The Impact of Global Health Disparities on Atopic Dermatitis in Displaced Populations: Narrowing the Health Equity Gap for Patients with Skin of Color

Sami Jelousi · Divya Sharma · Andrew Alexis · Jenny E. Murase

ABSTRACT

Atopic dermatitis (AD) is a relatively common inflammatory skin disease marked by eczematous lesions and pruritus often leading to significant morbidity and quality of life impairment for those affected. Recent studies have shown that patients with skin of color (SOC) carry a larger disease burden than patients of European descent. In the USA, these disparities are partly due to structural, environmental, and interpersonal racism. From a global perspective, there is a paucity of research on the burden of atopic dermatitis and other inflammatory skin diseases experienced by the record numbers of refugees, migrants, and asylum seekers around the world. Although it is still unclear whether the true prevalence of AD in displaced communities is higher compared with the general population, those who are displaced suffer from unique risk factors that render them especially vulnerable. In this review, we outline a number of factors contributing to AD susceptibility and/or aggravation in displaced communities. These include poor living conditions, climate change events, psychological stress, and lack of access to medical care and health-related behaviors.

Keywords: Atopic dermatitis; Skin of color; Refugees; Displaced populations; Climate change

Sami Jelousi and Divya Sharma are co-first authors.

S. Jelousi
San Francisco School of Medicine, University of California, San Francisco, CA, USA

D. Sharma
Department of Medicine, OhioHealth Riverside Methodist Hospital, Columbus, OH, USA

A. Alexis
Department of Dermatology, Weill Cornell Medicine, New York, NY, USA

J. E. Murase
Department of Dermatology, University of California, San Francisco, CA, USA
e-mail: jemurase@gmail.com

J. E. Murase
Department of Dermatology, Palo Alto Foundation Medical Group, 701 East El Camino Real (31-104), Mountain View, CA 94040, USA

© The Author(s) 2022
Key Summary Points

Atopic dermatitis leads to significant morbidity and quality of life impairment, often affecting certain populations disproportionately.

Displaced populations, most often including patients with skin of color, are particularly vulnerable to the detrimental effects of atopic dermatitis.

Poor living conditions, climate change events, psychological stress, and lack of access to medical care contribute to an increased disease burden of atopic dermatitis in displaced populations.

INTRODUCTION

Atopic dermatitis (AD) is a chronic inflammatory skin disease characterized by relapsing eczematous lesions and pruritus often leading to significant morbidity and quality of life impairment. Recent advancements in our understanding of AD have shown that certain populations carry larger disease burdens than others, particularly patients with skin of color (SOC) [1]. For instance, Black, Latino, and Asian patients are much more likely to visit their physician for AD than white patients in the USA [2]. African American children are 1.7 times more likely to develop AD than European American children after controlling for possible confounders [3]. Additionally, Black children with AD have a six times greater risk of having severe AD than their white counterparts [4]. In the USA, the origin of these disparities is likely multifactorial, often reflecting elements of structural, environmental, and interpersonal racism [5].

From a global perspective, little has been published on the burden of atopic dermatitis and other inflammatory skin diseases experienced by the large number of refugees, migrants, and asylum seekers around the world. Owing to its unique risk factors, this SOC subpopulation is particularly vulnerable and, therefore, requires special consideration by dermatologists as well as the global medical community at large. In this review, we outline the different factors contributing to AD susceptibility or aggravation in displaced populations, particularly refugees, migrants, and asylum seekers. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

TERMINOLOGY OF DISPLACED PERSONS

There are many terms to describe displaced individuals. This includes refugee, migrant, asylum seeker, and internally displaced person (IDP). Although these groups may share common risk factors and social determinants of health, they are not synonymous. The formal definitions of these terms are summarized in Table 1. Data from the year 2021 show that the most refugees come from nations with majority
SOC populations. In fact, more than two-thirds of the 25.7 million refugees and Venezuelans displaced abroad originated from just five countries: Syria (6.8 million refugees), Venezuela (4.4 million displaced abroad), Afghanistan (2.7 million refugees), South Sudan (2.3 million refugees), and Myanmar (1.1 million refugees). Similar trends are seen with asylum seekers [6, 7].

**PREVALENCE OF ATOPIC DERMATITIS IN DISPLACED GROUPS**

Although skin disease is reportedly ubiquitous among displaced populations, studies show that the prevalence of AD varies depending on a number of factors [13, 14].

For example, Saikal et al. investigated the profile of skin disease among refugees living in Al Za’atari refugee camp or presenting to community clinics in Jordan. They reported that “inflammatory conditions of the skin and subcutaneous tissue” was the most common diagnostic category, with “atopic dermatitis and eczemas” being the most common clinical entity, presenting in one-third of all patients assessed [15].

Additionally, Wollina et al. collected data from asylum seekers in a German refugee camp and found “eczematous dermatitis” to be the second leading diagnosis, with scabies being the most common diagnosis among the studied group [16]. Furthermore, Di Meco and colleagues led a cross-sectional study in collaboration with the Italian National Institute for Health Migration and Poverty (INMP). They reported that “dermatitis” was present in 7.5% of the 6188 migrants evaluated, making it the fifth most frequently encountered condition [17]. Finally, a study of 1182 patients from orphanages and refugee camps in rural Sudan found that “dermatitis/eczema” was present in less than 4% of patients [18].

It remains difficult to accurately estimate the prevalence of AD in displaced groups as there is a paucity of studies on the epidemiology of dermatologic disease in displaced communities. Additionally, many of the extant studies including the aforementioned articles often group atopic dermatitis with other eczematous disorders and report their prevalence under umbrella terms such as “eczematous dermatitis,” “dermatitis,” “contact dermatitis and other eczema,” or other categories [16, 17, 19]. The variety of terms are summarized in Table 2. Studies in nondisplaced populations have shown significant variation in AD prevalence across ethnicities; For example, in the USA, studies have found that African American children are 1.7 times more likely to develop AD than European American children, even after adjusting for confounders [20].

In addition to limitations in resources such as time, funding, and workforce, there are a host of methodological obstacles that make it difficult to design studies to estimate AD prevalence in displaced populations. These include differences in the diagnostic criteria used for AD, sample design, and populations covered.

| Study                  | Patient population | AD disease group                          | Prevalence |
|------------------------|--------------------|-------------------------------------------|------------|
| Saikal et al. [15]     | Refugees residing in Al Za’atari camp | *Dermatitis* and *eczema*                  | 33.8%      |
| Wollina et al. [16]    | Asylum seekers in a German refugee camp in Dresden | *Eczematous dermatitis* reported | Not reported |
| Di Meco et al. [17]    | Migrants arriving on the Italian coast | *Dermatitis*                              | 7.5%       |
| Padovese et al. [19]   | Migrants in reception centers in Malta | *Contact dermatitis* and other eczema *   | Not reported |
| Kibar Öztürk [18]      | Refugees and orphans in Nayal, Sudan | *Dermatitis/eczema*                        | 3.7%       |
Refugee camps are typically formed by ethnically diverse groups of individuals. Since AD prevalence can vary by ethnicity and country of origin, the prevalence of AD in a randomly selected sample of refugees may not be representative of the true AD prevalence in the entire population of refugees. The morphology or phenotype of AD in individuals with SOC is another complicating factor. For example, the masking of erythema in SOC may especially contribute to missed diagnoses and subsequently affect the estimated prevalence. Lack of trust in foreign health institutions or mistrust of local health providers can lead to lack of participation in prevalence studies by select refugee groups more than others, further compromising prevalence estimates. Finally, comparing AD prevalence in refugee populations with the general population while controlling for relevant variables remains a challenge as data on AD prevalence in many global regions remain scarce.

Whether the prevalence of AD is higher or lower in displaced communities than the general population remains to be elucidated. Regardless of the true prevalence, there are a host of unique aggravating and complicating factors affecting those with preexisting AD in displaced communities. These factors are often related to poor living conditions, climate change events, psychological stress, and lack of access to medical care.

POOR LIVING CONDITIONS

The substandard living conditions of refugees and migrants have been well documented. Low-quality housing is particularly common in refugee camps and immigrant resettlement communities [21–24]. Studies on these dwellings have identified many aspects that pose health risks. This includes excess dampness/humidity, mold growth, poor ventilation, pest infestation, overcrowding, and nonfunctioning sanitation facilities [21–24]. Refugees or migrants with AD living under these conditions can suffer from exacerbations or complications through various mechanisms. For example, exposure to dust mites—a known aggravator of AD—is common among refugees, as many refugee camps have been shown to suffer from dust mite infestations [25–27]. Similarly, sweating can induce pruritus and exacerbations of AD [25]. Interestingly, studies have shown that showering after episodes of sweating can help relieve symptoms of AD [28, 29]. Refugees and migrants often suffer from suboptimal hygiene due to the nature of their built environment and the lack of access to washing facilities. Sweating in this population might also be increased due to humidity and poor ventilation, further compounding the likelihood of AD exacerbation.

Additionally, overcrowding can foster the spread of skin infections and infestations [30]. This effect is likely augmented due to the increased risk for cutaneous infections from barrier defects and suppression of innate cutaneous immunity in patients with AD [31]. Studies have shown that poverty and overcrowding are independent risk factors for both impetigo and scabies [32–34]. Scabies infestations are prominent in refugee camps and among migrant populations [16, 35, 36]. The intense pruritus associated with scabies often leads to heavy morbidity, and the resultant excoriations predispose to secondary skin infections such as impetigo and cellulitis [32]. Refugees and migrants with AD are therefore rendered especially vulnerable to bacterial skin infections that may exacerbate their disease.

In addition to low-quality housing, the act of migration itself often subjects individuals to harmful exposures. For example, migrants traveling by sea may suffer from skin irritation due to prolonged immersion in seawater and contact with boat material such as kerosene, petrol, vapors, fumes, and dust [37–39]. In some instances, this can lead to severe cases of irritant contact dermatitis, a known trigger of AD [25, 37]. Migrants and refugees who undergo water submersion during flooding events often suffer from inflammatory and infectious skin disease as well [40].

Overall, the adverse living conditions associated with migration and refugee camps confer an increased risk of various diseases, commonly skin infections and infestations, whose
downstream effects frequently lead to aggravation or complication of AD in affected patients.

**CLIMATE CHANGE**

Anthropogenic climate change is poised to have a significant impact on dermatologic disease, in particular AD. Climate change affects AD in numerous ways, both directly and indirectly; a summary of the effects of climate change on AD is presented in Table 3. Per the United Nations High Commissioner for Refugees (UNHCR), displaced people are at the “frontlines of the climate emergency” [41]. Furthermore, the UNHCR concludes that displaced populations are often at the “hotspots” of climate change-induced events and are the least equipped to adapt to the catastrophic effects of climate change [41].

Air pollution, which both contributes to climate change and is worsened by climate change, can significantly affect patients with atopic dermatitis. For instance, air pollutants such as nitrogen oxides, particulate matter, formaldehyde, and sulfuric particles have been shown to worsen symptoms of AD [42–45]. Polycyclic aromatic hydrocarbons (PAHs), pollutants produced from vehicle emissions, forest fires, volcanoes, and industrial processes, can coat particulate matter and penetrate the skin due to their lipophilic nature [46]. PAHs have been linked to provocation of allergic responses and have even been shown to aggravate AD-like skin lesions in mice [46–48]. Additionally, a recent study focused on wildfire-related air pollution found an association between increased particulate matter and healthcare use for AD and itch [49]. When considering displaced people, it is imperative to remember that 60–80% of displaced populations live in urban areas, where air pollution affects those most [50, 51]. In addition to air pollution, higher temperatures due to climate change can lead to an earlier and higher intensity of pollen, potentially exacerbating AD in select patients [52, 53].

Anthropogenic climate change has also been shown to be associated with more frequent and intense extreme weather events, including heat waves, floods, droughts, and wildfires [54]. These environmental catastrophes will not only lead to the displacement of whole communities, creating new groups of refugees and migrants, but also disproportionately affect groups who are already displaced. As displaced people most

| Factor                        | Effect                                           | Study                        |
|-------------------------------|--------------------------------------------------|------------------------------|
| Air pollutants                | Increased prevalence of flexural eczema          | Lee et al. [60]              |
| Nitrogen oxides               |                                                  |                              |
| Carbon monoxide               |                                                  |                              |
| Air pollutants                | Increased visits to an atopic dermatitis clinic  | Fadadu et al. [49]          |
| Smoke plume density           |                                                  |                              |
| Particulate matter (PM$_{2.5}$) |                                                  |                              |
| Air pollutants                | Increased prevalence of eczema                   | Kathuria et al. [45]        |
| Nitrogen dioxide              |                                                  |                              |
| Sulfur oxides                 | Exacerbation of pruritus in pediatric atopic dermatitis patients | Song et al. [43]          |
| Particulate matter (PM$_{<1}$) |                                                  |                              |
| Earlier and more intense pollen seasons | Potential exacerbation of atopic dermatitis in select patients | Fölst-Holst et al. [52] |
| Increased propensity for extreme weather events | Increased disease burden of patients with atopic dermatitis via limited resources, psychological stress, and greater risk of infectious complications | Dayrit et al. [61]         |
|                              |                                                  | Luschkova et al. [53]       |
|                              |                                                  | Cruz et al. [55]            |
often have limited resources and infrastructure, they will be the least prepared to deal with extreme weather events, and their living conditions and well-being will suffer further. Additionally, as the number of displaced people grows, the communities in which they live may become overcrowded, worsening the scarcity of resources in these communities and contributing to poorer health outcomes. Thus, climate change, and extreme weather events in particular, have the potential to create displaced groups of people and in turn significantly worsen health outcomes of already displaced people.

Patients with AD will be affected by extreme weather events in unique ways. For instance, there is considerable psychological stress that results from experiencing an extreme weather event [55]. This stress can contribute to exacerbation of atopic dermatitis, as discussed further in the “Psychological Stress” section. Furthermore, a recent study from Taiwan found evidence suggesting a pathophysiologic link between flooding and AD severity. This study, which controlled for air quality and temperature, found that visits to the emergency department for AD were increased during weeks in which Taiwan Island experienced floods [56]. The increased risk for cutaneous infections in AD mentioned above may be even further exacerbated by extreme weather events [31]. This can occur through greater exposure to microbes in contaminated flood water or destruction of the resources necessary to prevent transmission of infectious disease [57]. For example, fungal infections can thrive in the abundant wet surfaces following floods and tsunamis. A study following the 2004 Indian Ocean tsunami found that the most common skin disorder in the aftermath was tinea corporis [58]. The secondary effects of extreme weather events such as population overcrowding and increased stagnant water, which can serve as breeding grounds for vector-borne diseases, may also further increase the risk of cutaneous infections in migrant populations with AD [59].

PSYCHOLOGICAL STRESS

The process of displacement is typically marked by various traumatic experiences. Persecution in all its forms and exposure to violence, war, and natural disasters are all examples of stressors that a refugee, migrant, or asylum seeker may experience prior to or during displacement. These experiences can have long-lasting effects on psychological well-being [62]. In fact, research shows that displaced persons have a higher prevalence of psychological disorders than the general population [62–64]. Depression, anxiety, and posttraumatic stress disorder (PTSD) in particular are present at high rates, often co-occurring in some individuals in this vulnerable population [62, 65–69]. In addition to premigration trauma, displaced persons frequently encounter postmigration stressors. These stressors may be due to socioeconomic factors such as financial and housing insecurity or interpersonal factors such as family separation and social isolation [70]. For displaced persons with AD, these stressors may exacerbate their condition. Emotional stress has been shown to increase itching and release of inflammatory mediators in patients with AD [71, 72]. Furthermore, repeated scratching behavior due to emotional stress may lead to a vicious cycle of scratching out of habit and in the absence of itching (habitual scratching), causing further skin damage and disease morbidity [25]. Although stress management and behavioral modifications have been shown to improve itching symptom of AD, displaced communities often have limited access to healthcare services, including mental health services, compounding their disease and perpetuating health disparities [73].

ACCESS TO CARE AND HEALTH-RELATED BEHAVIORS

Access to healthcare is a significant issue within displaced populations. Difficulty navigating foreign healthcare systems, limited financial and transportation-related resources, and communication barriers are ways in which displaced people receive decreased quality of care [74, 75].
Dermatologic care may be even more difficult to access for this population. Consider traditional healthcare service models, which most often provide dermatologic care through referral systems. To an ordinary citizen, this may not be an obstacle to healthcare; however, to a displaced person, there are many inequities in this process. Firstly, the use of secondary healthcare services may often rely on co-payments or out-of-pocket payments for migrants, presenting a financial obstacle to a group usually without significant financial resources [76]. Additionally, studies have found that referral services are often not well understood by new migrants [76]. The countries in which displaced people make their home also vary and evolve in their laws regarding healthcare of refugees, migrants, and asylum seekers [77, 78]. Notably, this has become a controversial and heavily politicized issue in many of these countries. For instance, Spain restricted access to healthcare for undocumented migrants in 2012, resulting in poorer health outcomes [79]. These inequities are likely worsened in the case of AD, a chronic, relapsing disease that requires consistent follow-up. Migrants and refugees may often not be able to establish a long-term therapeutic relationship with a provider while on their journey to a new country or area [76]. Furthermore, there may not be any standardized medical record system to document their treatment, limiting the opportunity to make proper therapeutic decisions in the future.

CONCLUSIONS

Skin disease remains a major issue affecting displaced populations such as refugees, migrants, and asylum seekers. Chronic inflammatory conditions, such as AD in particular, carry a heavier toll on patients in this group compared with the general population. This disparity is due to a multitude of factors, including but not limited to poor living conditions, climate change, psychological stress, and limited access to medical care and health-related behaviors. We hope that this unique review underscores the unmet health needs of this vulnerable patient population and encourages interventions from interested parties including clinicians, researchers, policymakers, and other stakeholders to address these health disparities. Finally, there is a need for additional research on skin disease in displaced communities and potential long-term strategies to address their needs in the future.

ACKNOWLEDGEMENTS

Funding. No funding or sponsorship was received for this study or publication of this article.

Author Contributions. Dr. Jelousi, Dr. Sharma, and Dr. Murase contributed equally to the study concept and design. Dr. Sharma, Dr. Jelousi, Dr. Murase, and Dr. Alexis contributed to writing the manuscript. Dr. Murase and Dr. Alexis contributed towards further conceptualization and design.

Disclosures. The author(s) have no proprietary or commercial interest in any materials discussed in this article. Dr. Murase has participated in Advisory Boards for Genzyme/Sanoïf, Eli Lilly, Dermira, LeoPharma, and UCB, participated in disease statement management talks for Regeneron and UCB, and provided dermatologic consulting services for UpToDate. Dr. Alexis has participated in Advisory Boards for AbbVie Inc, Bausch Health, Eli Lilly and Company and Galderma S.A and served as a consultant for AbbVie Inc, Arcutis Biotherapeutics Inc, Bristol-Myers Squibb Company, Dermavant Sciences Inc, Galderma S.A, Janssen Global Services LLC, LEO Pharma Inc, Pfizer Inc, Sanoïf-Genzyme, UCB Pharma Inc. Dr. Sharma and Dr. Jelousi have nothing to disclose.

Compliance with Ethics Guidelines. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.
**Data Availability.** Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

**Open Access.** This article is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, which permits any non-commercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit [http://creativecommons.org/licenses/by-nc/4.0/](http://creativecommons.org/licenses/by-nc/4.0/).

**REFERENCES**

1. Wilson BN, Alexis A, Murase JE. Art of prevention: Atopic dermatitis in women and families of color-prevalence, recognition, and prevention. Int J Womens Dermatol. 2022;8(1):e014. Published 2022 Mar 29. https://doi.org/10.1097/JW9.000000000000014

2. Janumpally SR, Feldman SR, Gupta AK, Fleischer AB Jr. In the United States, blacks and Asian/Pacific Islanders are more likely than whites to seek medical care for atopic dermatitis. Arch Dermatol. 2002;138(5):634–7. https://doi.org/10.1001/archderm.138.5.634 (PMID: 12020225).

3. Shaw TE, Currie GP, Koudelka CW, Simpson EL. Eczema prevalence in the United States: data from the 2003 National Survey of Children's Health. J Invest Dermatol. 2011;131(1):67–73. https://doi.org/10.1038/jid.2010.251.

4. Ben-Gashir MA, Hay RJ. Reliance on erythema scores may mask severe atopic dermatitis in black children compared with their white counterparts. Br J Dermatol. 2002;147:920–9256.

5. Martinez A, de la Rosa R, Mujahid M, Thakur N. Structural racism and its pathways to asthma and atopic dermatitis. J Allergy Clin Immunol. 2021;148(5):1112–20. https://doi.org/10.1016/j.jaci.2021.09.020.

6. UNHCR: Figures at a Glance. [https://www.unhcr.org/en-us/figures-at-a-glance.html](https://www.unhcr.org/en-us/figures-at-a-glance.html). Accessed June 25

7. UNHCR Refugee data finder. [https://www.unhcr.org/refugee-statistics/download/?url=ITKd65](https://www.unhcr.org/refugee-statistics/download/?url=ITKd65). Accessed June 25

8. The UN Refugee Agency USA. Refugee facts, what is a refugee. UNHCR website. [https://www.unrefugees.org/refugee-facts/what-is-a-refugee/](https://www.unrefugees.org/refugee-facts/what-is-a-refugee/). Accessed June 2, 2022.

9. Refugees and Migrants Definitions. [https://refugeesmigrants.un.org/definitions](https://refugeesmigrants.un.org/definitions). Accessed June 2, 2022.

10. UNHCR 'Refugees' and 'Migrants-Frequently Asked Questions (FAQs)'. 2016. [https://www.unhcr.org/en-us/news/latest/2016/3/56e956c676/refugees-migrants-frequently-asked-questions-faqs.html](https://www.unhcr.org/en-us/news/latest/2016/3/56e956c676/refugees-migrants-frequently-asked-questions-faqs.html). Accessed June 2, 2022.

11. UNHCR: Asylum-Seekers. [https://www.unhcr.org/asylum-seekers.html](https://www.unhcr.org/asylum-seekers.html). Accessed June 2, 2022.

12. Internally Displaced People. [https://www.unhcr.org/en-us/internally-displaced-people.html](https://www.unhcr.org/en-us/internally-displaced-people.html). Accessed June 2, 2022.

13. El-Khatib Z, Scales D, Vearey J, et al. Syrian refugees, between rocky crisis in Syria and hard inaccessibility to healthcare services in Lebanon and Jordan. Confl Health. 2013;7:18. [https://doi.org/10.1186/1752-1505-7-18](https://doi.org/10.1186/1752-1505-7-18).

14. Knapp A, Rehmus W, Chang A. Skin diseases in displaced populations: a review of contributing factors, challenges, and approaches to care. Int J Dermatol. 2020;59:1299–311.

15. Saikal SL, Ge L, Mir A, Pace J, Abdulla H, LeongKF, Benelkahla M, Olabi B, Medialdea-Carrera R, Padovese V. Skin disease profile of Syrian refugees in Jordan: a field-mission assessment. J Eur Acad Dermatol Venereol. 2020;34(2):419–25.

16. Wollina U, Gaber B, Mansour R, et al. Dermatological challenges of health care for displaced people: lessons from a German emergency refugee camp. Our Dermatol Online. 2016;7:136–8.

17. Eugenia DM, Anteo DN, Loredana MA, Antonio F, Gianfranco C, Alessandra R, Concetta M, Alessio P, The INMP Team. Infectious and dermatological
diseases among arriving migrants on the Italian coasts. Eur J Pub Health. 2018;28(5):910–916

18. Kibar ÖM. Skin diseases in rural Nyala, Sudan (in a rural hospital, in 12 orphanages, and in two refugee camps). Int J Dermatol. 2019;58(11):1341–9. https://doi.org/10.1111/ijd.14619 (Epub 2019 Sep 9 PMID: 31498882).

19. Valeska P, Ada ME, Tanya MF, Marika PC, Daniele D, Gianfranco C, Concetta M. Migration and determinants of health: clinical epidemiological characteristics of migrants in Malta (2010–11). J Public Health. 2014;36(3): 368–374

20. Kaufman BP, Guttman-Yassky E, Alexis AF. Atopic dermatitis in diverse racial and ethnic groups-variations in epidemiology, genetics, clinical presentation and treatment. Exp Dermatol. 2018;27(4): 340–57. https://doi.org/10.1111/exd.13514 (PMID: 29457272).

21. Richter JC, Jakobsson K, Taj T, et al. High burden of atopy in immigrant families in substandard apartments in Sweden—on the contribution of bad housing to poor health in vulnerable populations. World Allergy Organ J. 2018;11:9.

22. Alnsour J, Meaton J. Housing conditions in Palestinian refugee camps, Jordan. Cities. 2014;36: 65–73.

23. Al-Khatib IA, et al. Impact of housing conditions on the health of the people at al-Ama'ri refugee camp in the West Bank of Palestine. Int J Environ Health Res. 2003;13:4: 315–326.

24. Habib RR, Basma SH, Yeretzian JS. Harboring illnesses: on the association between disease and living conditions in a Palestinian refugee camp in Lebanon. Int J Environ Health Res. 2006;16(2): 99–111.

25. Tamagawa-Mineoka R, Norito K. Atopic dermatitis: identification and management of complicating factors. Int J Mol Sci. 2020;21(8):2671. https://doi.org/10.3390/ijms21082671

26. Mumcuoglu KY, et al. Asthma in Gaza refugee camp children and its relationship with house dust mites. Ann Allergy. 1994;72:163–6.

27. Al Khatib IA, Hasan T. Housing conditions and health in jalazone refugee camp in palestine. EMHJ-Eastern Mediterranean Health J. 2006;12(1–2), 144–152

28. Murota H, Takahashi A, Nishioka M, Matsui S, Terao M, Kitaba S, Katayama I. Showering reduces atopic dermatitis in elementary school students. Eur J Dermatol. 2010;20:4104–11. https://doi.org/10.1684/ejd.2010.0928.

29. Mochizuki H, Muramatsu R, Tadaki H, Mizuno T, Arakawa H, Morikawa A. Effects of skin care with shower therapy on children with atopic dermatitis in elementary schools. Pediatr Dermatol. 2009;26: 223–5. https://doi.org/10.1111/j.1525-1470.2009.00887.

30. Morrone A, Roderick H, Bernard N (eds). Skin Disorders in Migrants. Springer International Publishing. 2020.

31. Wang V, Boguniewicz J, Boguniewicz M, Ong PY. The infectious complications of atopic dermatitis. Ann Allergy Asthma Immunol. 2021;126(1):3–12. https://doi.org/10.1016/j.anai.2020.08.002.

32. Romani L, Steer AC, Whitfeld MJ, et al. Prevalence of scabies and impetigo worldwide: a systematic review. Lancet Infect Dis. 2015;15:960–7. https://doi.org/10.1016/S1473-3099(15)00132-2.

33. Mason DS, Marks M, Sokana O, et al. The prevalence of scabies and impetigo in the Solomon Islands: a population-based survey. PLoS Negl Trop Dis. 2016;10:e0004803. https://doi.org/10.1371/journal.pntd.0004803

34. Ibrahim F, Khan T, Pujalte GG. Bacterial skin infections. Prim Care. 2015;42:485–99. https://doi.org/10.1016/j.pop.2015.08.001.

35. Lapeere H, Naeyaert JM, De Weert J, et al. Incidence of scabies in Belgium. Epidemiol Infect. 2008;136: 395–8.

36. Bottoni U, Dianzani C, Rossi ME, et al. Skin diseases in immigrants seen as outpatients in the Institute of Dermatology of the University of Rome “La Sapienza” from 1989 to 1994. Eur J Epidemiol. 1998;14:201–4.

37. Cheng, HM, Sujith PK. Dermatological problems of asylum seekers arriving on boats: a case report from Australia and a brief review. Aust J Dermatol. 2014;55:4: 270–274.

38. Padovese V, Knapp A. Challenges of managing skin diseases in refugees and migrants. Dermatol Clin. 2021;39(1):101–15.

39. Knapp AP, Rehmus W, Chang AY. Skin diseases in displaced populations: a review of contributing factors, challenges, and approaches to care. Int J Dermatol. 2020;59(11):1299–311.

40. Tempark T, Lueangarun S, Chatproedprai S, et al. Flood-related skin diseases: a literature review. Int J Dermatol. 2013;52:1168–76.

41. UNHCR: Climate change and disaster displacement. Accessed 10 June 2022. Available from:
42. Eberlein-König B, Przybilla B, Kühl P, et al. Influence of airborne nitrogen dioxide or formaldehyde on parameters of skin function and cellular activation in patients with atopic eczema and control subjects. J Allergy Clin Immunol. 1998;101(1 Pt 1): 141–3.

43. Song S, Lee K, Lee YM, et al. Acute health effects of urban fine and ultrafine particles on children with atopic dermatitis. Environ Res. 2011;111:394–9.

44. Kim EH, Kim S, Lee JH, et al. Indoor air pollution aggravates symptoms of atopic dermatitis in children. PLoS One. 2015;10: e0119501.

45. Kathuria P, Silverberg JI. Association of pollution and climate with atopic eczema in US children. Pediatr Allergy Immunol. 2016;27(5):478–85. https://doi.org/10.1111/pai.12543 (Epub 2016 May 13 PMID: 26842875).

46. Yanagisawa R, Koike E, Takano H. Benzo[a]pyrene aggravates atopic dermatitis-like skin lesions in mice. Hum Exp Toxicol. 2021;40(12 suppl): S269–S277. (Epub 2021 Aug 23. PMID: 34424081).

47. Takenaka H, Zhang K, Diaz-Sanchez D, Tsien A, Saxon A. Enhanced human IgE production results from exposure to the aromatic hydrocarbons from diesel exhaust: direct effects on B-cell IgE production. J Allergy Clin Immunol. 1995;95(1 Pt 1): 103–15. https://doi.org/10.1016/s0091-6749(95)70158-3 (PMID: 7529782).

48. Liu H, Xu C, Jiang ZY, Gu A. Association of polycyclic aromatic hydrocarbons and asthma among children 6–19 years: NHANES 2001–2008 and NHANES 2011–2012. Respir Med. 2016;110:20–7. https://doi.org/10.1016/j.rmed.2015.11.003 (Epub 2015 Nov 10 PMID: 26624652).

49. Fadadu RP, Grimes B, Jewell NP, Vargo J, Young AT, Abubara K, Balmes JR, Wei ML. Association of wildfire air pollution and health care use for atopic dermatitis and itch. JAMA Dermatol. 2021;157(6): 658–66. https://doi.org/10.1001/jamadermatol.2021.0179. PMID:33881450;PMCID:PMC8060890.

50. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and health impacts of air pollution: a review. Front Public Health. 2020;8(6):14. https://doi.org/10.3389/fpubh.2020.00014. PMID:32154200;PMCID:PMC7044178.

51. Park H. The Power of Cities. United Nations High Commissioner for Refugees Innovation [Internet]. 2016 Nov 25. Available from: https://www.unhcr.org/innovation/the-power-of-cities/#: ~:text=Displaced%20populations%20are%20also%20part%20of%20employment%20and%20access%20to%20services.

52. Fölster-Holst R, Galecka J, Weißmantel S, et al. Birch pollen influence the severity of atopic eczema—prospective clinical cohort pilot study and ex vivo penetration study. Clin Cosmet Investig Dermatol. 2015;29:539–48.

53. Luschkova D, Zeiser K, Ludwig A, Traidl-Hoffmann C. Atopic eczema is an environmental disease. Allergol Select. 2021;5:244–250. (Published 2021 Aug 23). https://doi.org/10.5414/ALX02258E.

54. IPCC, 2022. Summary for Policymakers [Pörtner H-O, Roberts DC, Poloczanska ES, Mintenbeck K, Tignor M, Alegria A, Craig M, Langsdorf S, Löschke S, Möller V, Okem A (eds)]. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Pörtner H-O, Roberts DC, Tignor M, Poloczanska ES, Mintenbeck K, Alegria A, Craig M, Langsdorf S, Löschke S, Möller V, Okem A, Rama B (eds.)]. Cambridge University Press. In Press.

55. Cruz J, White PCL, Bell A, Coventry PA. Effect of extreme weather events on mental health: a narrative synthesis and meta-analysis for the UK. Int J Environ Res Public Health. 2020;17(22):8581. (Published 2020 Nov 19). https://doi.org/10.3390/ijerph17228581.

56. Chen NT, Chen MJ, Wu CD, Guo YL. Emergency room visits for childhood atopic dermatitis are associated with floods? Sci Total Environ. 2021;773:145435. (Epub 2021 Jan 28. PMID: 33940726). https://doi.org/10.1016/j.scitotenv.2021.145435.

57. Schachtel A, Dyer JA, Boos MD. Climate change and pediatric skin health [published correction appears. Int J Womens Dermatol. 20228;7(5Part B):867]. Int J Womens Dermatol. 2020;7(1):85–90. (Published 2020 Jul 24). https://doi.org/10.1016/j.ijwd.2020.07.006.

58. Lee SH, Choi CP, Eun HC, Kwon OS. Skin problems after a tsunami. J Eur Acad Dermatol Venereol. 2006;20(7):860–3. https://doi.org/10.1111/j.1468-3083.2006.01666.x (PMID: 16898911).

59. Dayrit JF, Bintanjooyo L, Andersen LK, Davis MDP. Impact of climate change on dermatological conditions related to flooding: update from the International Society of Dermatology Climate Change Committee. Int J Dermatol. 2018;57(8):901–10. https://doi.org/10.1111/ijd.13901 (Epub 2018 Jan 29 PMID: 29377078).
60. Lee YL, Su HJ, Sheu HM, Yu HS, Guo YL. Traffic-related air pollution, climate, and prevalence of eczema in Taiwanese school children. J Invest Dermatol. 2008;128(10):2412–20. https://doi.org/10.1038/jid.2008.110.

61. Dayrit JF, Sugiharto A, Coates SJ, Lucero-Prisno DE 3rd, Davis MDD, Andersen LK. Climate change, human migration, and skin disease: Is there a link? Int J Dermatol. 2022;61(2):127–38. https://doi.org/10.1111/ijd.15543.

62. Fazel M, Wheeler J, Danesh J. Prevalence of serious mental disorder in 7000 refugees resettled in western countries: a systematic review. Lancet. 2005;365(9467):1309–14.

63. Porter M, Haslam N. Predisplacement and postdisplacement factors associated with mental health of refugees and internally displaced persons: a meta-analysis. JAMA. 2005;294(5):602–12.

64. Tempany M. What research tells us about the mental health and psychosocial wellbeing of Sudanese refugees: a literature review. Transcult Psychiatry. 2009;46(2):300–15.

65. Silove D, Sinnerbrink I, Field A, Manicavasagar V, Steel Z. Comorbidity of PTSD and depression in asylum-seekers: associations with pre-migration trauma and post-migration stressors. Br J Psychiatry. 1997;170:351–7.

66. Momartin S, Silove D, Manicavasagar V, Steel Z. Anxiety, depression and PTSD in asylum seekers: associations with pre-migration trauma and post-migration stressors. Br J Psychiatry. 2004;80(2–3):231–8. https://doi.org/10.1016/S0165-0327(03)00131-9.

67. Lindert J, Ehrenstein OS, Priebe S, Mielck A, Brähler E. Depression and anxiety in labor migrants and refugees—a systematic review and meta-analysis. Soc Sci Med. 2009;69(2):246–57.

68. Bogic M, Njoku A, Priebe S. Long-term mental health of war-refugees: a systematic literature review. BMC Int Health Hum Rights. 2015;15(15):29. https://doi.org/10.1186/s12914-015-0064-9. PMID:26510473; PMCID:PMC4624599.

69. Steel Z, Chey T, Silove D, Marnane C, Bryant RA, van Ommeren M. Association of torture and other potentially traumatic events with mental health outcomes among populations exposed to mass conflict and displacement: a systematic review and meta-analysis. JAMA. 2009;302(5):337–49.

70. Li SSY, Liddell BJ, Nickerson A. The relationship between post-migration stress and psychological disorders in refugees and asylum seekers. Curr Psychiatry Rep. 2016;18:82.

71. Hashizume H, Horibe T, Ohshima A, Ito T, Yagi H, Takigawa M. Anxiety accelerates T-helper 2-tilted immune responses in patients with atopic dermatitis. Br J Dermatol. 2005;152:1161–4.

72. Hashiro M, Okumura M. The relationship between the psychological and immunological state in patients with atopic dermatitis. J Dermatol Sci. 1998;16:231–5.

73. Katoh N, Ohya Y, Ikeda M, Ebihara T, Katayama I, Saeki H, Shimojo N, Tanaka A, Nakahara T, Nagao M, et al. Clinical practice guidelines for the management of atopic dermatitis 2018. J Dermatol. 2019;46:1053–101. https://doi.org/10.1111/1346-8138.15090.

74. Kang C, Tomkow L, Farrington R. Access to primary health care for asylum seekers and refugees: a qualitative study of service user experiences in the UK. Br J Gen Pract. 2019;69(685):e537–e545. (Epub 2019 Feb 11. PMID:30745354; PMCID:PMC6617541). https://doi.org/10.3399/bjgp19X701309.

75. Iqbal MP, Walpola R, Harris-Roxas B, Li J, Mears S, Hall J, Harrison R. Improving primary health care quality for refugees and asylum seekers: a systematic review of interventional approaches. Health Expect. 2021. (Epub ahead of print. PMID:34651378). https://doi.org/10.1111/hex.13365.

76. Bartovic J, Padovese V, Pahlman K. Addressing the challenges to skin health of refugees and migrants in the WHO European region. Trop Med Int Health. 2021;26(5):602–6. https://doi.org/10.1111/tmi.13552 (Epub 2021 Feb 15 PMID:33471432).

77. Lebano A, Hamed S, Bradby H, Gil-Salmerón A, Durá-Ferrandis E, Garcés-Ferrer J, Azzedine F, Riza E, Karmaki P, Zota D, Linos A. Migrants’ and refugees’ health status and healthcare in Europe: a scoping literature review. BMJ Public Health. 2020;20(1):1039. https://doi.org/10.1136/bmjpubh-2020-000749. PMID:32605605; PMCID:PMC7329528.

78. European Union Agency for Fundamental Rights. Migrants in an irregular situation: access to healthcare in 10 European Union Member States. Vienna: European Union Agency for Fundamental Rights; 2011.

79. Legido-Quigley H, Pajin L, Fanjul G, Urdaneta E, McKee M. Spain shows that a humane response to migrant health is possible in Europe. Lancet Public Health. 2018;3(8):e358. (Epub 2018 Jul 3. PMID:29980489). https://doi.org/10.1016/S2468-2667(18)30133-6.