption of alcohol have been associated with various dermatologic conditions including psoriasis, discoid eczema, rosacea, porphyria cutanea tarda, postadolescent acne, and superficial cutaneous infections.[10-13] Liver disease associated with chronic alcohol abuse modulates estrogen and bile salt metabolism, leading to the characteristic findings of spider angiomas, palmar erythema, and pruritus.[10,14] Additionally, chronic alcohol abuse has been shown to be a predisposing factor for necrotizing wound infections, cellulitis, and delays in wound healing.[15] The pathogenesis of skin diseases related to alcohol consumption includes immunosuppression, malnutrition, hepatic disease,[16] and changes in lipid metabolism.[17] Both acute and chronic alcohol abuse decrease immune function,[18] which explains their effects on skin conditions that have an immune pathogenetic mechanism.[16] Systemic and superficial dermal infections, including bacterial and fungal infections, are also more prevalent in individuals with alcohol dependence.[15,19,20] The higher incidence of infections is likely attributable to a variety of influences, including immunodeficiency in combination with alcohol-associated nutritional deficiencies. Zinc and vitamin C deficiencies contribute to impaired wound healing, weakened mucosal barriers, and altered immunity with increased risk for infections. Alcoholism can also result in malabsorption, leading to cutaneous manifestations including angular stomatitis, glossitis, perifollicular hemorrhages, pellagra, petechiae, and ecchymoses.[19-21]

DIET

Dietary interventions may influence the prevention, risk, health outcomes, and progression of dermatologic conditions.[22] The association between increased acne and dairy consumption has been elucidated in the literature.[23-25] Mechanisms by which dairy products mediate changes in acne severity relate to the presence of growth hormones in milk, anabolic steroids, and carbohydrate content.[26,27] High levels of serum

Abbreviations used:

HPA: hypothalamic-pituitary-adrenal
ROS: reactive oxygen species
UV: ultraviolet

insulin and insulin-like growth factor (IGF-1) from high–glycemic index foods augment sebum production and increase androgen synthesis/bioavailability, playing a role in the pathogenesis of acne.[28] The Western diet, with its high glycemic content, has been shown to be a potential cause of acne.[29] This is further supported by the absence of acne in native non-Westernized populations and the improvement of acne when a diet with low glycemic load is adopted.[28,30] Interestingly, this increase in acne was seen primarily with low-fat milk and skim milk but was not seen with intake of whole milk.[23,25,31]

Diet has also been linked to changes in skin characteristics and risk of skin cancer. Ingestion of sugar and cooking processes such as grilling, frying, and roasting accelerate signs of aging by mediating the cross-linking of collagen fibers and their degradation into advanced glycation end products, which result in increased stiffness and reduced skin elasticity.[32-34] The intake of fruits and vegetables has been associated with a reduction in skin cancer risk.[35] Ingestion of vitamins C and E, beta-carotene, selenium, isoflavones, polyphenols, curcumin, lycopene, grape seed extract, and ellagic acid have been shown to protect skin against UV damage and nonmelanoma skin cancers.[36-39] Contrarily, a dietary pattern rich in meats and fats was shown to increase the risk of squamous cell carcinoma.[40] Finally, skin conditions such as psoriasis associated with significant comorbidities (ie, obesity, diabetes, dyslipidemia, and cardiovascular disease) would greatly benefit from dietary changes to reduce comorbid disease risk.[22,41-43] Patients with psoriasis eating a Mediterranean-style diet had lower markers of inflammation.[44] Thus, diets rich in fruits, vegetables, and whole grains are recommended as therapeutic interventions for these patients.[22]

EXERCISE

The role of exercise in dermatology is not as well characterized as other lifestyle factors, yet several research studies report the benefits of physical activity on improving skin conditions. Regular moderate-intensity exercise protects against oxidative stress mediated by reactive oxygen species (ROS), thereby helping maintain redox balance in the body.[45] An increased amount of ROS exceeding the capacity of the antioxidant defense system can lead to chronic inflammation, which can cause collagen fragmentation and disorganization of skin cell function. Moreover, oxidative stress participates in the pathogenesis of many dermatologic diseases and promotes the progression of carcinogenesis, including skin cancer.[46] Physical activity improves the antioxidant defense system by increasing the production of antioxidants and anti-inflammatory factors such as glutathione and superoxide dismutase. Furthermore, exercise decreases the concentration of quinone intermediates that form unstable, highly reactive complexes with DNA and promote cell proliferation. Dynamic exercise generates thermoregulatory demands that are met by increases in blood flow to the skin.[47] The increased blood flow transports oxygen and nutrients throughout the body and carries away waste products, helping nourish skin cells and eliminate free radicals.[48] Additionally, 1 study showed that exercise significantly increases dorsal skin perfusion in individuals with diabetes by modulating prostaglandins, nitric oxide, and endothelium-derived hyperpolarizing factor vasodilatory pathways.[49] Exercise also helps skin repair more quickly, purges the body of pore-clogging toxins, and decreases levels of the stress-related hormone cortisol.[50] High cortisol levels can lead to acne breakouts and cause collagen to break down in skin. Regular moderate-intensity physical activity is beneficial to maintaining skin homeostasis and preventing the onset and progression of skin diseases.

ILLICIT DRUGS

Drug abuse and addiction may produce cutaneous signs. Cocaine, a powerful stimulant drug, is available as white crystalline powder and can be inhaled, orally ingested, or mixed with water for injection.[51] Dermatologic manifestations of cocaine abuse include cuts and burns on the lips from broken pipes, madarosis from hot steam, and palmar and digital hyperkeratosis.[52,53] Adverse drug reactions such as acute generalized exanthematous pustulosis and Stevens-Johnson syndrome, as well as snorter warts caused by the transmission of human papillomavirus from person to person by snorting cocaine on dollar bills, have been reported.[54-56] Cocaine abuse has been linked to vasculitis and formication, the tactile hallucination of insects crawling under the skin, leading to skin picking and excoriations.[57-59] In addition, levamisole is an antihelminth drug that is a common contaminant in cocaine, with approximately 71% of cocaine in the United States containing some level of this

Table I. Comparison of modifiable lifestyle factors affecting dermatologic conditions

Lifestyle factor	Skin condition(s) affected*	Mechanism of action*	Positive effects on skin*	Negative effects on skin*	Evidence for use	Modifiability†
Alcohol	Skin cancer, psoriasis, discoid eczema, rosacea, porphyria cutanea tarda, acne, cutaneous infections, wound healing, cellulitis, spider angiomas, palmar erythema, pruritus, pellagra, petechia, ecchymosis, perifollicular hemorrhages	Decreased skin permeability barrier, decreased carotenoid antioxidants in skin, changes in estrogen, lipid and bile salt metabolism, immunosuppression, nutritional deficiencies, malabsorption, hepatic disease	N/A	Increased risk of skin disease(s)	Multiple well-controlled RCTs[2-21]	High
Diet	Acne, psoriasis, aging, skin cancer	High serum insulin and IGF-1 increases sebum production and androgen synthesis; cross-linking of collagen and degradation into AGEs increases stiffness and decreases skin elasticity	Diets rich in fruits, vegetables, and micronutrients protect against skin cancer, minimize acne and inflammatory skin conditions, have antiaging effects	Increases risk of skin disease(s)	Multiple well-controlled RCTs[22-42]	High
Exercise	Acne, skin cancer, aging	Improvement in antioxidant defense system, increased production of anti-inflammatory factors (glutathione, SOD), increased resistance to free radicals, decreased quinone intermediates, vasodilation, promotes skin repair, clears toxins, decreases stress hormone (cortisol)	Regular moderate-intensity exercise decreases risk of skin cancer, improves acne, mediates antiaging effects, promotes dorsal skin perfusion (individuals with diabetes)	High-intensity exercise may exacerbate certain inflammatory skin conditions	Few RCTs[43-47]	High
Illicit drugs	Cuts/burns, madarosis, hyperkeratosis, drug reactions, snorter warts, vasculitis, skin excoriations, urticaria, pruritus, ulcers, necrotizing cellulitis, acne, aging, hyperpigmentation, scars/keloids	Mechanism of action specific to drug(s) of abuse	None	Increased risk of skin disease(s)	Multiple well-controlled RCTs[48-64]	High

Continued

Table I. Cont'd

Lifestyle factor	Skin condition(s) affected*	Mechanism of action*	Positive effects on skin*	Negative effects on skin*	Evidence for use	Modifiability†
Sleep	Aging, wound healing, acne, inflammatory skin disorders	Increased glucocorticoid production alters HPA axis, immunosuppression, increased matrix metalloproteinases and interleukin 1B, inhibition of collagen production	Sufficient sleep improves skin texture and tone, decreases signs of aging, promotes wound healing	N/A	Several RCTs[48-54]	High
Smoking	Aging, skin cancer, wound healing, hidradenitis suppurativa, diabetic skin lesions/infections, SLE, discoid lupus	Stimulation of dermal matrix metalloproteinases, downregulation of TGFβ, peripheral vasoconstriction, local dermal ischemia, formation of ROS, pro-oncogenic cell proliferation, microvascular damage to hair papilla	N/A	Increased risk of skin disease(s)	Multiple well-controlled RCTs[55-88]	High
Stress	Psoriasis, acne, atopic dermatitis	Increased glucocorticoids through the HPA axis, impaired skin barrier, increased inflammation and substance P, inhibition of epidermal lipid synthesis, antimicrobial defense, skin barrier	N/A	Increased risk of skin disease(s)	Multiple well-controlled RCTs[89-106]	High

AGE, Advanced glycation end products; *HPA,* hypothalamic-pituitary-adrenal; *IGF-1,* insulin growth factor 1; *N/A,* not available; *RCT,* randomized control trial; *ROS,* reactive oxygen species; *SOD,* superoxide dismutase; *SLE,* systemic lupus erythematous; *TGFβ,* transforming growth factor.

*Skin condition(s), mechanisms, and positive/negative effects as reported in the current scientific literature. More studies are needed to elucidate the long-term effects of these lifestyle factors on dermatologic health.

†Degree of modifiability of lifestyle factors as deemed controllable by the patient.

contaminant.[60] Although cocaine use itself is linked to vasculitis formation, levamisole-induced vasculitis can also occur with smoked crack cocaine or inhaled cocaine when contaminated with levamisole.[61] Heroin is an opiate synthesized from morphine, a naturally occurring substance from the poppy plant that can be injected, inhaled, snorted, or smoked.[51] Users can develop urticaria, intense pruritus on the face and genital region, penile ulcers after injection into the dorsal penile vein, and necrotizing cellulitis of the scrotum after injection into the femoral artery.[62-64] Other associated skin conditions include pemphigus vegetans, fixed drug eruptions, toxic epidermal necrolysis, and acanthosis nigricans.[64,65] Methamphetamine is a stimulant drug with euphoric and hallucinatory effects and can be snorted, smoked, injected, or even taken orally. It has been shown to produce xerosis, pruritus, intense body odor, premature skin aging, hyperhidrosis, acne, and lichenoid drug eruptions.[66] Ecstasy is a recreational drug that produces feelings of euphoria, intimacy, and enhancement of body sensation and can be orally ingested or snorted. It is known to elicit an acneiform eruption called *ecstasy pimples*, a skin eruption of papules and pustules on the face without comedones, similar to perioral dermatitis.[67] Track marks caused by repeated intravenous drug injection occur because of venous damage with subsequent scarring of veins, hyperpigmentation of overlying skin, and irreversible tissue injury, leading to hypertrophic scars and keloids.[68,69] Importantly, all of the illicit drugs discussed have a high potential for abuse, which can lead to overdose, infections, health complications, and, in some cases, death.[70]

SMOKING

Tobacco smoke has been shown to adversely affect various organ systems and produces harmful and noticeable dermatologic changes by instigating and intensifying the course of various skin diseases. There is a significant relationship between pack-years of smoking and wrinkling, even after controlling for age, sex, sun exposure, and skin pigmentation.[71-74] Although the pathogenesis of wrinkling has not been entirely elucidated, cigarette smoke appears to stimulate dermal matrix metalloproteinases[75] while downregulating transforming growth factor β in cultured fibroblasts.[76] Smoking leads to microvascular angiogenesis and increases levels of blood vasopressin. This results in peripheral vasoconstriction and local dermal ischemia.[77-79] Subsequent postischemic reperfusion leads to the formation of ROS in addition to the ROS produced by the cigarette compounds themselves.[80,81] ROS are a major component of UV injury,[82] photoaging,[82] delayed cutaneous wound healing,[83-85] and oncogenesis.[86-89] Smoking is pro-oncogenic via augmented mitotic activity of basal cells and the appearance of hypertrophic epithelial cells in the epidermis.[88] Furthermore, related to dermatologic surgery, smoking can cause wound dehiscence, prolonged healing time, and an increased risk of infections and postoperative complications. This occurs through a number of different mechanisms, including a decrease in peripheral blood flow,[90] an increase in microvascular occlusion and tissue ischemia,[91] and a decrease in collagen synthesis and fibroblast proliferation.[92] In addition to direct skin injury, nicotine damages the microvasculature of dermal hair papilla, resulting in DNA damage of the hair follicle. This, in turn, leads to an imbalance in the follicular protease/antiprotease systems affecting the hair growth cycle and increases proinflammatory cytokine release, resulting in hidradenitis suppurativa.[93-96] Smoking increases the likelihood of skin ulcers and infections in individuals with diabetes, exacerbates diabetic skin lesions because of its unfavorable effects on dermal blood flow and immune response,[97-99] and is associated with various HIV-related dermatologic conditions, including oral thrush and hairy leukoplakia.[100,101] Smoking can also decrease the efficacy of antimalarial therapy, increase the cutaneous manifestations associated with systemic lupus erythematosus, and increase the severity of psoriasis by decreasing its response to treatment.[102-106] With the rising popularity of e-cigarettes, 1 recent case report linked vaping with discoid lupus erythematous.[107] The proposed mechanisms of smoking-induced psoriasis exacerbation include oxidative stress, interaction with signaling pathways active in psoriasis, and vascular involvement.[108]

STRESS

Emotional and psychological stresses impart severe consequences to overall human health and to skin. Stress impairs the barrier function of skin, increases inflammation, and induces or worsens the course of various skin disorders such as psoriasis, acne, and atopic dermatitis.[109-111] Stress affects the hypothalamic-pituitary-adrenal (HPA) axis and releases corticotropic-releasing hormone, which activates the HPA axis, leading to modulation of the inflammatory response. Both emotional and psychological stress can increase endogenous glucocorticoids through the HPA axis.[112,113] An increase in glucocorticoids affects skin quality through inhibition of epidermal lipid synthesis, antimicrobial defense, and barrier ability,[113,114]

acting as a trigger factor for various skin conditions. In 1980, researchers noticed that patients with psoriasis reported an increase in stressful life situations before the onset of disease.[115] Additional studies showed that patients with psoriasis had higher levels of perceived stress and higher levels of cortisol at moments of high stress.[116,117] Stress can also affect the severity and progression of acne. Substance P production increases during stress and can induce the proliferation and differentiation of sebaceous glands in the skin.[118,119] Furthermore, the stress impact on the HPA pathway and overexpression of corticotropic-releasing hormone can exacerbate acne lesions.[120] Studies suggest that stress is an important factor in the pathogenesis of up to 90% of acne cases[121-124] and have been implicated in the progression of atopic dermatitis. One study showed that children suffering from mental stress due to divorce of the parents or severe disease/death of a family member were significantly more likely to develop atopic dermatitis.[125] In fact, family environment is considered an important predictor of atopic dermatitis symptom severity.[126]

SLEEP

Like stress, increased sleep deprivation can have drastic effects on the integrity and function of skin. It is well known that sleep deprivation can exacerbate stress and that this increase in stress can modulate the HPA axis, resulting in glucocorticoid production, as discussed earlier.[127] Sleep deprivation can affect the skin integrity and ability to regenerate. One study showed that 42 hours of sleep deprivation causes a significant increase the levels of interleukin 1B, leading to the inhibition of collagen production and compromise of the skin barrier.[128] Both in vitro and in vivo studies have shown that variations in body homeostasis triggered by lack of sleep can cause changes in the skin's extracellular matrix and collagen.[129-131] In humans, topical application of glucocorticoids caused an 80% reduction in the levels of type I and type II collagen. Furthermore, in vitro studies using human fibroblasts treated with glucocorticoids resulted in a 70% reduction of type I and type II collagen.[131] Other studies have shown that sleep plays an important role in regulating the body's immune system. Therefore, decreased sleep can lead to an immunosuppressed state.[132] Sleep has been suggested to be an important factor in the progression and severity of acne. A community-based study conducted in Japan showed that more than 50% of students (n = 859) reported stress and lack of sleep as aggravating factors to their acne.[133] Another study (N = 13,513) compared sleep-wake disorders (ie, obstructive sleep apnea) with the precipitation of inflammatory skin disorders, showing a significant link between them.[134]

CONCLUSION

There is a substantial amount of research supporting the relationship between skin disease outcome and diet, sleep, exercise, stress, smoking, alcohol, and illicit drug use. Well-controlled, robust clinical studies evaluating the relationship between lifestyle factors and dermatology are continuing to evolve; alcohol, diet, stress, smoking, and illicit drug use had the most clinical evidence to date. The lifestyle factors in this review have been substantiated to some degree by scientific research and appear to play a critical role in modulating aspects of skin disease. Going forward, we anticipate more studies on holistic dermatology and the complex interplay between modifiable lifestyle factors and skin disease, with increased attention given to holistic approaches to dermatologic care and a positive shift in the patient-physician relationship to promote wise personal choices and enhanced self-care.

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