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Climate change, human migration, and skin disease: is there a link?

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Abstract

Climate change, exemplified by higher average global temperatures resulting in more frequent extreme weather events, has the potential to significantly impact human migration patterns and health. The consequences of environmental catastrophes further destabilize regions with pre-existing states of conflict due to social, political, and/or economic unrest. Migrants may carry diseases from their place of origin to their destinations and once there may be susceptible to diseases in which they had not been previously exposed to. Skin diseases are among the most commonly observed health conditions observed in migrant populations. To improve awareness among dermatologists of the burden of skin diseases among migrants, the group searched the English language scientific literature to identify articles linking climate change, migration, and skin disease. Skin diseases associated with human migration fall into three major categories: (i) communicable diseases, (ii) noncommunicable diseases, and (iii) environmentally mediated diseases. Adopting comprehensive global strategies to improve the health of migrants requires urgent attention.

Introduction

The impact on skin diseases of population displacement and migration due to climate change has not been well recognized until recently. Few articles have been written on the intertwined relationship of these topics.[1] Migration has been a consistent human activity across history and has been characterized by the search for better living conditions or

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to escape unfavorable circumstances in their home regions.[1] Migration has substantially increased due to globalization, ease of international transport and communication, armed conflict, political upheaval, and climate change which is sometimes linked with the other phenomena.[2,3] International Organization for Migration (IOM) estimates that in 2020, a total of around 272 million people will be on the move internationally.[4] This number reflects 3.5% of the global population, and a much larger number of movements were observed within countries.[4]

Global climate change may become apparent by the increased frequency of hurricanes, cyclones, droughts, and floods.[5,6] Subsequently, these climatic disturbances may negatively impact fresh water sources (supplies), increase soil salinization and land degradation, and may ultimately result in reduced crop yields.[5,6] Due to substantial decreases in food availability, famine and social unrest may ensue. Distress migration may be observed as accelerated and atypical migration patterns. Distress migration patterns are reflected by an increase in climate change migrants.[5]

These increasing number of migrants pose new challenges to the healthcare systems in destination countries. Dermatologists in these countries, in particular, have been confronted with a rising number of patients with rare and/or unusual infectious skin diseases not previously observed in their settings. These diseases that are presenting outside their traditional boundaries may be easily overlooked, resulting in a delayed diagnosis or a misdiagnosis.[9] These diagnostic delays may increase negative patient outcomes and may enhance dissemination of these diseases in the local population.[9]

This paper provides an update of the existing literature on skin diseases among migrant populations as an effect of climate change.

The group developed a conceptual framework (Fig. 1) to provide an overview of the variables and outcomes considered in this review.

Methods

Peer-reviewed English language literature using the electronic searchable databases PubMed, ScienceDirect, and Google Scholar was searched. The group included the following search terms: climate change AND immigration OR refugee AND skin disease OR dengue, OR varicella zoster virus OR leprosy OR cutaneous tuberculosis OR methicillin-resistant *Staphylococcus aureus* OR dermatophytoses OR mycetoma OR cutaneous leishmaniasis OR scabies OR pediculosis OR myiasis OR sexually transmitted infections OR atopic dermatitis OR Behçet's disease OR Patera foot syndrome. By reading reference titles and abstracts, the group focused on systematic reviews, epidemiological studies, and case reports that described the demography and epidemiology of skin diseases due to climate change-related migration and refugee status. Abstracts were reviewed by at least two authors. Full papers of the chosen articles were collected.

Results

A summary of human migration-related communicable skin diseases is presented in Table 1.

Discussion

Previous publications demonstrate that climate change characterized by variations in regional and global climate patterns over an extended period of time directly and indirectly impact migration patterns and the health of populations.[5] Climate changes such as more intense storms, cyclones, drought, sea level rise, and flood result in increased soil salinization and land degradation. The unfavorable agricultural circumstances result in diminished harvest yields and a scarcity of local food resources. Decreased food supplies coupled with high birth rates may drive further deterioration of the population's health status. Food scarcity may thus initiate population migration.[5,7,8]

Soil degradation, food scarcity, poor health conditions, high birth rates, overcrowding, and armed conflict in the region may fuel population migration. Forced migration causes a lot of stress which may also result in an increase of skin diseases. The increase in human diseases as an effect of climate change is also due to the creation of newly favorable habitats for infectious agents, their vectors, and their reservoirs.[9,10] Global warming may also be the cause of extreme weather events such as heat waves, hurricanes, and flooding which may result in infectious disease outbreaks including insect-borne diseases, airborne diseases, zoonoses, newly endemic saprophytic and dimorphic fungal infections, fecal–oral diseases, and severe allergic disease.[9,11] Migrants can also be carriers and/or vectors of the diseases of their place of origin bringing them to their destinations and affecting the native populations.[12] For example, in an epidemiologic study among migrants in Malta, skin diseases such as eczemas, pruritus, scabies, and fungal diseases were frequently diagnosed.[13] Climate-related migration also exposes migrants to endemic infectious diseases to which they have had no previous exposure and subsequently no (immunological) resistance.[6] These transmissions occur within the context of vulnerable environments, health behaviors in settlement sites, and bad access to healthcare services.[6] In the next section, we will look at specific prevalent skin diseases among these migrants pushed by climate change.

Communicable Diseases

Emerging viral infections

Dengue—Dengue, a prevalent mosquito-borne disease, infects 390 million people each year in the tropics and subtropics. Cutaneous manifestations of dengue may include a diffuse morbilliform rash, which may be pruritic and heal with desquamation.[15] Cases of dengue have been reported in a refugee camp near Hargeysa, Somalia, in 1985, 1986, and 1987.[16] Between August 2015 and February 2016, a dengue outbreak occurred in 29 refugee camp health clinics located in four of the five Darfur states in Western Sudan.[17] While a dengue epidemic in eastern Sudan had occurred in the early 1900s, only a few cases of dengue had been reported in the Darfur states prior to 2014.[17] When Darfur has suffered civil war and massive human migration, there has been an influx of economic immigrants from eastern Sudan.[17] The poor living conditions of immigrants predisposed them to dengue as well as other arboviral infections.[17] Treatment for dengue is nonspecific and supportive.[15] A quadrivalent vaccine is currently being used in Brazil, Mexico, and the Philippines.[15,18] A systematic review of the economic evaluation of dengue vaccination in Southeast Asia concluded that vaccination is a cost-effective public health intervention.[19] In

endemic regions, vector control is still considered to be the most important public health control measure.[20]

Varicella zoster virus (VZV)—Varicella zoster virus (VZV) is a highly contagious virus. Clinical manifestations of infection typically include crops of vesicles in a dermatomal distribution. These signs of infection are usually preceded by fever, fatigue, malaise, anorexia, and headaches.[21] The seroprevalence of VZV differs greatly between temperate and tropical regions. In temperate regions, the seroprevalence is higher (>90%) among persons older than 12 years, but in tropical regions, it can be as low as 30% in adults.[22] In rural Africa, people are seldom immunized against this disease. More specifically, low VZV immunization rates have been found in refugees from Somalia, Eritrea, and Sudan.[23] Persons migrating from low- to high-seroprevalence countries are therefore at risk of acquiring VZV.[22] A recent study noted a higher number of VZV cases among migrants coming to Italy via the "central Mediterranean route," particularly from Ghana, Nigeria, Somalia, and Eritrea.[24] VZV can cause significant morbidity and mortality when it infects susceptible adult populations. Vaccination should be considered for migrants, mainly those who come from low seroprevalence countries.[22,23] The seroprevalence observed in adult asylum seekers from tropical regions is as low as 30%.[22] It has been reported that widespread vaccination of all individuals reporting a negative history of chickenpox is more effective at preventing outbreaks than the rapid response vaccination.[22]

Emerging bacterial infections

Leprosy, or (Hansen's disease)—Leprosy, or (Hansen's disease), is an infection caused by the bacterium *Mycobacterium leprae*. It affects the skin and peripheral nerves and may lead to pronounced functional limitations.[25] It may present with a wide spectrum of cutaneous manifestations including macules, papules, anesthetic patches and plaques, and sometimes palpable peripheral nerves[26] (Fig. 2a, b). The clinical signs may mimic common skin diseases, and the diagnosis can be easily missed if leprosy is not considered in the differential diagnosis.[26] Leprosy occurs primarily in Low- and Middle-Income Countries (LMICs): 71% in the World Health Organization (WHO) Region of South-East Asia, 15.5% in the Americas, 8.8% in Africa, 3.3% in the Western Pacific, and 1.2% in the Eastern Mediterranean.[25] In Spain, 168 cases of leprosy were reported from 2003 to 2013. Of these, 40 (24.6%) were in Spanish patients, while 128 (76.2%) were diagnosed in legal resident immigrants, mainly from Latin America.[25] Furthermore, between 2004 and 2013, 38 cases of leprosy were reported in New Zealand, mainly among immigrants from countries with endemic leprosy; the majority were from the Pacific Islands, with a minority coming from Asia.[26] Diagnosis is determined by skin biopsy and Polymerase Chain Reaction (PCR) detection of *M. leprae* DNA in tissue. Treatment consists of multidrug therapy, which may take months to years to achieve clinical cure.[26] Patients are considered to be noninfectious within 72 hours of starting treatment.[27]

Cutaneous tuberculosis—Cutaneous tuberculosis (TB) occurs in both LMICs and high-income countries (HICs) and is associated with lower socioeconomic status as well as crowded living conditions.[28] It has several clinical manifestations including verrucous papules or plaques of tuberculosis verrucosa cutis, cervical scrofuloderma, plaque, and

ulcerative lupus vulgaris affecting the face, tender nodules on the legs (erythema induratum of Bazin), necrotic papules (papulonecrotic tuberculid), pruritic follicular papules (lichen scrofulosorum), and acute miliary TB.[29] In many HICs, the number of reported cases of tuberculosis has increased recently, particularly among immigrants.[30–32] Immigrants from LMICs may arrive infected with *Mycobacterium tuberculosis*, and the clinical manifestations may present a diagnostic challenge to clinicians in the host countries (Fig. 3a–d).[28,33] Tuberculosis burden in migrant populations may be due to reactivation of remotely acquired latent tuberculosis infection, presence of active TB on arrival, or acquisition of TB, following arrival, through local transmission.[30] In Europe, multidrug-resistant tuberculosis (MDR-TB) in countries with low baseline incidence is more prevalent among migrants than the native population, with 73.4% of MDR-TB occurring in migrants born outside the reporting country.[34] A significant proportion of MDR-TB cases in migrants is due to reactivation of latent infection.[34] Refugees and asylum seekers may have a heightened risk of MDR-TB infection and poorer outcomes.[34] Migrants are particularly vulnerable to MDR-TB due to overcrowded living conditions, delayed diagnosis caused by financial constraints, poor health literacy and healthcare seeking behaviors, poor treatment adherence, and high default rates.[34]

Cutaneous tuberculosis usually represents as a paucibacillary disease, from exogenous reinfection in previously sensitized individuals.[35] The diagnosis is typically made presumptively based on the correlation of various criteria including the presence of active tuberculosis elsewhere, histopathologic findings, clinical history and physical signs, a positive purified protein derivative (PPD) skin test reaction, and a therapeutic response to anti-TB treatment.[35] The optimal means of diagnosis for cutaneous tuberculosis is via demonstration of acid-fast bacilli in skin lesions and bacterial culture. However, cultures provide a low diagnostic yield in cutaneous tuberculosis.[35]

Community-acquired methicillin-resistant Staphylococcus aureus— Community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) infection presents with skin and soft tissue infections (SSTIs), such as abscesses.[36] CA-MRSA may be associated with mass human migration due to its relationship to poor hygiene and/or crowded living conditions.[37] As an example, 15 cases of CA-MRSA infections were reported among immigrants from South America to Barcelona, Spain.[37] A Norwegian study compared the time trend to acquire MRSA infection among people with an immigrant versus Norwegian background and concluded that immigration and importation, especially among persons aged <40 years, represented important risk factors for acquiring MRSA infections.[38] Further, among 898 asylum seekers in the Netherlands, 10% were MRSA positive.[39] Moreover, immigrants to the United States are more likely to present with methicillin-susceptible *S. aureus* (MSSA) SSTIs than US-born individuals.[36]

MRSA infection should be managed with judicious empirical antibiotics.[40] Empiric treatment for CA-MRSA for 5–10 days is recommended in patients who do not respond to beta-lactam antibiotics or to those with systemic toxicity.[41] Oral antibiotic options for treating SSTIs in patients with CA-MRSA include clindamycin, trimethoprim/sulfamethoxazole (TMP/SMX), a tetracycline (doxycycline or minocycline, and linezolid).[41] Options for treating both β-hemolytic streptococci and community-associated MRSA

include clindamycin alone, TMP/SMX or a tetracycline in combination with a beta-lactam antibiotic (cephalexin), or linezolid alone.[41] Decolonization to decrease microbial carriage may be considered for patients with recurrent infections.[40] Most decolonization regimens include some combination of nasal mupirocin, antiseptic baths (including chlorhexi-dine or diluted bleach baths), or oral rifampin.[40] Improving potable water supply as well as decreasing household crowding can reduce the transmission and impact of this disease.[40]

Emerging fungal infections

Dermatophytoses—Dermatophytoses are fungal infections of the skin, hair, and nails, caused by the species *Trichophyton*, *Microsporum*, and *Epidermophyton*.[42] The clinical manifestations vary from annular plaques with raised, scaly borders to arcuate and polycyclic plaques with pustules.[42] The distribution of dermatophytes varies by geographic location and is influenced by climate, migration, and socioeconomic conditions.[42,43] In Greece, Sweden, Spain, and Switzerland, the incidence of tinea capitis due to *Trichophyton violaceum* (*T. violaceum*) has increased over the last few decades, a phenomenon that may have been driven by immigration.[43] Imported *T. violaceum* and *T. soudanense*, which are common causes of tinea capitis in parts of Africa and West Asia, were already reported among 24 African immigrants and native-born Americans living in Maryland, USA, between the years 2000 and 2006.[42]

Tinea capitis has been seen to be higher in pediatric refugee populations in Tel Aviv, Israel.[44] In a 2011–2014 study, children of African origin had the highest tinea capitis incidence relative to other ethnic groups.[44] Among pediatric migrants in Melbourne, Australia, dermatophytes were isolated in 21% (32/153) of children, with a higher incidence among those from Africa and the Middle East.[45] In a refugee health clinic in Western Australia, 297 (28.8%) of 1,026 refugee children of over 30 different ethnicities had tinea capitis and corporis.[46] In Belgium, 122 cases of tinea capitis were found among immigrants from North Africa.[47] Among Liberian adopted children in Ohio, two cases of *T. soudanense* have been reported.[48] Larger number of tinea capitis cases among African refugees has been reported in Western Australia, Belgium, and Ohio.[46–48]

Topical antifungal therapy has little place in the management of tinea capitis except as an adjunct to oral therapies such as terbinafine, itraconazole, griseofulvin, and fluconazole.[49] To prevent tinea capitis transmission, one should prevent opportunities for transfer from another person or animal.[49] Migrants should avoid sharing caps, hair brushes, and combs particularly within the poor living conditions of camps and shelters.[49] Pillows and bed linens should be washed thoroughly and regularly.[49] Hair equipment should be cleaned, disinfected, or replaced altogether.[49] Ketoconazole shampoo, selenium sulfide applied two to three times weekly, or oral antifungals may be helpful to prevent the disease from spreading.[49]

Emerging protozoan infections

Cutaneous leishmaniasis—Cutaneous leishmaniasis (CL) is an infection caused by various species of *Leishmania*, an obligate intramacrophage parasite transmitted by female phlebotomine sandflies (Fig. 4a,b). It is characterized by a spectrum of cutaneous,

mucocutaneous, and visceral clinical manifestations.[50] CL can manifest with localized cutaneous ulcers, diffuse painless dermal nodules, oropharyngeal ulcers, or all of these.[51] Various factors in CL outbreaks, including collapsed health care infrastructure and population displacement, play an important role in CL outbreaks.[52] In Turkey, which has received more Syrian war refugees than any other country, increased prevalence of CL has been reported in correlation with the influx of Syrian refugees.[53] This is, in part, related to the impact of crowded populations on the CL vector and animal reservoir populations and in part due to patients arriving from areas of higher endemicity.[53] CL has also emerged among refugee populations in Lebanon, Libya, and Yemen.[52,54] In 2012, there was a reported outbreak of 948 cases of CL among Syrian refugees in Lebanon.[54]

Diagnosis of leishmaniasis can be made by obtaining a Giemsa stain from a slit skin smear of a cutaneous lesion, histopathology, culture methods, and PCR.[50,55,56] Cutaneous lesions of Old World leishmaniasis and, less commonly, New World leishmaniasis can spontaneously heal over months to years. Prompt treatment is necessary for patients with ≥3 lesions, lesions >2.5 cm, lesions on specific locations (the face, hands, feet, or over joints), and lesions in immunocompromised patients.[55] Pentavalent antimonials (sodium stibogluconate and meglumine antimoniate) are the mainstay of therapy. Alternatives to pentavalent antimonials include liposomal amphotericin and miltefosine; azole agents, such fluconazole, have also been reported to be efficacious.[55]

Continued improvement of living conditions and hygiene infrastructure for refugees, clean water and food, and sanitation services all aid in the prevention and control of CL among endemic refugee populations.[52] Insecticides may be effective at reducing the incidence of CL. Treatment of clothing and bed sheets or use of nets remains preventive.[52]

Emerging ectoparasitic infections

Scabies and pediculosis—Scabies and pediculosis are directly transmitted from human to human, often in the setting of poor hygiene and overcrowded living conditions. Infestation with the scabies mite results in an intensely itchy skin eruption consisting of papules, nodules, and/or vesicles, typically distributed between the fingers, wrists, axillae, groins, buttocks, genitals, and/or breasts.[57] Pediculosis, or lice infestation, manifests with pruritus, excoriations, and/or impetiginization.[58] Scabies and pediculosis are among the most common skin diseases in migrants who travel to Italy via the “central Mediterranean route,” with the highest incidence of scabies being among migrants from Somalia and Eritrea.[24]

Individual migrants with uncomplicated scabies can be effectively treated with topical permethrin or oral ivermectin, in addition to washing clothing and drying it at high heat.[59,60] Mass drug administration with one dose oral ivermectin (0.2 mg/kg) has been demonstrated to be efficacious for controlling scabies, especially during disease outbreaks.[59,60] Pyrethroids, lindane, malathion, benzyl alcohol, and spinosad are available treatment modalities for head lice. Furthermore, addressing potential fomite exposure, disinfecting the environment, as well as doing prophylaxis treatment to the close contacts may help to control the disease.[61] Pediculicide choices of body lice are the same as for head lice.[61] The key to controlling body lice infestation is to address poor hygiene by washing

clothing and drying it at high heat and addressing the social circumstances underlying infestation.[61]

Myiasis—Myiasis is an infestation of live human and vertebrate animals by larvae of a variety of fly species of the order Diptera.[55,62] An increased incidence of myiasis has been noted in nonendemic countries due to travelers returning from tropical countries in Latin America.[55,63] Some cases have also been attributed to increased immigration from endemic regions.[55,64]

Cutaneous myiasis presents in three forms: furuncular, migratory, and wound, depending on the infesting larvae.[62] Dermoscopy may also aid in the diagnosis of *Dermatobia hominis* papular lesions which would reveal a yellowish caudad end of the larva emerging through the central pore of the lesion.[62] Treatment options include oral ivermectin, surgical removal or debridement under local anesthesia, and/or occlusion of the central punctum for several hours to block the larvae respiratory spiracles.[55,62]

Sexually transmitted infections

The WHO estimates that more than 340 million new cases of curable bacterial and protozoal sexually transmitted infections (STIs) occur annually worldwide.[65] The highest number occur in Sub-Saharan Africa, South Asia, and Southeast Asia, followed by Latin America and the Caribbean.[65] Migrants, especially refugees, are at increased risk for STIs because of many factors associated with civil disruption and displacement, including poor socioeconomic status, sexual exploitation, and lack of access to preventive and educational efforts.[65] In Minnesota, a total 18,516 (72%) of 25,779 newly arriving refugees from the Middle East, Eastern Europe, Southeastern Asia, or sub-Saharan Africa were tested for at least one STI from January 2003 to December 2010.[65] The prevalence of chlamydia and gonorrhea was 0.6% and 0.2%, respectively.[65] The prevalence of syphilis was 1.1%, and human immunodeficiency virus (HIV) was 2.0%.[65] These prevalence data are relatively high compared with the prevalence in the general population in Minnesota, where the prevalence in 2010 was 311 cases per 100,000 population for chlamydia,[66] 43 cases per 100,000 population for gonorrhea,[66] 3 cases per 100,000 population for syphilis,[66] and 176 cases per 100,000 population in 2016 for HIV.[67] In another study in the United States (2009–2013) among 233,446 refugees, 874 syphilis cases (373 cases per 100,000 refugees) were identified,[68] while in the normal population in the United States in 2017 yielded only of 9.5 cases per 100,000 population.[69] The highest overall prevalence rates of syphilis seropositivity were observed among refugees from Africa (1,340 cases per 100,000) followed by East Asia and the Pacific Islands (397 per 100,000).[68]

In the European Union, a study reported 156,817 HIV cases from 2007–2012, of which 60,446 (38%) were among migrants.[70] Of these, 53% were from Sub-Saharan Africa and 12% from Latin America.[70] Studies on HIV prevalence in Europe revealed variable results. One study of migrants presenting at the Greek-Turkish border found only two cases of HIV (0.2% of the total, one each from Morocco and Iraq);[71] a study found an HIV prevalence of 1.5% in African refugees in Italy.[72] Another study reported 2% HIV prevalence among

1,187 immigrants in a center in Lisbon.[73] Finally, a study found an HIV prevalence of 4% in all asylum seekers in the United Kingdom.[74]

More than 95% of HIV patients have cutaneous manifestations, and dermatologists may be the first physicians these patients encounter.[75] HIV transmission in Europe has declined during the past decade, and migrants constitute 35% of new HIV cases in Europe. Nonetheless, there is evidence that many migrants acquire HIV after their arrival.[76] Dermatologists should be aware of the various skin manifestations of HIV disease and recognize the need to identify and treat other STIs when HIV is discovered.[75]

Noncommunicable diseases

Migrants may be predisposed to develop certain noncommunicable diseases (NCDs) and may suffer more from its consequences because these conditions often require continuous care over a prolonged period of time. Atopic dermatitis, Bechet's disease, environmental allergies, and asthma are among the NCDs that have been linked to migration.[77–79]

Migrants may bring with them their past medical problems, including pre-existing skin conditions such as psoriasis or acne, which may be aggravated by the psychological and physiological stress of or lack of medication during the travel period.[80] Stress can precipitate new skin conditions such as telogen effluvium. Pre-existing psychiatric conditions—including depression, anxiety, psychosis, and personality disorders—may be exacerbated by migration and can give rise to a variety of skin conditions, such as neurotic excoriations and trichotillomania.[80]

Environmentally mediated conditions

Environmental factors play an important part in the pathogenesis of skin conditions. Traveling on foot or by boat or on foot along with prolonged sun exposure can cause any of the following: skin erythema, edema, vesicles, and skin peeling.[81] These factors may also exacerbate pigmentary disorders such as melasma and post-inflammatory hyperpigmentation.[81] Other environmental factors essential in history taking are the following: (i) history of immersion in water, (ii) mode of transport, (iii) skin exposure to the immediate environment such as the material of the boat, and (iv) other associated substances such as kerosene, petrol, diesel, vapor, fumes, or dust.[81] Common pathogens implicated include *Streptococcus pyogenes* and *Staphylococcus aureus*. Other pathogens associated with prolonged contaminated water immersion include *Aeromonas* spp, *Pseudomonas* spp, *Vibrio* spp, *Burkholderia pseudomallei*, and atypical mycobacteria (i.e., *Mycobacterium marinum*).[81]

Mycetoma

Mycetoma is a chronic and destructive infection caused by either fungus (eumycetoma or mycotic mycetoma) or bacteria (actinomycetoma).[82] This type of infection has a known geographic distribution, with the highest incidence in equatorial, tropical, and subtropical areas known as the "mycetoma belt," including Sudan, Somalia, Senegal, India, Yemen, Mexico, Venezuela, Colombia, and Argentina.[82] The soil is its natural reservoir, and the

infection usually follows a traumatic inoculation of the organism into subcutaneous tissue via contaminated mechanical vectors (e.g., a thorn or splinter). *Madurella mycetomatis* is particularly endemic in Sudan, Africa.[82] It is the most common cause of mycotic mycetoma and typically presents as a tumor with suppuration, tumefaction, sinuses, and granules. In the last decade, there has been significant immigration from mycetoma-endemic regions of Africa to Israel where multiple cases of mycetoma have now been reported among immigrants.[82]

Diagnosis of this condition can be confirmed via direct microscopy, histology revealing characteristic grains, culture, serology, and/or radiologic imaging.[83] Treatment is challenging and typically includes antimicrobial or antifungal agents combined with surgery.[83]

Patera foot syndrome

Patera foot syndrome is a rare SSTI of the lower limbs observed in immigrants from Sub-Saharan Africa who cross the Atlantic Ocean to Spain and other European countries via overcrowded small fishing boats (*pateras*).[84] During this several-day journey, travelers are exposed to extreme conditions including cold weather, deficient hygiene, prolonged sitting in the same position, and prolonged immersion of their feet in sea water that may be contaminated by traces of feces, urine, decaying food, or fuel–water emulsions, as well as the pathogen *Shewanella algae*.[84] The clinical presentation is a painful cellulitis with minimal or imperceptible port of entry, deep abscesses, and tissue necrosis.[84] An ischemic mechanism may be crucial in the development of these destructive infections.[84] Response to surgical debridement and broad-spectrum antimicrobial drugs is frequently poor, making amputation necessary in many cases.[84] The initial selection of empirical therapy, which should cover those pathogens, and early surgical evaluation are crucial in preventing major disability for these patients, many of whom are young.[84]

Migration and health systems

Climate change leads to increased internal and external migration. A global strategy addressing the health of migrants, therefore, requires more attention. Although migration health policies exist, regional and global health protection agreements are limited.[2]

At the international level, the 61st World Health Assembly adopted a resolution that encouraged states to develop migrant-sensitive health policies and practices.[2] The selected regional and national examples indicate the somewhat disjointed, sometimes conflicting, nature of migration health policymaking, as well as important gaps.[2] For instance, migrant health insurance schemes may be encumbered by restrictive immigration legislation or exclude undocumented migrants and migrants' family members from coverage.[2] Moreover, the gap between practice and policy, for example, to provide health services to migrants versus to make policies about migrants' entitlements (restrictive entry, detention, restricted asylum reception, and refugee status), is increasingly evident.[2,85] Ideally, immigration policies should not interfere with the ethical obligation to provide care for all, even for the undocumented migrants.[2,85]

The WHO recommends that health checks be offered and provided to ensure access to health care for all refugees and migrants. Migrants should be evaluated for both communicable diseases and noncommunicable diseases, with careful attention to respecting the human rights and dignity of each patient.[86] Providers should be mindful of the need to provide health care while preventing contagious disease outbreaks. Vaccinations to prevent, for example, VZV and dengue outbreaks have been reported to be more effective, sustainable, and ethically preferable rather than rapid response involving isolation of affected individuals and vaccination of the susceptible contacts.[18,22] Every immigrant should be provided access to a hospitable environment, especially for prevention (such as vaccination) and, when needed, to high-quality health care, without discrimination on the basis of gender, age, religion, nationality, race, or legal status.[86]

The specific health needs of migrants are not widely recognized.[14] Barriers to health care include limited access to pharmaceuticals, poor continuity of care, and inadequate referral or access to specialists.[87] Better access to health care, improvement of living conditions and hygiene, and increased availability of medications are all interventions that could reduce the skin disease burden in this population.[87]

Legal status is one of the most important determinants of the access to health services for migrants arriving in a destination country. The WHO supports policies that prioritize providing health care services irrespective of legal status.[86] As rapid access to health care can result in cure, it can help prevent the unnecessary spread of disease; it is therefore in the interests of both migrants and destination countries to ensure access to high-quality care.[86]

The health systems in countries receiving migrants should be well-equipped to diagnose and treat common infectious and noncommunicable diseases as a part of providing comprehensive health. According to the *International Health Regulations* (2005), all countries should have effective disease surveillance and reporting systems and capacity for outbreak investigation, case management, and response.[86]

As globalization appears to be inextricably linked to population mobility, and having demonstrated that individuals will continue to migrate and re-migrate, all of which is aggravated by the deteriorating condition of climate change, it is high time for decision-makers from the migration and health sectors, including the dermatology associations, to strengthen health systems that provide a more comprehensive approach, which includes improved dermatologic disease prevention, and management of diseases affecting vulnerable migrant populations. Finally, dermatologists should play a more active clinical role in both refugee camps and migrant intake centers in order to address the high burden of skin disease in this population.

Questions (answers provided after references)

1. Which of the following parameters is related to climate change?
   - **A.** Droughts
   - **B.** Floods

C. Land degradation

D. Rising sea levels

E. All of the above

2. Migration: How many people are on the move internationally?

A. 50 million

B. 76 million

C. 156 million

D. 214 million

E. 278 million

3. In which of the following geographical areas is leprosy (Hansen's Disease) often seen?

A. Eastern Mediterranean

B. Western Pacific

C. Europe

D. South-East Asia

E. Australia

4. Which of the following skin diseases is commonly seen in African immigrants?

A. Scabies

B. Malaria

C. Atopic dermatitis

D. Bechet's disease

E. Psoriasis

5. Which of the following parameters affects the geographical location of dermatophytoses?

A. Climate

B. Migration

C. Socioeconomic conditions

D. None of the above

E. All of the above

6. Which of the following diseases is transmitted by sandflies?

A. Dengue

B. Leprosy

C. Cutaneous leishmaniasis

D. Mycetoma

E. Tuberculosis

7. Which of the following diseases is associated with poor/crowded living conditions?

A. Scabies

B. Community-acquired methicillin resistant *Staphylococcus aureus*

C. Sexually transmitted infections

D. Tuberculosis

E. All of the above

8. Which of the following diseases is transmitted by fly larvae (dipterous)?

A. Myiasis

B. Leishmanisis

C. Dengue

D. Leprosy

E. Mycetoma

9. Which of the following diseases is associated with tumors that contain suppuration, tumefaction, sinuses, and granules?

A. A Dengue

B. B HIV

C. C Mycetoma

D. D Patera foot syndrome

E. E Syphilis

10. Physiological stress among immigrants has been associated with one of the following skin diseases?

A. A Telogen effluvium

B. B Malaria

C. C Tuberculosis

D. D Varicella zoster virus

E. E Myiasis

Answers to Questions

1 E; 2 D; 3 D; 4 A; 5 E; 6 C; 7 E; 8 A; 9 C; 10 A

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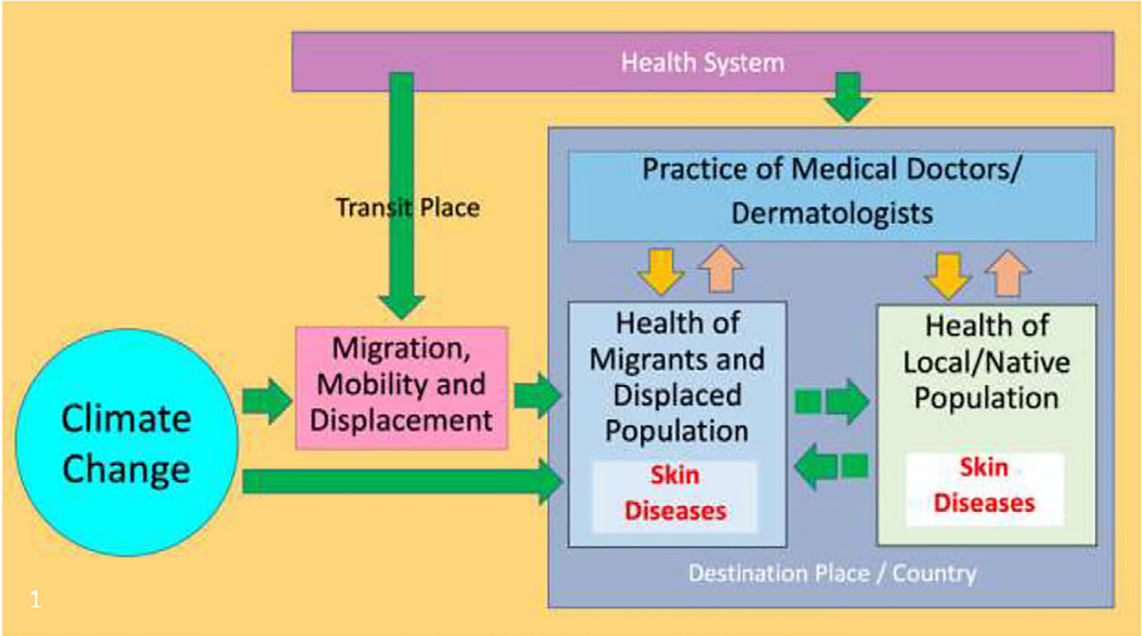

Figure 1.
Conceptual framework of the impact of climate change on the skin diseases of migrants and displaced population

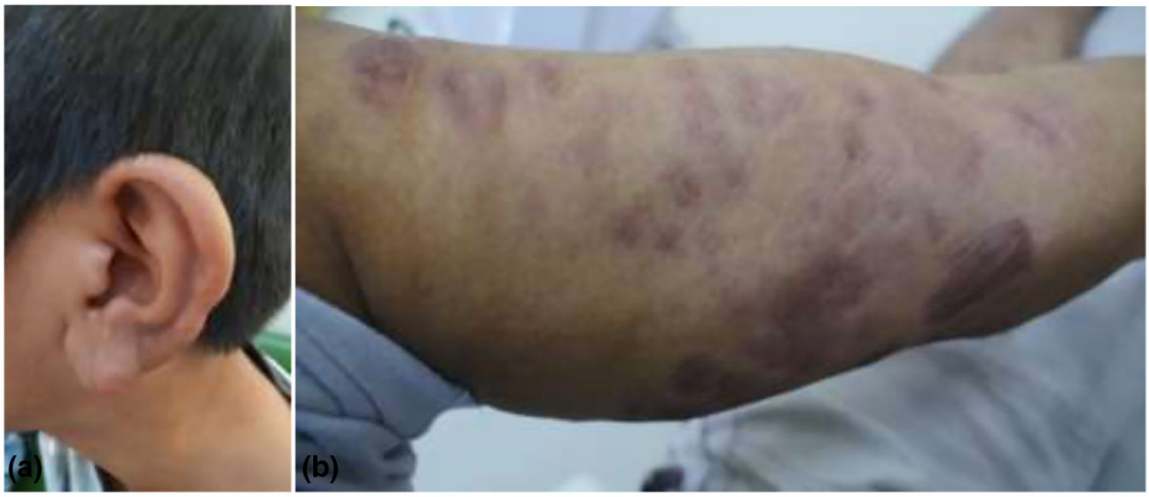

Figure 2.

Lepromatous leprosy in a 13-year-old male who stayed in Australia for 6 years. He was treated for ichthyosis and atopic dermatitis. Biopsy of enlarged earlobe in the Philippines revealed Hansen's disease, lepromatous (a). Borderline leprosy with neuritis in a 50-year-old male who worked and stayed in the Middle East for 7 years (b)

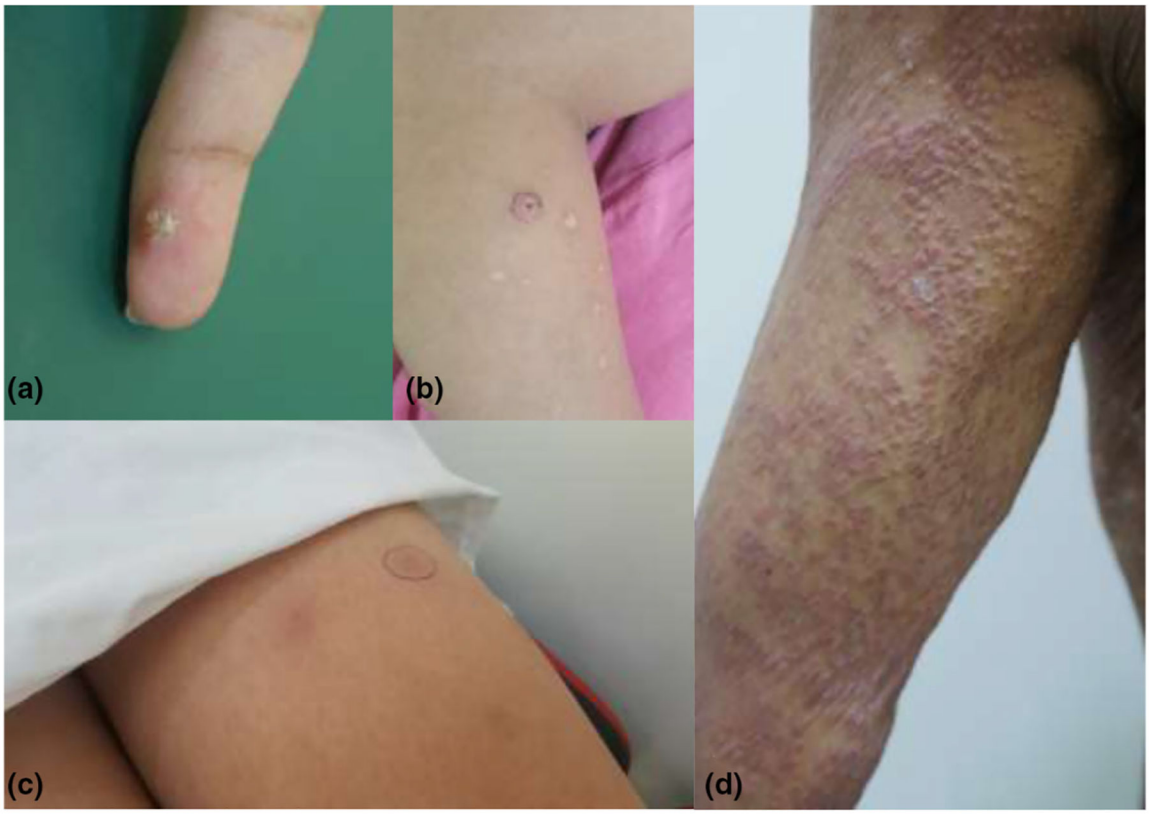

Figure 3.

Tuberculosis verrucosa cutis on the finger of a 23-year-old health worker (a). Papulonecrotictuberculid in a 25-year-old female with concomitant pulmonary tuberculosis (b). Tender nodules of erythema induratum of Bazin in a 32-year-old female (c). Pruritic widespread flat topped papules of lichen scrofulosorum in a 67-year-old male with pulmonary tuberculosis (d)

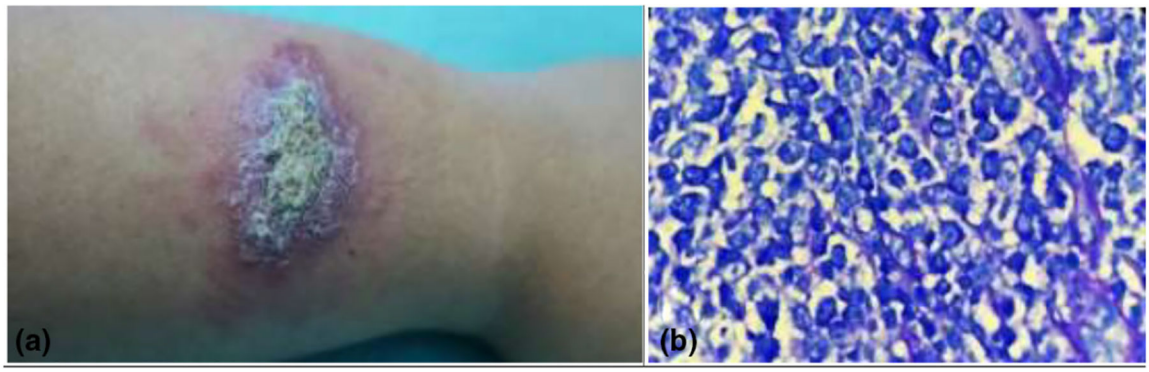

Figure 4.

Cutaneous leishmaniasis in a 32-year-old male overseas Filipino worker returning from Iraq who presented with “volcaniform” ulcerated nodules and plaques surrounded by small satellite erythematous papules (a). Round to oval basophillic structures (Leishman Donovan bodies) are present in the cytoplasm of macrophages, Giemsa stain ×400 (b)

Table 1

Human migration-related communicable skin diseases

Diseases	Number of cases	Country of origin	Country of migration	Author
Dengue	39% (15/38) of refugees with malaria-like illness	Somalia	N/A	Botros BA *et al.* (1998)[16]
	15.7% (32 out of 560 suspected cases)	N/A	Darfur, Western Sudan	Ahmed A *et al.* (2019)[17]
Varicella	31 refugees	Sudan	France	Lesens O *et al.* (2015)[23]
	Cross-sectional study (n = 6, 188). Diagnosis of varicella was the most represented infectious disease and was more probable among Ghanaians (OR: 13.58) and Nigerians (OR: 9.79)	Ghana and Nigeria	Italy	Di Meco E *et al.* (2018)[24]
Leprosy (Hansen's disease)	76.2% (128/168 leprosy cases 2003–2013) were detected in legally resident immigrants	Latin American migrants (Brazilians, Paraguayans, Bolivians), South and Central America	Spain	Ramos JM *et al.* (2016)[25]
	38 cases (2004–2013) among immigrants	Majority of the cases were from the Pacific Islands, and minority from Asia	New Zealand	Yu R *et al.* (2015)[26]
Cutaneous tuberculosis	1 case of ulcer type cutaneous TB	Senegal	Sicily	Gulisano G (1998)[31]
	1 case of scrofuloderma	Morocco	Italy	Forgione P *et al.* (2004)[32]
MRSA	19 cases of CA-MRSA, 15 of them were immigrants	South America	Barcelona, Spain	Manzur A *et al.* (2008)[37]
	10% of 898 asylum seekers were MRSA positive	N/A	Netherlands	Ravensbergen SJ *et al.* (2017)[39]
Tinea capitis	21% (32/153 early arrived children migrants)	Africa and Arabic country	Melbourne	Mcpherson ME *et al.* (2008)[45]
	28.8% (297/1,026) refugee children of over 30 different ethnicities	N/A	Western Australia	Mutch RC *et al.* (2012)[46]
	122 cases. Represented 89.34% of the cases. *Microsporum langeronii* (39.34%), *Trichophyton soudanense* (28.69%), *T. violaceum* (18.03%) and *T. tonsurans* (3.28%).	North African	Brussels	Kolivras A *et al.* (2003)[47]
	2 cases (Liberian adopted children) of *T. soudanense*	Liberia	Ohio	Markey RJ *et al.* (2003)[48]
Cutaneous leishmaniasis	948 cases among refugees	Syria	Lebanon	Saroufim M *et al.* (2012)[54]
Scabies and pediculosis	Cross-sectional study (n = 6,188). The most frequent diagnoses were scabies (58% of patients), skin infections, pediculosis and dermatitis	Eritrea, Nigeria, and Somalia	Italy	Di Meco E *et al.* (2018)[24]
Myiasis	1 case of scalp myiasis	N/A	Spain	Belda HS *et al.* (2003)[64]
Syphilis	1.1% (183/17,235) of nearly arrived refugees (2003–2010)	Middle East, Eastern Europe, Southeastern Asia, or sub-Saharan Africa	Minnesota, USA	StaufferWM *et al.* (2012)[65]
HIV	0.2–4% of refugees or asylum seekers	Africa and Middle East	Turkey, USA, Italy, UK	Eonomopoulou A *et al.* (2017)[71] Stauffer WM *et al.* (2012)[65]

Diseases	Number of cases	Country of origin	Country of migration	Author
				Tafuri S *et al.* (2010)[72] Dias S *et al.* (2014)[73] Clark RC (2007)[74]