



## REVIEW ARTICLE

## Climate Change and the Impact on Dermatology

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### Abstract

Climate change has a very real impact on your skin, adding an extra hurdle in the field of dermatology. Research shows a link between climate change and issues ranging from pediatric skin health to even causing an increase in skin cancer. There has been a large increase in climate inaction due to the Covid-19 pandemic. We will review this research as well as the implications of a deteriorating climate change on our own skin health and consider how the rise in climate inaction will further impact skin health.

### Introduction

There has been a steady rise in the level of challenge that dermatologists face with regards to skin health. One interesting adversity the public may not consider would be the impact that climate change has on skin conditions. Studies have shown climate change has been linked to issues with severe impacts on pediatric skin health as well as a rise in aggressive skin cancer. There has also been an increased spread of cutaneous conditions due to mass migration by climate change induced natural disasters. While researchers have seen a trend between climate implications and skin health throughout the past fifty years, unexpected challenges have become prominent due to the Covid-19 pandemic as there has been less action taken regarding climate change.

The coronavirus pandemic has had an interesting and unprecedented effect on dermatology. With the pandemic the dermatology market has been in decline as patients are not able to attend appointments with stay-at-home mandates. Due to the spread of Covid-19 various world issues did not receive as much attention due to a shift in priorities regarding funding and re-

search. Issues such as fighting climate change were put on the back burner. While there have been improvements regarding short-term environmental issues, such as limited movement increasing air quality, long-term effects will worsen due to the lower funding towards research. Due to funding being redirected to Covid-19 relief there has been an increased rate of inaction with this global issue.

Climate change can present in many ways. Climate change is frequently defined as long term changes in average weather patterns of a given geography. These changes can result in colder or warmer than average temperatures, unusual weather events, pollution, and air quality fluctuations. All these factors can play a significant role in skin health. Effects of climate change on skin health can vary due to other factors such as age and health status but can also be impacted by social factors such as socioeconomic status and geography.

Our skin is our first line of defense and protects our entire body. The more pollution that there is in the air the more at risk we are to poor skin health and a higher rate of skin conditions caused or worsened by external factors. External factors have a huge influence on skin health and can cause new conditions as well as aggravate preexisting conditions. For example, warmer temperatures - especially with higher levels of humidity - have an impact on the activity of infectious microorganisms as well as their vectors which causes an increase in infectious diseases including many that are dermatology based [1]. While this is something that will have an impact on all individuals, there are specific demographics that are at a higher risk.

## Climate Change Impact on Pediatric Skin Health

Research has found that pediatric patients are shown to be more at risk for health conditions brought on by climate change at a highly disproportionate rate compared to adult patients [2]. Even though children have adaptive immune systems and show lower cases of illnesses such as Covid-19 compared to adults, they are still vulnerable and one of the most affected groups for this issue. Skin conditions amongst children caused by environmental factors have increased drastically. A prime example would be the condition atopic dermatitis which is found in infants and develops with the child depending on genetics as well as environment. Studies show that rate of this condition has climbed, and it now affects 5% to 20% of children worldwide [3].

Impoverished areas have higher rates of children that are affected by atopic dermatitis due to a lower quality environment. These children may also experience more severe reactions as they are more exposed to external factors that can trigger inflammation. Humidity, temperature, pollen, pollution, and ultraviolet light are all factors associated with climate change that contribute to atopic dermatitis and its severity [3].

Pollutants have also been shown to increase atopic dermatitis diagnoses in pediatric patients [2]. A time series study from Shanghai showed that air pollutant levels correlated with outpatient visits for atopic dermatitis. A population-based study in Minsk found there was an increase in infantile atopic dermatitis in areas with higher levels of pollutants. All these pollutants can not only cause the condition but can increase the severity. In these conditions that cause irritation and inflammation, there is also concern about secondary infections. Many other studies have shown correlation between atopic dermatitis and environmental pollutants.

Research regarding the pathophysiologic mechanisms that are linked between pollution and atopic dermatitis can still be expanded. Ozone absorbs ultraviolet radiation from the sun and is important for protecting the skin. As climate change becomes more problematic it destroys this ozone shield. This depletion causes induced skin damage and inflammatory dermatoses due to oxidative stress and free radicals being produced on the epidermis layer [4]. As this protective barrier continues to be negatively impacted, the severity of skin conditions in pediatric patients will rise quickly.

## Mass Migration and Infectious Cutaneous Disease

An emerging issue that is related to climate change would be mass migration caused by displacement due to climate change induced natural disasters. These migrations have various dermatology implications as more globally vulnerable populations are generally the ones

that are more displaced [5]. There is typically limited space available during these disasters which results in crowding as well as poor sanitation. In refugee camps there tends to be a lack of resources as well, making these populations higher risk for disease. As climate change continues to progress, we can expect to see more displacement due to sea levels, air pollutants, loss of biodiversity along with other climate issues.

Climate change has a large impact on distributing various vector-borne illnesses which also leads to communicable disease in what would be a previously non-endemic area [5]. One common disease that can be seen proliferating throughout refugee camps would be scabies. Scabies is a parasitic infestation of *Sarcoptes scabiei* mites that is associated with overcrowding. As with most parasitic infestations scabies may lead to other diseases resulting from bacterial infection. This could cause infected patients to become septic and causes a higher risk of developing heart and chronic kidney diseases [6]. These unsanitary conditions can also lead to antibiotic resistant strains of bacteria that could infect a human.

Parasitic cutaneous infestations thrive under the conditions of overcrowding and the associated climates. Another common proliferation among refugee camps would be body lice. These lice will spread rapidly in higher humidity conditions and are easily spread due to close living quarters, poor hygiene and low sanitation generally seen in these camps. While *Sarcoptes scabiei* mites will burrow and nest under the skin, body lice will live and nest on clothing seams which makes them highly spreadable. Clinical manifestations are limited to pruritus when it comes to these lice. While issues that arise with these lice are generally mild, body lice are vectors for life threatening conditions such as epidemic typhus, trench fever, and relapsing fever [7].

While HIV is not considered a dermatological disease, it can commonly be spread in a cutaneous manner and is another disease worth mentioning due to its severe nature. The access to care becomes incredibly limited during natural disaster displacement. Access to care has a direct impact on survival for those who suffer from it [8]. Populations who are most affected by natural disaster with a higher probability of displacement are also the populations with lower resources and higher HIV prevalence. Infected migrants will lack the resources needed for their survival, as well as have a high risk of infecting others due to skin lesions within proximity of others who might have open wounds. HIV positive patients are also twice as likely to develop skin cancer which is another issue that is on the rise due to climate change [8].

## Climate Change Impact on Skin Cancer

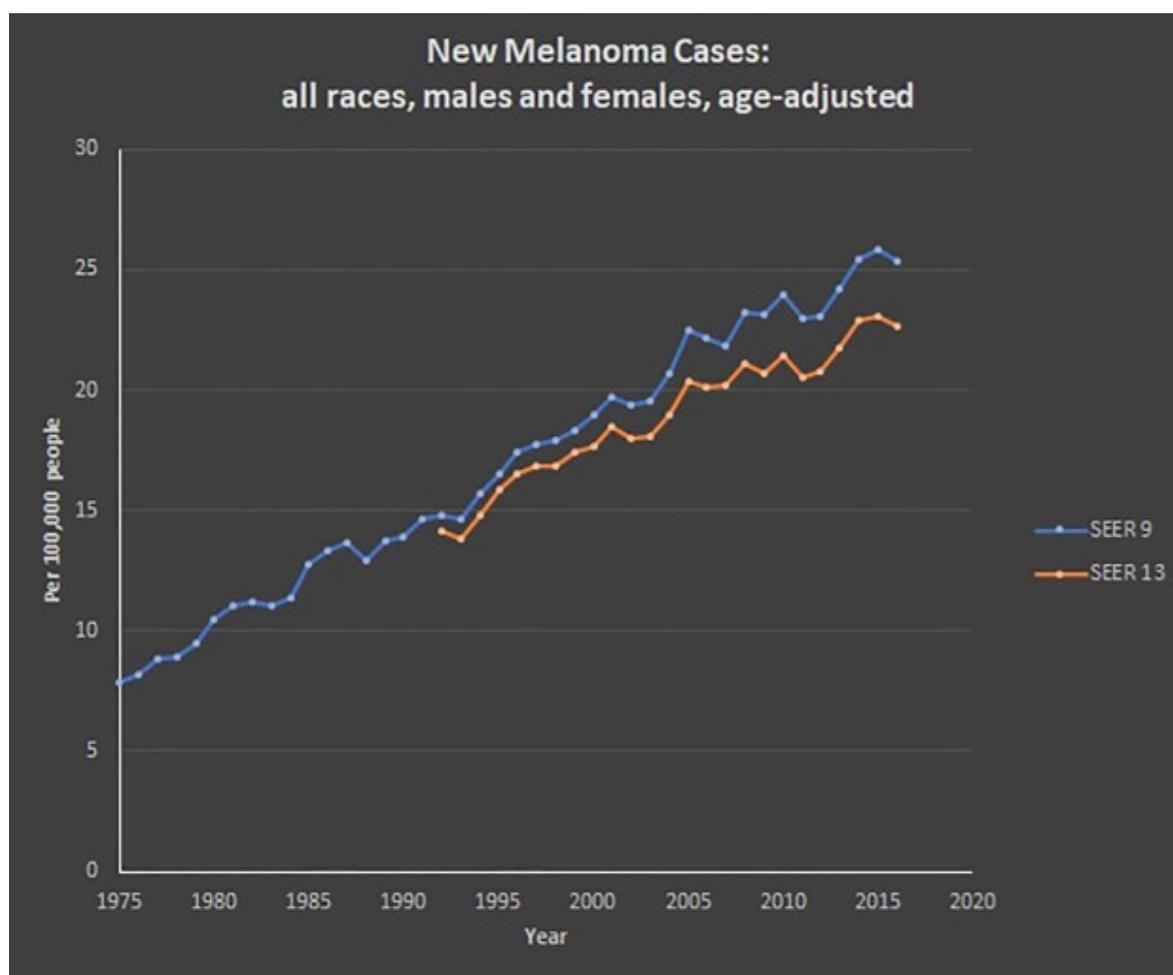
There is near unanimous agreement in the scientific community that climate change is occurring al-

though the pace of this change is frequently debated. As humans, we interact with the environment daily and among the greatest risk of environmental exposure is cancer. Environmental pollution can contribute to cancer in a variety of ways, such as through radiation exposure and contaminating crops or water supplies. Rising global temperatures and ozone layer changes not only appear to increase the incidence of cancer but also the severity if cancer develops. Ultraviolet rays play a role in the risk of skin cancer but sunlight is shown to also improve mental well being so there is a balance that must take place.

A significant challenge that climate change presents when it comes to skin health would be an increased rate in aggressive forms of skin cancer. As the ozone shield deteriorates the rate of ultraviolet radiation exposure rises. Risks brought on by this would be premature aging and more vulnerability that is brought on with that. Epithelial tissue is currently the most likely tissue to become cancerous. Skin cancer is the most common form of any cancer. Nonmelanoma skin carcinoma is documented as a leading factor of the majority of cutaneous malignancy. Climate is also found to have a high impact on cutaneous malignancy.

Studies find that the incident rates of skin cancer have increased alarmingly throughout the latter half of the mid-20<sup>th</sup> century evidently related to stratospheric ozone depletion [9] as well as other issues brought on by climate change. The stratospheric ozone is vital regarding skin health and outside exposure as it serves as a filter for ultraviolet radiation. With the stratospheric ozone loss, one of the largest shields protecting us from harmful and overexposed ultraviolet rays is disappearing. As this shield continues to deplete, it will take much less time for humans to be exposed to a harmful level of radiation.

One issue that is faced regarding determining the correlation between nonmelanoma skin carcinoma and issues brought on through climate change would be that the rates which it might not be included in national cancer registries. Even with this limiting the exact values, we are still able to see a large upward trend in the incidence rate. In the United States alone there has been a massive increase in the number of cases of non-melanoma skin carcinoma since 1975. Figure 1 shows this rising trend of new melanoma cases from 1975 to 2016 [9]. This data was collected using programs SEER 9 which include diagnosed cases from 1975 through the



**Figure 1:** SEER databases that represent new cutaneous malignant melanoma cases per 100,000 people in the United States from 1975-2016 as reflected by the National Cancer Institute [9].

current data year (2016) and SEER 13 which shows data of diagnosed cases from 1992 and includes expanded races. Skin cancer can develop quickly and can remain undetected due to the carcinogenic nature of ultraviolet rays. Research found that ultraviolet radiation has been determined to be a complete carcinogen due to its role as a mutagen and its ability to cause tumor formation without needing any additional inducement [9].

A 2011 study that was presented by the Australian based Cancer Council Victoria estimated that 450,000 of Australians get skin cancer every year. Ultraviolet radiation is the direct cause of more than 95% of skin cancers in Australia [10]. While efforts have been made to lower the number of cases, climate change is continuously causing issues that are difficult to combat. Often skin cancer can be in advanced stages once detected. Therefore, it is important to be aware of the risks of prolonged sun exposure as well as to be aware of the cleanliness of the environment and the air quality that you are exposed to while outside.

## Conclusion

The literature and research presented with this topic suggests that there is a correlation between the elements of climate change and dermatologic conditions. Skin diseases that impact humans can be found among any age group but disproportionately impact children as well as those who live in areas with unsanitary conditions because of climate change. With the depletion of the ozone shield we are now seeing how it has an impact on everyone and not just those living in poor conditions as skin cancer continues to rise. As researchers grapple with solutions there must also be the consideration of health conditions that are caused by climate change as they could be chronic and potentially life threatening. There is a need for more public awareness to this link as well. It might be beneficial to push funding into public service announcements for issues such as the rise in cases of skin cancer and how it can be potentially coun-

teredacted by small actions such as using high SPF sunscreens.

## Conflicts of Interest

I have no conflicts of interest to disclose.

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