

Vaping Culture and Cutaneous Health: A Trend with Skin-Deep Consequences

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Abstract

Originally developed as smoking cessation aids, electronic cigarettes have evolved into widely used lifestyle devices, with usage rates reaching 18.3% among 18-24-year-olds in 2023. While research initially focused on respiratory and systemic effects, growing attention is now being paid to dermatological consequences. Vaping exposes users to a diverse chemical milieu, including nicotine, metals, and toxic and carcinogenic compounds, which can induce oxidative stress, promote inflammation, and impair vascular function in the skin. Acute dermatological effects include allergic or irritant contact dermatitis, burns, and perioral irritation, often precipitated by device malfunctions or contact with e-liquids and vapor. Chronically, vaping may accelerate skin aging, impair wound healing, and exacerbate existing conditions like acne, eczema, and psoriasis, with mechanisms involving collagen degradation, altered pigmentation, and disrupted microcirculation. Case reports further link vaping to unusual presentations such as morphea, urticaria, and surgical complications, sometimes due to toxic contaminants or chronic low-level exposure. While epidemiological data remain limited, some findings raise concerns about potential carcinogenicity. Critically, dermatologists may be the first clinicians to identify vaping-related skin changes, positioning them as key players in early intervention, patient education, and harm reduction. Significant research gaps persist, particularly regarding long-term effects, underscoring the urgent need for large-scale, longitudinal studies. As vaping continues to permeate youth culture, multidisciplinary strategies integrating dermatology, public health policy, and education are essential to address the expanding spectrum of cutaneous and systemic risks associated with e-cigarette use.

1. INTRODUCTION

Over the past decade, vaping has become an increasingly visible part of modern culture. Vaping was initially introduced as a method for smoking cessation; however, it has gained significant popularity among adolescents and adults [1]. A survey conducted in England found a continual increase in long-term vaping among adults from 2013 to 2023, while another survey documented an uptick in adolescent vaping from 2017 to 2019 [2,3]. Together, these findings suggest a global upward trend in

electronic cigarette use among different age groups. In 2023 alone, there was a reported 18.3% incidence of vaping in individuals aged 18-24 [4]. As vaping use continues to rise, the potential long-term health consequences are becoming a growing public health concern.

Beyond systemic effects, vaping may have specific dermatological consequences. Exposure to electronic cigarette (e-cigarette) vapor has been shown to stimulate the release of proinflammatory cytokines such as IL-6, IL-8, and IL-10, which are known mediators in

inflammatory skin processes [5]. This proinflammatory response may contribute to a variety of cutaneous manifestations. For instance, Rutecka et al. reported that vaping contributes to the development of contact dermatitis, morphea, discoid lupus, thermal and chemical injuries, and slow wound healing [6]. Given the rising prevalence of vaping, a corresponding increase in vaping-related dermatologic conditions is likely. While some studies have examined the dermatological effects of vaping, the increasing incidence highlights a need for further research. This review aims to evaluate the current literature on the cutaneous manifestations of vaping and their implications for clinical practice in the field of dermatology.

2. BACKGROUND

Beyond their widespread use, the mechanics and contents of vaping devices warrant closer examination due to their potential health implications. These handheld devices work by vaporizing a liquid, commonly referred to as vape juice or e-liquid, which typically contain nicotine, propylene glycol, vegetable glycerin, and various flavoring agents. The chemical composition of e-liquids is highly variable. Barrington-Trimis et al. identified over 60 chemical compounds in e-liquids and 47 in their corresponding aerosols. These substances include known respiratory irritants and toxicants such as formaldehyde, acetaldehyde, benzene, and heavy metals such as nickel, chromium, and lead [7]. The presence of these compounds, many of which are associated with carcinogenicity or respiratory harm, raises concerns regarding both the short and long-term health effects of e-cigarette use. While e-cigarettes were initially perceived as healthier substitutes for conventional cigarettes, emerging evidence indicates that vaping can produce significant adverse health effects, including on the skin [8]. Rutecka et al.'s systematic review examined the dermatologic consequences of e-cigarette use and identified associations with a range of skin conditions, including contact dermatitis, delayed wound healing, and thermal injuries resulting from device malfunctions [6]. These findings underscore the potential for e-cigarettes to impair skin integrity and recovery, particularly among individuals with preexisting dermatologic conditions or those undergoing procedures that rely on intact skin healing.

3. MECHANISMS OF CUTANEOUS IMPACT

Electronic cigarettes have transformed nicotine consumption by delivering vaporized aerosols

through a range of customizable devices. Vapes operate by using an atomizer, a small heating element, that heats a metal coil powered by a battery, which then aerosolizes the vaping liquid for inhalation. These devices vary widely, ranging from cigarette look-alikes and disposable systems to 'mods,' which allow users to adjust airflow and power to modify vapor production [9]. JUUL is a popular brand known for its sleek, rectangular design and use of interchangeable pods filled with flavored vaping liquid. In 2017, about 8% of American youth aged 15 to 24 reported using JUUL within the past 30 days, a trend likely influenced by targeted social media marketing. Although the FDA banned fruit-flavored JUUL pods in 2022, many users have since switched to other disposable or refillable vaping devices [10,11]. As vaping technology continues to evolve and diversify, understanding its appeal and impact, especially among youth, is essential for informing public health policies and regulatory efforts.

Vaping's impact on the skin extends beyond superficial irritation, involving complex biochemical and vascular mechanisms that can compromise cutaneous health. Vaping initiates oxidative stress leading to the release of reactive oxygen species (ROS), which contribute to endothelial damage, increased plasma viscosity, and systemic inflammatory responses [12]. These pathological changes not only cause direct damage to skin cells but also impair the skin's ability to heal and defend against environmental insults, potentially exacerbating existing dermatologic conditions and increasing susceptibility to new ones. Furthermore, Lyytinen et al. demonstrated that vaping aerosols enhance thrombogenicity by stimulating platelet aggregation and fibrin clot formation, while also causing vasoconstriction that reduces skin blood flow, collectively increasing the risk of clot development [13]. This vascular impairment not only raises concerns for systemic cardiovascular health but also suggests a significant potential for compromised skin healing and increased susceptibility to dermatologic complications.

4. DERMATOLOGICAL MANIFESTATIONS ASSOCIATED WITH VAPING

4.1. Acute Effects

Acute dermatological manifestations associated with vaping are increasingly recognized in clinical practice. Among the most frequently reported are cases of contact dermatitis, which may be allergic or irritant in nature. Allergic contact dermatitis is often linked to exposure to

metals such as nickel in heating coils, certain flavoring agents, and propylene glycol in e-liquids. Irritant contact dermatitis can also develop from direct skin contact with e-liquids or vapor, especially on exposed areas such as the hands, face, and neck [6]. In addition to dermatitis, burns and thermal injuries represent well-documented acute risks, typically resulting from device malfunctions, such as battery explosions, or accidental exposure to hot components or leaking e-liquids. In fact, Seitz et al. reviewed 31 case reports involving 164 patients who experienced burn injuries from e-cigarette explosions, most frequently while devices were stored in pants pockets. The resulting injuries, often localized to the thighs and hands, ranged from superficial to full-thickness burns requiring hospitalization, surgical debridement, or grafting. These thermal injuries can result in long-term dermatologic consequences, including scarring, dyspigmentation, and impaired skin barrier function, underscoring the relevance of patient counseling on safe e-cigarette use [14]. Additionally, perioral and perinasal irritation, characterized by redness, scaling, and discomfort around the mouth and nose, has been observed in individuals who vape, likely due to repeated exposure of these areas to vapor and direct contact with the device. [15] While these acute effects can be alarming, they are often preventable with proper device handling and awareness of potential allergens. Clinicians should maintain a high index of suspicion for vaping-related skin injuries, especially in younger patients or those presenting with unexplained dermatitis or burns. Early recognition and patient education are key to minimizing complications and promoting skin health in the context of rising e-cigarette use.

4.2. Chronic Effects

Vaping has a wide range of effects on the skin. In addition to triggering inflammatory skin conditions, it also induces premature skin aging. Kelesidis et al. reported that a single vaping session can increase oxidative stress in individuals with no prior history of electronic cigarette use [16]. Increased oxidative stress and free radical activity promote the breakdown of collagen and elastin, two structural proteins that are essential for maintaining skin elasticity and firmness. Vaping, like traditional smoking, can also decrease the synthesis of type I and III collagen, abundant in skin, bone, and blood vessels, and increase levels of matrix metalloproteinase (MMP)-8, an enzyme that

degrades type I collagen [17]. This accelerated breakdown of collagen can manifest as discoloration, deep wrinkles, or a sallow complexion. Additionally, vaping also dehydrates the skin which can cause more prominent lines, dryness, and redness. Nicotine has also been shown to alter melanocyte production and skin pigmentation. Taub and Matarasso suggest that low levels of nicotine can stimulate melanin production, leading to hyperpigmentation. In contrast, high nicotine levels can induce cell damage that reduces melanin synthesis, resulting in hypopigmentation [18]. These effects can present as areas of uneven skin tone with both hypopigmented and hyperpigmented patches. Moreover, although the direct relationship between vaping and acne is still being established, the mechanisms by which vaping could aggravate or trigger acne are consistent with acne pathogenesis. Vaping may contribute to acne as it introduces environmental pollutants and chemicals that can interact with the skin barrier, sebaceous glands, and immune responses. According to Dréno et al., tobacco and related exposures, including e-cigarettes, are considered part of the “acne exposome” and may play a role in the occurrence and severity of acne [19]. While more research is needed, these findings provide a strong biological rationale for the observation that vaping may worsen or exacerbate acneiform eruptions in susceptible individuals.

Delayed wound healing is another well-documented effect of nicotine exposure through combustion-free nicotine delivery systems like e-cigarettes. Nicotine disrupts wound healing by impairing keratinocyte migration via activation of nicotinic acetylcholine receptors, hindering the cells' ability to move effectively and cover wound sites. Additionally, nicotine interferes with mitochondrial function by increasing oxidative stress and reducing the energy available for tissue repair [20, 21]. A study by Troiano and Spiegel published in *JAMA Facial Plastic Surgery* found that exposure to both e-cigarette vapor and traditional cigarette smoke resulted in a statistically significant increase in tissue death (flap necrosis) and delayed wound healing in animal models, with no meaningful difference between the two groups. Notably, nicotine levels were carefully controlled to isolate its effects, confirming that nicotine alone, rather than other tobacco byproducts, was the primary contributor to tissue damage [22]. These findings challenge the perception of vaping as a safer alternative to smoking, especially in

surgical and dermatologic contexts where post-procedural healing is critical. Patients who vape remain at elevated risk for complications, highlighting the importance of counseling that switching to e-cigarettes does not eliminate nicotine-related risks to skin repair. Although a definitive timeline for preoperative smoking cessation is not yet established, the World Health Organization (WHO) recommends a nicotine-free period of at least four weeks before surgery to improve health outcomes by approximately 19% [23]. Therefore, comprehensive patient education and strict preoperative nicotine cessation are essential to minimize vaping-related risks and optimize surgical and dermatologic outcomes. Vaping has been increasingly recognized as a factor that can exacerbate chronic skin conditions such as eczema, psoriasis, and rosacea, as well as the development of pigmentary changes. Chemicals and toxins present in e-cigarette vapor, including nicotine, propylene glycol, and various flavorings, can irritate the skin, disrupt the skin barrier, and promote inflammation, making flare-ups more likely in those with pre-existing skin problems [6, 12, 24]. Even among individuals without a prior dermatologic history, vaping may contribute to new-onset or unexplained skin symptoms, particularly when exposure is chronic or involves contaminants not disclosed in product labeling [6]. This has led to growing concern about the underrecognized dermatologic risks of vaping, especially in patients presenting with persistent or atypical skin eruptions. One illustrative example comes from a case report describing a unique presentation of chronic urticaria linked to long-term vaping exposure.

Despite having no prior history of urticaria or known allergies, the patient began experiencing chronic, recurrent hives that were unresponsive to standard therapies. Laboratory investigations revealed elevated levels of cadmium, a toxic heavy metal sometimes found in vaping products. The chronic skin symptoms were attributed to this cadmium exposure, likely introduced through her long-term vaping habit. Notably, her urticaria resolved only after she discontinued vaping and underwent chelation therapy to reduce her cadmium levels [25]. This case highlights the potential for chronic dermatological reactions linked not only to the direct irritant or allergic effects of vaping but also to toxic contaminants present in e-cigarette devices or liquids. It emphasizes the importance for clinicians to consider vaping as a possible etiology in patients presenting with unexplained

or treatment-resistant skin eruption. Individual susceptibility to the chronic dermatologic effects of vaping likely varies, but emerging clinical observations suggest a link between regular vaping and unexplained skin changes or flares of existing conditions. While longitudinal research is still needed, dermatologists should remain vigilant, routinely ask about vaping habits during skin evaluations, and provide early education and cessation support to help reduce potential long-term skin complications.

4.3. Hair and Nail Health

Nicotine from vaping may significantly impact hair health by interfering with the biological processes that support healthy hair growth. Nicotine acts as a vasoconstrictor, narrowing blood vessels and reducing blood flow to the scalp. This diminished circulation limits the delivery of oxygen and nutrients to hair follicles, potentially disrupting the hair growth cycle and contributing to hair thinning or loss [26]. Kavadya et al. reported that nicotine can also induce inflammation of the hair follicle and damage neurotransmitter receptors, further impairing follicle health and increasing the risk of both androgenetic alopecia (pattern hair loss) and premature graying [27]. Moreover, animal studies and clinical reviews have observed that chronic nicotine exposure leads to hair follicle fibrosis and increased cellular apoptosis, both of which are detrimental to hair density and quality [26]. This damage isn't limited to hair; nicotine also affects other keratinized structures such as the nails. Nicotine and tobacco byproducts are well-known for causing yellow staining of the nails, often referred to as the "nicotine sign." This discoloration results from the dynamic process of new nail growth becoming stained by ongoing exposure to nicotine and other chemicals. While there is clear evidence of cosmetic changes, the direct impact of nicotine on nail strength and growth is less well documented [28, 29]. Some sources suggest that reduced blood flow from vasoconstriction could potentially impair nail growth and contribute to brittleness, but robust clinical data are limited [28]. Most existing research has focused on staining and discoloration rather than structural nail changes, highlighting a notable gap in the literature regarding the effects of nicotine on nail brittleness and delayed growth. Maintaining healthy hair and nails often reflects overall vascular and metabolic health, so any factor that impairs microcirculation, such as nicotine-induced vasoconstriction, may have subtle but cumulative effects over time.

5. CASE REPORTS AND SERIES

Multiple case reports have linked e-cigarette use to a range of dermatologic conditions. One such report described a woman who developed oral erythema multiforme after a year of regular vaping. Both traditional and electronic cigarettes contain chemicals that have been implicated as potential triggers for cutaneous and mucosal reactions. As previously discussed, allergens present in e-liquids may be absorbed through the oral mucosa, where they stimulate cytotoxic T lymphocytes and pro-inflammatory cytokines, ultimately resulting in keratinocyte apoptosis [30]. In another case, chemically induced morphea was reported, with silica identified as the likely culprit [31]. This finding aligns with earlier research linking silica exposure to immune dysregulation and fibrotic skin disorders, highlighting how components of vaping aerosols may trigger or exacerbate autoimmune-mediated dermatoses in susceptible individuals.

The Koebner phenomenon has been proposed as a contributing mechanism in vape-associated dermatologic conditions, particularly due to chronic, low-grade heat exposure from e-cigarette devices. In one case, a patient with active discoid lupus erythematosus developed persistent lesions in areas repeatedly exposed to the e-cigarette mouthpiece, with symptoms continuing due to ongoing vape use [32]. Additional evidence of koebnerization comes from a report of Sweet's syndrome, in which lesions developed on both hands after the patient alternated which hand held the vaping device [33]. These cases suggest that repeated thermal or mechanical contact with vape components may act as localized physical triggers, exacerbating or initiating lesions in individuals with underlying inflammatory skin disorders. Beyond inflammatory and autoimmune-related conditions, a variety of other dermatologic and surgical complications have also been linked to e-cigarette use. Additional dermatologic conditions associated with e-cigarette use include palmoplantar pustulosis, lingua villosa nigra, and hyperplastic candidiasis, findings that parallel those observed in traditional cigarette smokers [34]. Emerging evidence also points to potential perioperative complications. One report detailed a case of mastectomy skin flap necrosis and failure of breast reconstruction in a patient who used e-cigarettes, suggesting that the perioperative risks linked to vaping may mirror those of conventional smoking [35]. These findings emphasize that while e-cigarettes are

often marketed as safer alternatives, they may carry similar, if not unique, dermatologic and surgical risks, warranting greater awareness among clinicians and patients alike.

5.1. Vaping and Skin Cancer Risk

The long-term risk of skin cancer associated with vaping remains unclear, and current evidence is limited. While epidemiologic data are still emerging, several plausible biological mechanisms raise concern. For example, e-cigarette vapor has been shown to induce apoptosis in human keratinocytes, suggesting potential for direct cytotoxic effects on the skin [36]. Additionally, similar to traditional tobacco, nicotine from e-cigarette liquids can persist on surfaces and in the oral cavity, creating opportunities for prolonged dermal exposure to residual carcinogens [37]. This raises important concerns regarding chronic low-level exposure to skin-damaging agents in both users and those in close contact with vape aerosols or contaminated surfaces. Notably, four major classes of carcinogens have been identified in e-cigarette vapor: tobacco-specific nitrosamines, heavy metals, volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs) [38]. With vaping increasingly common among younger individuals, prolonged exposure raises concerns about cumulative carcinogenic effects that may contribute to cancers beyond the respiratory system.

Epidemiological evidence on the relationship between vaping and skin cancer remains limited and inconclusive. One study identified a significant association between cigarette smoking and skin cancer but found no similar link with nonmelanoma skin cancer among e-cigarette users; however, this finding was limited by a short follow-up period and the relatively recent adoption of vaping [39]. Given the generally lower carcinogen exposure from vaping compared to traditional smoking, a longer latency period may be required before any potential association with skin cancer becomes apparent. Notably, another study reported lower odds of skin cancer in Caucasians over age 45 who used e-cigarettes, while finding higher odds in Asian American women aged 45–64 [40].

These contrasting subgroup results underscore the complexity of factors such as genetics, environmental exposures, and behavioral differences that may influence risk and highlight the need for careful interpretation without assuming causality. Collectively, these findings emphasize the critical need for long-term, large-

scale prospective studies to better understand the potential carcinogenic impact of e-cigarette use, especially as cumulative exposure grows over time and across diverse populations.

5.2. Public Policy and Future Directions

Despite growing evidence of its systemic effects, the dermatologic risks of vaping remain largely absent from public discourse and policy. While e-cigarette packaging often discloses the presence of nicotine, humectants, and flavoring agents, many harmful compounds, including carcinogens and respiratory irritants, go unlabeled, leaving consumers unaware of their true exposure [41]. Compounding this issue, flavoring chemicals labeled “Generally Recognized as Safe” for ingestion have not been adequately assessed for inhalation toxicity [42].

This regulatory gap underscores the need for more stringent labeling requirements and oversight. Given that many adolescents, who represent a significant portion of e-cigarette users, often delay or avoid routine primary care, dermatologists may be among the first healthcare providers to identify the physical signs of vaping. By recognizing early skin changes and initiating discussions about nicotine use, dermatologists are uniquely positioned to intervene, educate, and guide patients toward harm-reduction strategies. In this way, dermatologists can serve as both clinicians and public health educators, filling a critical gap left by insufficient regulation and public awareness.

While current studies have offered some insight into dermatological effects of vaping, significant research gaps remain. Most existing data come from case reports or small observational studies, highlighting the need for large-scale, longitudinal research to evaluate the long-term effects on skin health. The chronic dermatological consequences of vaping are largely unknown, in part because vaping devices have only been available since the early 2000s, though their popularity continues to grow. New approaches must be explored to educate the younger population on not only the respiratory risks, but also the importance of the dermatological effects that vaping can lead to, given the vulnerability of this age group. Prospective cohort studies could track these effects over time and can provide real-world data on the long-term complications that vaping may lead to. Utilizing skin biopsies in these patients could provide a deeper look into how these devices may affect the histological makeup of our skin barrier over time. These types of studies are crucial to understand what diseases vaping can

cause after years of repeated abuse, and to have data to educate and advise against continued use in patients.

6. CONCLUSION

Vaping has extensive detrimental effects on the physiological processes within the human body, including those that impact skin health. The carcinogenic and hazardous substances found in e-cigarettes have the potential to cause and exacerbate various dermatological conditions. In the short term, vaping has been associated with allergic or irritant contact dermatitis, burns and thermal injuries, as well as perioral and perinasal irritation. Long term consequences may include premature skin aging, dehydration of the skin, acneiform eruptions, delayed wound healing, and worsening of preexisting skin conditions. Although vaping is advertised to be less harmful than traditional smoking, the nicotine found within vape cartridges can contribute to disease processes affecting the skin, hair, and nails. While existing research provides some evidence of vaping’s dermatologic impact, there are still major gaps in understanding the intricacies and long term effects of how vaping contributes to cutaneous pathology. Dermatologists play a critical role not only in recognizing and managing these effects but also in educating patients on the risks associated with vaping, helping patients to make more informed decisions. Researchers and clinicians alike are called upon to prioritize this emerging public health concern within both scientific inquiry and patient care.

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