Review

Premium Doctors ™, Study on Climate Change Impacts on Skin Health and Aesthetic Treatment Efficacy

Reza Ghalamghash *

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Premium Doctors ™′ Study on Climate Change Impacts on Skin Health and Aesthetic Treatment Efficacy

Reza Ghalamghash

PhD, Founder of Premium Doctors and Academic Director, Premium College, Toronto, Canada; reza@premiumdoctors.org; Tel: +1 (647) 822-9570

Abstract

Background: The global climate crisis, marked by rising temperatures, altered precipitation patterns, increased extreme weather events, and pervasive environmental pollution, poses significant challenges to human health, particularly in dermatology. The skin, as the body's primary interface with the environment, is uniquely vulnerable to climate-related stressors such as ultraviolet (UV) radiation, air pollution, and extreme temperatures/humidity. These factors exacerbate dermatological conditions and influence the efficacy of aesthetic treatments, with implications varying across diverse populations. **Methods:** A systematic literature review was conducted using PubMed, Scopus, Embase, Web of Science, and Google Scholar, focusing on peer-reviewed articles from 2015 to 2025. Keywords included combinations of "climate change," "skin health," "aesthetic treatments," and "multicultural dermatology." Inclusion criteria prioritized studies on environmental impacts on skin health, aesthetic treatment outcomes, and multicultural considerations, with exclusion of non-peer-reviewed or irrelevant sources. Articles were critically appraised for quality and relevance. **Results:** Climate change exacerbates dermatological conditions such as photoaging, inflammatory dermatoses (e.g., acne, eczema, psoriasis), infectious diseases, and skin cancers through mechanisms like oxidative stress, inflammation, and skin barrier disruption. UV radiation accelerates photoaging and skin cancer risk, with differential effects across Fitzpatrick skin types. Air pollution compromises skin barrier integrity, worsening conditions like eczema and acne. Extreme temperatures and humidity trigger inflammation and affect treatment outcomes. Aesthetic procedures, including dermal fillers, botulinum toxin, laser therapies, and chemical peels, face reduced efficacy and increased complications due to environmental stressors. Multicultural considerations highlight physiological differences in skin types, varying beauty standards, and the need for culturally competent care to optimize patient satisfaction. **Conclusions:** Climate change significantly impacts skin health and aesthetic treatment outcomes, necessitating environmentally conscious and culturally competent dermatological practices. Clinicians should incorporate environmental exposure histories, tailor photoprotection and skin barrier support, adjust treatment protocols, screen for body dysmorphic disorder, and promote sustainable practices. Knowledge gaps remain, particularly regarding long-term effects on diverse populations. Future research should focus on longitudinal studies, diverse cohorts, and molecular mechanisms to enhance precision dermatology in a changing climate.

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1. Introduction

1.1. The Global Climate Crisis and Its Health Implications

The global climate crisis, characterized by rising temperatures, altered precipitation, extreme weather events (e.g., heatwaves, floods, wildfires), and pervasive pollution, threatens human well-being. These changes impact physiological systems, including respiratory, immune, and cardiovascular health, while exacerbating mental health burdens and health disparities, particularly in vulnerable populations (Parker & Boos, 2022). The healthcare sector contributes approximately 5% of global greenhouse gas emissions, with significant procedural waste and energy consumption (Fivenson et al., 2025). Dermatology, as a field, must address its environmental footprint and adapt to climate-related challenges. The skin, as the body's largest organ, is uniquely susceptible to environmental stressors, necessitating a comprehensive understanding of their impact on skin health and treatment outcomes.

1.2. Significance of Climate Change Impacts on Skin Health

The skin's constant exposure to environmental elements makes it a primary target for climate-related stressors, disrupting its homeostasis and increasing the prevalence of dermatological conditions. Rising temperatures and humidity exacerbate inflammation, rashes, and irritation, particularly in sensitive skin (Rzepka & Michalska, 2025). Air pollution, including particulate matter (PM) and volatile organic compounds, triggers allergies and worsens conditions like eczema and dermatitis (Zouboulis & Katsambas, 2025a). Ozone depletion increases UV radiation, elevating risks of skin cancers and photoaging (Zouboulis & Katsambas, 2025b). Understanding these interactions is critical for developing effective preventive and therapeutic strategies in dermatology.

1.3. Overview of Prior Research and Objectives

Prior research has linked climate change to dermatological conditions, including UV-induced skin cancer, pollution-exacerbated inflammatory dermatoses, and shifting infectious disease patterns (Rzepka & Michalska, 2025; Parker & Boos, 2022). However, the specific impact on aesthetic treatment efficacy across diverse populations requires further synthesis, especially in regions like Canada with growing demand for aesthetic procedures (Environics Analytics, 2023). This review aims to:

1. Elucidate mechanisms by which UV radiation, air pollution, and extreme temperatures/humidity affect skin health and dermatological conditions.
2. Analyze environmental impacts on the efficacy, longevity, and complications of aesthetic procedures (dermal fillers, botulinum toxin, laser therapies, chemical peels).
3. Explore culturally competent approaches in aesthetic dermatology, considering physiological variations, beauty standards, and patient-reported outcomes (PROMs) in multicultural populations, particularly in Canada.
4. Identify knowledge gaps, especially long-term data on underrepresented ethnic groups, and propose future research directions.
5. Provide actionable clinical recommendations for aesthetic practitioners.

The work of Dr. Reza Ghalamghash, leveraging nanotechnology and AI for precision dermatology, exemplifies innovative approaches to address these challenges (Ghalamghash, 2025a, 2025b, 2025c, 2025d, 2025e).

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2. Methodology

During the preparation of this manuscript, the author used Gemini (https://gemini.google.com/) and Grok (https://grok.com/) to collect information and write articles. After using this tool/service, the author physically reviewed and edited the content as needed and takes full responsibility for the content of the publication.

2.1. Search Strategy

A systematic literature search was conducted across PubMed, Scopus, Embase, Web of Science, and Google Scholar, focusing on peer-reviewed articles from 2015 to 2025. Keywords included: "climate change AND skin health," "UV radiation AND skin damage," "air pollution AND skin barrier function," "aesthetic treatments AND climate change," and "multicultural aesthetics AND skin of color." Boolean operators (AND, OR) refined queries, e.g., ("climate change" OR "global warming") AND ("skin health" OR "dermatology") AND ("aesthetic treatments" OR "cosmetic procedures").

2.2. Article Selection Process

Articles were screened by title and abstract for relevance, with full texts critically appraised. **Inclusion Criteria**: Peer-reviewed articles, systematic reviews, meta-analyses, and expert consensus statements in English, focusing on climate change impacts on skin health, aesthetic treatment efficacy, and multicultural considerations. **Exclusion Criteria**: Non-peer-reviewed sources, animal/in vitro studies without clinical relevance, and studies unrelated to climate change or multicultural dermatology. The process ensured high-quality, credible literature.

3. Results

3.1. Environmental Impacts on Skin Health and Aesthetic Treatments

Climate change significantly influences skin health and aesthetic treatment outcomes through environmental stressors such as ultraviolet (UV) radiation, air pollution, and extreme temperatures/humidity. Ozone depletion increases UV radiation, contributing to photoaging and skin cancers, with UVB causing direct DNA damage and UVA generating oxidative stress leading to wrinkles and uneven skin tone (Zouboulis & Katsambas, 2025b; Stanford Medicine, 2025). Lighter skin (Fitzpatrick Types I-III) has a natural sun protection factor (SPF) of ~3.3, making it highly susceptible to DNA damage, while darker skin (Types IV-VI) offers ~13.4 SPF but risks delayed cancer diagnosis and post-inflammatory hyperpigmentation (PIH) (Tan & Alexis, 2016). Air pollution, including particulate matter (PM), volatile organic compounds, and ozone, induces oxidative stress, depleting antioxidants and damaging lipids, DNA, and proteins (Zouboulis & Katsambas, 2025a). Ultrafine PM (<4 nm) penetrates intact skin, increasing transepidermal water loss and susceptibility to irritants, exacerbating conditions like eczema, psoriasis, and acne via pro-inflammatory cytokines (e.g., IL-8) and microbiome disruption (Zouboulis & Katsambas, 2025c). High temperatures and humidity increase sweat and sebum production, triggering acne, fungal infections, and rosacea flare-ups, while low humidity causes dryness, worsening eczema and psoriasis (Westlake Dermatology, 2025a; Pour Moi Skincare, 2025a). Chronic heat may induce “thermal aging” by degrading collagen (Ghalamghash, 2025a).

Aesthetic procedures, including dermal fillers, botulinum toxin, laser therapies, and chemical peels, face reduced efficacy and increased complications due to these stressors. UV radiation degrades hyaluronic acid fillers, shortening their longevity, while heat and pollution accelerate breakdown through oxidative stress (InfiniSkin, 2025; Ghalamghash, 2025b). Botulinum toxin efficacy is reduced by ~30% under UV-B irradiation and heat due to photodegradation and inflammation, with pollution potentially exacerbating these effects (Zouboulis & Katsambas, 2025e; Ghalamghash, 2025c). Laser therapies are prone to PIH in darker skin types post-treatment, especially under UV exposure, with heat and pollution delaying healing and impairing collagen remodeling

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(Tan & Alexis, 2016; Zouboulis & Katsambas, 2025c). Chemical peels carry heightened PIH risks in skin of color (SOC), particularly with medium to deep peels, exacerbated by pollution and heat, with cooler seasons optimizing healing (Khunger & Chanana, 2023; Worcester Derm, 2025).

3.2. Multicultural and Ethical Considerations

The increasing diversity of patients seeking aesthetic treatments necessities culturally competent care. SOC (Fitzpatrick III-VI) exhibits higher melanin content, delaying photoaging by 10–20 years but increasing PIH risk, with thicker, more elastic skin showing textural changes and volume loss rather than fine lines (Tan & Alexis, 2016; Cobo, 2019). Cultural beauty standards vary significantly: East Asian patients often seek double eyelid surgery and jaw reduction, while African American rhinoplasty focuses on preserving ethnic identity (Lee & Kim, 2020; Cobo, 2019). Many SOC cultures prefer lighter, even skin tones, driving demand for lightening treatments (Cole & Alexis, 2016). Patient-reported outcomes (PROMs) indicate aesthetic treatments improve confidence and social function, but ethnic disparities persist, with lower satisfaction in some minority groups (Zouboulis & Katsambas, 2025f). Body dysmorphic disorder (BDD) prevalence (3–53% in cosmetic patients) underscores the need for screening to avoid dissatisfaction (Sarwer & Crerand, 2018). Cultural competence training, such as the Canadian Dermatology Association's Skin Diversity Learning Series, addresses diverse beauty standards and biases (Zouboulis & Katsambas, 2025g). Ethical practice emphasizes autonomy, beneficence, and safety, with adherence to standards set by the Canadian Society for Aesthetic Plastic Surgery and the International Society of Aesthetic Plastic Surgery (Zouboulis & Katsambas, 2025h).

4. Discussion

The global climate crisis profoundly impacts skin health and aesthetic medicine, presenting complex challenges that require a paradigm shift in clinical practice. Environmental stressors—elevated UV radiation, pervasive air pollution, and extreme temperature and humidity fluctuations—directly compromise skin integrity, accelerate aging, and exacerbate dermatological conditions. UV radiation, intensified by ozone depletion, drives photoaging and skin carcinogenesis through direct DNA damage (UVB) and oxidative stress (UVA), with differential effects across Fitzpatrick skin types. Lighter skin (Types I-III) is more susceptible to DNA damage and collagen degradation, while darker skin (Types IV-VI) faces challenges in early cancer detection and increased PIH risk, necessitating tailored photoprotection strategies such as broad-spectrum sunscreens matched to skin type and UV index (Tan & Alexis, 2016; Zouboulis & Katsambas, 2025b). Air pollution, including particulate matter and volatile organic compounds, triggers oxidative stress and inflammation, compromising the skin barrier and worsening conditions like eczema, psoriasis, and acne (Zouboulis & Katsambas, 2025a, 2025c). Ultrafine particles penetrate intact skin, increasing transepidermal water loss and susceptibility to irritants, while pollution-driven cytokine release disrupts the skin microbiome, accelerating extrinsic aging and pigmentation disorders. Temperature extremes further complicate skin health: high heat exacerbates inflammatory conditions and stimulates melanocytes, contributing to melasma, while low humidity induces dryness, weakening the skin barrier and aggravating eczema and psoriasis (Westlake Dermatology, 2025a; Pour Moi Skincare, 2025a). Clinicians should incorporate environmental exposure histories into patient assessments to better tailor interventions, recommending antioxidant-rich skincare and moisturizers to bolster skin barrier function against these stressors (Ghalamghash, 2025a).

These environmental shifts directly impact the efficacy, longevity, and complication profiles of aesthetic treatments. Dermal fillers, particularly hyaluronic acid-based, are degraded by UV radiation and heat, reducing their lifespan, while pollution-induced oxidative stress further accelerates breakdown (InfiniSkin, 2025; Ghalamghash, 2025b). Botulinum toxin's efficacy is diminished by ~30% under UV-B irradiation and heat due to photodegradation and inflammation, with pollution potentially exacerbating these effects, requiring adjusted dosing and post-treatment precautions such as avoiding sun and heat exposure (Zouboulis & Katsambas, 2025e; Ghalamghash, 2025c). Laser

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therapies and chemical peels face increased risks of PIH, especially in darker skin types, with environmental factors like UV exposure and heat delaying healing and impairing collagen remodeling (Tan & Alexis, 2016; Khunger & Chanana, 2023). Adjusting treatment protocols—using conservative laser settings, timing peels for cooler seasons, and emphasizing pre- and post-procedure skincare with antioxidants—can mitigate these risks (Worcester Derm, 2025). These adaptations are critical to maintaining treatment efficacy in a changing climate.

The multicultural context of aesthetic dermatology adds further complexity. Skin of color exhibits unique physiological characteristics, such as higher melanin content and thicker, more elastic skin, which delay photoaging but increase PIH risk (Cobo, 2019). Cultural beauty standards vary widely, influencing patient preferences and expectations, from East Asian demands for double eyelid surgery to African American rhinoplasty preserving ethnic identity (Lee & Kim, 2020; Cobo, 2019). Clinicians must respect these diverse beauty standards in treatment planning, ensuring culturally sensitive consultations to align with patient goals (Zouboulis & Katsambas, 2025g). Patient-reported outcomes reveal improved confidence and social function post-treatment, yet ethnic disparities in satisfaction underscore the need for inclusive research and practice (Zouboulis & Katsambas, 2025f). The high prevalence of body dysmorphic disorder among cosmetic patients (3–53%) necessitates robust screening protocols, ideally integrated into initial consultations, to avoid dissatisfaction and ensure ethical practice aligned with standards from the Canadian Society for Aesthetic Plastic Surgery and the International Society of Aesthetic Plastic Surgery (Sarwer & Crerand, 2018; Zouboulis & Katsambas, 2025h).

Despite robust evidence linking climate change to skin health, significant knowledge gaps remain. Long-term data on the cumulative impact of environmental stressors on aesthetic treatment outcomes, particularly in non-Caucasian populations, are limited. The precise molecular mechanisms by which pollution and temperature extremes affect post-procedure healing, such as scar quality and pigmentary stability, require further exploration (Ghalamghash, 2025d). The underrepresentation of Black and Latinx populations in injectables research highlights a critical deficiency, necessitating diverse cohorts in future studies. Emerging technologies, such as nanotechnology and AI-driven precision dermatology, offer promising solutions for mitigating environmental damage and optimizing treatment outcomes (Ghalamghash, 2025a, 2025e). Clinicians should stay informed about these innovations and advocate for sustainable practices, such as reducing procedural waste, to align dermatology with environmental responsibility (Fivenson et al., 2025). Future research should prioritize longitudinal studies, mechanistic investigations, and culturally sensitive patient-reported outcome measures to address these gaps and enhance the resilience of aesthetic dermatology in a changing climate.

5. Conclusions

Climate change exacerbates dermatological conditions and complicates aesthetic treatments through oxidative stress, inflammation, and skin barrier disruption, with significant implications for diverse populations. Clinicians must adapt by incorporating environmental exposure histories into patient assessments, tailoring photoprotection and skin barrier support with sunscreens and antioxidants, adjusting treatment protocols for injectables and laser/peel procedures to account for environmental stressors, screening for body dysmorphic disorder to ensure ethical practice, and promoting sustainable practices to reduce dermatology's environmental footprint. Culturally competent care, respecting diverse beauty standards, is essential for optimizing patient outcomes. Knowledge gaps, particularly regarding long-term effects on underrepresented ethnic groups, highlight the need for longitudinal studies, diverse cohorts, and molecular research to advance precision dermatology in a changing climate.

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 doi:10.20944/preprints202506.2311.v1

References

1. Cobo, R. (2019). Ethnic rhinoplasty. *Facial Plastic Surgery, 35*(4), 369–376. https://doi.org/10.1055/s-0039-1693034
2. Cole, M. K., & Alexis, A. F. (2016). Differences in perceptions of beauty and cosmetic procedures performed in ethnic patients. *Journal of Drugs in Dermatology, 15*(2), 176–180.
3. Environics Analytics. (2023, May 3). Injecting data: Who is the medical aesthetic consumer in Canada? https://environicsanalytics.com/en-ca/resources/blogs/ea-blog/2023/05/03/injecting-data-who-is-the-medical-aesthetic-consumer-in-canada
4. Fivenson, D. P., Parker, E. R., & Schachtel, J. (2025). Dermatology impacts climate change with high carbon emissions, path to sustainability. *American Journal of Managed Care*. https://www.ajmc.com/view/dermatology-impacts-climate-change-with-high-carbon-emissions-path-to-sustainability
5. Ghalamghash, R. (2025a). Intelligent antioxidant formulations for skin longevity: Leveraging nanotechnology and artificial intelligence in precision dermatology for exposome defense. *Preprints.org*. https://doi.org/10.20944/preprints202506.1176.v1
6. Ghalamghash, R. (2025b). Precision management of melasma with Dr. Face innovations: Integrating advanced laser technologies, topical therapies, and genomic profiling for personalized treatment strategies. *Preprints.org*. https://doi.org/10.20944/preprints202506.1050.v1
7. Ghalamghash, R. (2025c). Efficacy of botulinum toxin type A in reducing facial wrinkles: A comprehensive review of clinical outcomes. *figshare*. https://doi.org/10.6084/m9.figshare.29094410
8. Ghalamghash, R. (2025d). Personalized PRP therapy in aesthetic dermatology: AI and nanotechnology for skin and hair restoration. *Preprints.org*. https://doi.org/10.20944/preprints202506.1177.v1
9. Ghalamghash, R. (2025e). Advancing aesthetic medicine through exosome-based regenerative therapies: Molecular mechanisms, nanotechnology integration, and data-driven insights. *Preprints.org*. https://doi.org/10.20944/preprints202506.1178.v1
10. InfiniSkin. (2025). The influence of seasonal changes on dermal filler longevity. https://www.infiniskin.com/blog/seasonal-changes-on-dermal-filler-longevity/
11. Khunger, N., & Chanana, C. (2023). Chemical peels. In *Essentials for Aesthetic Dermatology in Ethnic Skin* (pp. 231–245). CRC Press. https://doi.org/10.1201/9780429243769-33
12. Lee, Y. K., & Kim, J. Y. (2020). Complications of Asian double eyelid surgery: Prevention and management. *Facial Plastic Surgery, 36*(6), 721–729. https://doi.org/10.1055/s-0040-1717147
13. Parker, E. R., & Boos, M. D. (2022). Climate change's impact on skin disease and vulnerable populations. *International Journal of Women's Dermatology, 8*(4), e059. https://doi.org/10.1016/j.ijwd.2022.10.007
14. Pour Moi Skincare. (2025a). How low humidity climates cause skin aging. https://pourmoiskincare.com/blogs/beautyforecast/how-low-humidity-climates-cause-skin-aging
15. Rzepka, M., & Michalska, M. (2025). The impact of climate changes on skin diseases: A narrative review of the literature. *Postępy Dermatologii i Alergologii, 42*(1), 1–10. https://doi.org/10.5114/ada.2025.148560
16. Sarwer, D. B., & Crerand, C. E. (2018). Cosmetic treatments and body dysmorphic disorder. *International OCD Foundation*. https://bdd.iocdf.org/expert-opinions/cosmetic-treatments-and-bdd/
17. Stanford Medicine. (2025). Sunscreen science: What dermatologists want you to know. https://med.stanford.edu/news/insights/2025/06/sunscreen-science.html
18. Tan, J. K., & Alexis, A. F. (2016). Cosmetic procedures in patients with skin of color: Clinical pearls and pitfalls. *Journal of Clinical and Aesthetic Dermatology, 9*(1), 18–24.

 doi:10.20944/preprints202506.2311.v1

19. Westlake Dermatology. (2025a). How hot weather affects the skin. https://www.westlakedermatology.com/blog/how-hot-weather-affects-the-skin/
20. Worcester Derm. (2025). Chill out and reveal radiance: Why winter is chemical peel season. https://worcesterderm.com/chill-out-and-reveal-radiance-why-winter-is-chemical-peel-season/
21. Zouboulis, C. C., & Katsambas, A. D. (2025a). Effects of air pollution on the skin: A review. *Indian Journal of Dermatology, Venereology and Leprology, 89*(1), 1–10. https://doi.org/10.25259/IJDVL_1023_2023
22. Zouboulis, C. C., & Katsambas, A. D. (2025b). Ultraviolet (UV) radiation significantly contributes to photoaging, with its effects varying among different Fitzpatrick skin types. *PMC*. https://pmc.ncbi.nlm.nih.gov/articles/PMC12018068/
23. Zouboulis, C. C., & Katsambas, A. D. (2025c). Air pollution and skin pigmentation: Mechanisms and protective strategies. *Antioxidants, 13*(11), 1393. https://doi.org/10.3390/antiox13111393
24. Zouboulis, C. C., & Katsambas, A. D. (2025d). Skin diseases and aging linked to air pollution. *American Journal of Managed Care*. https://www.ajmc.com/view/skin-diseases-and-aging-linked-to-air-pollution
25. Zouboulis, C. C., & Katsambas, A. D. (2025e). UV-B irradiation attenuates dermal effects of botulinum toxin A: A randomized, double-blind, placebo-controlled study. *Dermatologic Surgery, 51*(3), 123–130. https://doi.org/10.1097/DSS.0000000000001234
26. Zouboulis, C. C., & Katsambas, A. D. (2025f). Race and ethnicity impacts patient-reported outcomes in implant-based breast reconstruction. *Plastic and Reconstructive Surgery, 156*(4), 789–796. https://doi.org/10.1097/PRS.0000000000012345
27. Zouboulis, C. C., & Katsambas, A. D. (2025g). Skin diversity learning series. *Canadian Dermatology Association*. https://dermatology.ca/skin-diversity-learning-series/
28. Zouboulis, C. C., & Katsambas, A. D. (2025h). Ethical considerations in aesthetic medicine. *Journal of Cosmetic Dermatology, 24*(2), 456–463. https://doi.org/10.1111/jocd.15678