

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/371013976>

Heat-related illnesses are an increasing threat for travellers to hot climate destinations

Article in *Journal of Travel Medicine* · May 2023

DOI: 10.1093/jtm/taad072

CITATIONS

14

READS

102

3 authors, including:



[Sakarn Charoensakulchai](#)

Mahidol University

31 PUBLICATIONS 179 CITATIONS

[SEE PROFILE](#)



[Aisha Khatib](#)

University of Toronto

25 PUBLICATIONS 236 CITATIONS

[SEE PROFILE](#)

Perspective

Heat-related illnesses are an increasing threat for travellers to hot climate destinations

Wasin Matsee^{1,2,*}, Sakarn Charoensakulchai¹, MD¹ and Aisha N. Khatib, MD³

¹Thai Travel Clinic, Hospital for Tropical Diseases, Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand,

²Travel Medicine Research Unit, Department of Clinical Tropical Medicine, Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand and ³Department of Family & Community Medicine, University of Toronto, Toronto, ON Canada

*To whom correspondence should be addressed. Email: wasin.mat@mahidol.edu

Submitted 8 May 2023; Revised 15 May 2023; Editorial Decision 18 May 2023; Accepted 18 May 2023

Key words: Heat-related illness, threat, climate change, travellers, heat, El Niño

Climate change has led to an increase in average global temperatures, with the last 8 years being the warmest on record. Global temperatures have risen significantly over the past two decades, compared to the average temperature during 1910–2000 (<https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/global/time-series>). Asia has experienced the highest increase at 1.78°C per century, followed by Europe at 1.51°C (Figure 1). The United Nations World Meteorological Organization recently reported that the probability of El Niño developing this year is growing.¹ El Niño is an irregularly occurring climate pattern of unusual warming of sea surface temperatures in the central and eastern tropical Pacific Ocean, occurring every 2–7 years.¹ El Niño can disrupt normal weather patterns globally, and is forecasted to drive global temperatures even higher than the already occurring human-induced warming from greenhouse gases.¹ In combination with El Niño, 2023 and 2024 are predicted to be amongst the warmest years in almost two centuries. Tropical regions appear to be significantly impacted, with several countries in South America, South and Southeast Asia, Southwestern Europe and Northern Africa experiencing summer temperatures that exceed 35°C and can easily surpass 40°C. The extreme heat effects of El Niño have already been witnessed this year with record shattering temperatures recorded this April in Peru, Spain, Portugal, Morocco and Algeria. As a result, the impact of heat on health is unavoidable for both locals and travellers, particularly those travelling to hot climate destinations who are not acclimatized.

A recent study found that the annual heat-related mortality of people over the age of 65 increased by an estimated 68%

in the past two decades.² Additionally, more than one-third of heat-related deaths during the past 30 years (37%; range, 20.5–76.3%) are directly attributed to climate change.³ Hot weather can lead to significantly increased mortality and morbidity due to cardiopulmonary causes, mental health issues, dermatological malignancies, allergies, renal function loss, tropical infections, heat stroke and exhaustion and adverse pregnancy outcomes.^{4,5} Heat-related morbidity and mortality have been high in several Asian countries, such as India, Thailand, Vietnam and Myanmar. Thailand experienced an average of 2500–3000 cases of heat-related illness (<https://www.thaipbs.or.th/news/content/326162>), whilst India had 31 000 heat-related deaths from 2017 to 2021 (<https://timesofindia.indiatimes.com/india/a-recent-study-has-shown-that-heat-related-deaths-in-the-country-have-gone-up-by-more-than-50-percentage/articleshow/95089618.cms>). Heat stress is also a significant occupational hazard for athletes and outdoor workers.^{2,4} This was recently witnessed by the hundreds of migrant workers who suffered from heat-related illness in preparation for the Qatar World Cup in 2022 (<https://time.com/6227277/qatar-extreme-heat-world-cup-2022>). Furthermore, urbanization in major cities creates an urban heat island effect, which poses health risks for city dwellers.⁴ Increased heat can domino to affect and devastate agriculture through drought, impair socioeconomics, displace populations, increase vulnerability to infectious diseases transmission and increase major natural disasters and extreme weather events.^{4,6} Canada, for example, has just declared a provincial state of emergency in response to raging wildfires amid the hot weather, which can also result in respiratory exacerbations due to smoke and poor air quality.

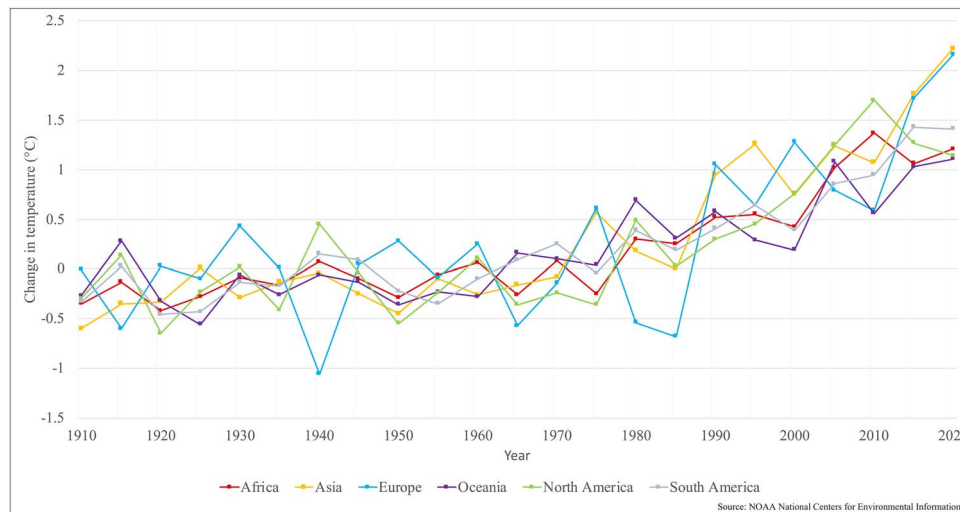


Figure 1. Changes in annual average temperature during 1910–2020 in relation to a 1910–2000 average baseline temperature (in °C)

Heat-related illnesses (HRI) are rarely discussed during pre-travel consultation due to it being an invisible danger.⁷ However, HRI are often highlighted as a major health threat in specific mass gathering events, such as amongst Hajj pilgrims and at World Cup or Olympic games.^{8,9} **Insufficient airflow, restricted access to drinking water, heat released from human bodies, heat emitted from surrounding structures and vehicles and a lack of shade are the primary factors contributing to HRIs during these events.**⁸ Additionally, many of these events take place during the hottest summer months, which further increases the risk of HRI events.⁹ Although it is assumed that the incidence and mortality of HRI amongst travellers is underestimated, there is a recognized higher risk of developing HRI, particularly amongst those who are not acclimatized to hot and humid environments.¹⁰ During the past decade, reports of travellers' death from heat began to increase, with some cases shown in [Supplementary Table 1](#).

HRI can range from mild heat cramps to severe heat exhaustion or even life-threatening heat stroke (Table 1). Heat stroke may be just the 'tip of the iceberg' of HRI that gain public attention due to its severity. Factors that increase the risk of HRI in travellers include high temperatures, high humidity, extreme ages, pre-existing health conditions, strenuous physical activity and inadequate hydration.^{4,10,11} Travellers who do not undergo the heat acclimatization process after arriving in warmer travel destinations are at higher risk of HRI. However, this process takes several days to complete and is often not feasible for travellers with tight and short travel itineraries. **Outdoor activities also increase the risk of HRIs amongst travellers. Older travellers are at higher risk due to reduced glomerular filtration and perspiration, as well as the use of medications that impair heat acclimatization.**^{4,10} Child travellers are also at risk due to their greater surface area to body mass ratio, resulting in more heat absorption, slower perspiration rate and inability to behaviourally thermoregulate.⁴ Certain health conditions such as obesity, diabetes, autonomic neuropathy, mental illness, chronic kidney disease and cardiovascular diseases can also increase the risk of HRI due to impaired thermoregulatory responses, such as vasodilatation, perspiration and fluid retention, increased

coronary oxygen demand, altered thermoregulation behaviour or reduced heat acclimatization ability.⁴ Moreover, medications like antihistamines, benzodiazepines, narcoleptics, loop diuretics, anticholinergics, antipsychotics, beta-blockers and calcium channel blockers can increase the risk of HRIs.^{10,11} Alcohol consumption can also slow the heat acclimatization process, reduces perception to heat and inhibit the antidiuretic hormone that induces relative dehydration.^{10,11} Illicit drugs such as cocaine and methamphetamine used by tourists can increase metabolism and cause hyperthermia.¹¹

Travel destinations with hot and humid climates are more dangerous **than those with hot and dry climates because high atmospheric humidity reduces perspiration rate.**^{2,4,10} **Excessive outdoor activities, especially the long distance and ultra-endurance sports, and insufficient fluid intake can lead to dehydration** and electrolyte depletion, particularly hyponatremia (exercise-associated hyponatremia), which can quickly contribute to HRIs. Dehydration resulting from diarrheal disease, which can be a manifestation of heat exhaustion itself, can also exacerbate HRI if not properly managed through fluid replacement and oral rehydration therapy.¹¹

In travel medicine practice, physicians should provide counselling on HRI prevention for travellers to hot climate destinations and include health action plans in their travel advice, particularly for vulnerable populations (Table 2).^{7,10,11} It is essential to screen travellers' outdoor activities during peak daytime hours, and those with certain health conditions should be thoroughly assessed and counselled. Physicians may help counsel travellers to adjust their travel plans to **acclimatize** to hot climates and avoid extreme heat.⁶ **If outdoor activities during the daytime cannot be avoided, then shade, loose-fitting clothing and adequate rest can help reduce the risk.** Most importantly, adequate fluid intake is crucial to avoid HRI. During hot weather, travellers should not wait until they are thirsty to drink water but should drink constantly throughout the day. If travellers engage in vigorous outdoor activities, oral rehydration solution (ORS) can be dissolved into their water. In the event of heat stroke, rapid cooling is the mainstay of treatment.¹¹ Physicians should advise travellers

Table 1. Clinical presentation and first aid treatment of HRI^a

Heat-Related Illness	Symptoms	First Aid Treatment
Heat rash	• Itchy prickly rash • Mild swelling of affected areas	• Move to a shaded or indoor cool area • Cool off by using a wet towel or a fan. Rub the towel in the opposite direction to hair follicles
Heat cramp	• Cramp in the leg • Moist, flushed skin	• Move to a shaded or indoor cool area • Remove clothing • Provide the patient with water and ORS
Heat oedema	• Pitting oedema of lower extremities • Skin appears shiny and stretched	• Move to a shaded or indoor cool area • Raise the legs • Do not use diuretics
Heat syncope	• Fainting • Dizziness • Light-headedness, usually during long duration of standing in hot weather	• Move to a shaded or indoor cool area • Remove clothing • Place the patient in a supine position • Cool the patient with a wet towel or a fan. Rub the towel in the opposite direction of the hair follicles • Provide the patient with water and ORS. If the patient loses consciousness, intravenous (IV) fluids may be necessary • If the patient has underlying cardiopulmonary disease, it is recommended to refer them to a hospital
Heat exhaustion	• Muscle cramp • Headache • Nausea and vomiting • Diarrhoea • Weakness and fatigue • High body temperature • Irritability • Pale, moist skin	• Move to a shaded or indoor cool area • Remove clothing • Place the patient in a supine position • Cool the patient with a wet towel or a fan. Rub the towel in the opposite direction of the hair follicles • Provide the patient with water and ORS. If the patient loses consciousness, IV fluids may be necessary • Observe the patient's neurological symptoms and clinical improvement. If there is no improvement or the patient develops neurological symptoms, take them to the emergency room
Heat stroke	• Warm, dry skin • Headache • Nausea and vomiting • Confusion and slurred speech • Agitation • Loss of consciousness • Tachycardia • High body temperature over 40°C • Seizure and death are possible	• Move to a shaded or indoor cool area • Remove clothing • Place the patient in a supine position and extend their extremities • Assess the patient's airway, breathing and circulation • Cool the patient by submerging them in an ice water tub (if possible). If not, frequently rub the patient's skin with a wet towel in the opposite direction of the hair follicles, rinse the patient's skin with running water, and place a wet towel in the patient's armpits, groin and popliteal spaces • Use a fan to cool the skin and spray water vapour around the patient. • Call an ambulance

^a Adapted from Centre for Disease Control and Prevention (<https://www.cdc.gov/niosh/topics/heatstress/heatrel illness.html>) and reference 11.

on the early signs of heat exhaustion and stroke and how to perform first aid if it occurs.

Public health authorities should communicate the risks of and prevention measures for HRI to both locals and travellers during high-risk periods. Plans for mitigating risks and improving healthcare services during mass gathering events are crucial for preventing HRI.⁸ Overall, as the planet continues to warm, HRI will become increasingly inevitable, and long-term prevention efforts will require national and public health interventions. These interventions should include assessment, funding, research and strategies for identifying vulnerable groups and protecting them, improving preparedness for health emergencies, and implementing warning systems and interventional measures to mitigate the effects of natural phenomena associated with increasing heat. Plans for stabilizing and lowering heat, such as increasing urban green space, implementing greenhouse gas emission laws, investing in clean energy, as well as granting financial supports

for resource-limited vulnerable countries, should also be developed.^{2,5,6} As many wealthier countries have disproportionately contributed to the environmental crisis, it is essential to urge their leaders to create cleaner, healthier and more resilient societies beyond their current commitments.⁵

Whilst there is ample information about the impact of heat on the health of resident populations, such knowledge is lacking for travellers. Certain travel destinations, activities and demographics put travellers at higher risk of HRI than local populations. Therefore, it is essential to address the incidence and mortality of HRI, physiological adaptation in extreme heat conditions, risks of developing HRI amongst vulnerable groups, as well as prevention and management plans for travellers. Filling these knowledge gaps in pre-travel consultations to prepare the traveller to hot climate destinations will be increasingly important and necessary as we transition to and brace for this upcoming powerful El Niño oscillation.

Table 2. Prevention of heat stroke in vulnerable travellers to hot climate destinations^{9,10,12}

Vulnerable group	Risks/activities	Recommendations
All travellers	Walking tour/outdoor sightseeing/doing outdoor activities/mass gathering events	• Avoid activities during extreme heat • Wear a hat and loose-fitting clothing • Use an umbrella and portable fan • Drink more fluids than usual • Get adequate sleep • Avoid crowded places • Avoid consuming alcohol and recreational drugs • Avoid physical exertion during extreme heat • Use sunscreen • Recognize early signs and symptoms of heat-related illnesses and know how to provide first aid
Travellers engaging in strenuous outdoor activities	Athletes/exercising/sport events	• Acclimate to the heat • Exercise indoors during extreme heat • Dissolve ORS in water • Improve physical fitness before travelling to a hot climate • Wear clothing that allows for easy evaporation of sweat • Ensure that emergency healthcare services are readily available • Participate only in sporting events that have a well-planned first aid team
	Trekking	• Acclimate to the heat • Take frequent rest intervals in shaded areas • Dissolve ORS in water • Improve physical fitness before travelling to a hot climate • Wear clothing that protects the skin from the sun and allows for easy evaporation of sweat • Learn about the trekking route, including shaded areas and water sources along the way • If participating in activities in remote areas, travellers should arrange a means of communication (such as a satellite phone, global positioning system application, and pre-travel contact) with healthcare and rescue services
Travellers with extreme age	Children	• Engage in indoor activities with adequate airflow or air-conditioned facilities • Provide shade for children when outdoors • Take frequent baths or showers to cool down • Never leave children in hot cars • Do not leave children outdoors without supervision • Ensure adequate hydration and observe signs of dehydration, especially in infants • Ensure children are well-fed and receive adequate nutrition
	Elderly	• Engage in indoor activities with adequate airflow or air-conditioned facilities • Take frequent baths or showers to cool down • If elderly travellers have pre-existing health problems, see recommendations below
Travellers with pre-existing medical conditions	Pre-existing metabolic diseases/cardio-pulmonary diseases/chronic kidney disease/epilepsy/psychiatric disease/skin diseases	• Ensure that any pre-existing health conditions are well-managed and under control • Encourage heat acclimatization for obese travellers • Ensure adequate fluid intake, especially if the traveller is taking diuretic drugs • Encourage the traveller to consult with their regular physician for a medication review and any necessary dose adjustments prior to travel • Travellers with reduced ability to sweat or vasodilate, especially due to skin or cardiopulmonary diseases, should use alternative methods such as fans and wet towels to help cool down
	Limited mobility/disability	• Ensure that the traveller is not left outdoors or in hot cars. • Accompanying travellers should provide shade, such as an umbrella, for disabled travellers • Accompanying travellers should observe signs of dehydration, especially for travellers with limited communication
	Allergy	• Consider using alternatives such as steroids, nasal irrigation or nasal decongestants instead of antihistamines
	Jet lag	• Consider using timed light exposure or melatonin instead of benzodiazepines

Supplementary data

Supplementary data are available at *JTM* online.

Funding

None.

Conflict of interest: None to declare.

Author Contributions

Wasin Matsee (Conceptualization [Lead], Data curation [Equal], Formal analysis [Equal], Methodology [Equal], Supervision [Lead], Visualization [Supporting], Writing—original draft [Equal], Writing—review & editing [Lead]), Sakarn Charoensakulchai (Conceptualization [Equal], Data curation [Lead], Formal analysis [Equal], Methodology [Equal], Resources [Equal], Validation [Equal], Visualization [Lead], Writing—original draft [Equal]) and Aisha Khatib (Conceptualization [Equal], Data curation [Equal], Formal analysis [Equal], Methodology [Equal], Supervision [Equal], Validation [Equal], Writing—review & editing [Equal]). Sakarn Charoensakulchai and Wasin Matsee developed the initial manuscript draft. Wasin Matsee and Aisha N. Khatib critically revised and edited the manuscript. All authors read and approved the final manuscript.

References

1. World Meteorological Organization (WMO). *WMO Update: Prepare for El Niño*. Available from <https://public.wmo.int/en/media/press-release/wmo-update-prepare-el-ni%C3%B1o> (Accessed 4 May 2023)
2. Romanello M, Di Napoli C, Drummond P *et al*. The 2022 report of the lancet countdown on health and climate change: health at the mercy of fossil fuels. *Lancet* 2022; 400:1619–54.
3. Vicedo-Cabrera AM, Scovronick N, Sera F *et al*. The burden of heat-related mortality attributable to recent human-induced climate change. *Nat Clim Chang* 2021; 11:492–500.
4. Ebi KL, Capon A, Berry P *et al*. Hot weather and heat extremes: health risks. *Lancet* 2021; 398:698–708.
5. Atwoli L, Baqui AH, Benfield T *et al*. Call for emergency action to limit global temperature increases, restore biodiversity, and protect health. *J Travel Med* 2021; 28:taab125. <https://doi.org/10.1093/jtm/taab125>.
6. Laybourn-Langton L, Muhia J, El-Adawy M *et al*. COP27 climate change conference: urgent action needed for Africa and the world. *J Travel Med* 2022; 29:taac114.
7. Khatib AN. Climate change and travel: harmonizing to abate impact. *Curr Infect Dis Rep* 2023; 25:77–85.
8. Yezli S, Khan A, Bouchama A. Summer hajj pilgrimage in the era of global warming: a call for vigilance and better understanding of the risks. *J Travel Med* 2019; 26:taz069.
9. Nakamura S, Wada K, Yanagisawa N, Smith DR. Health risks and precautions for visitors to the Tokyo 2020 Olympic and Paralympic games. *Travel Med Infect Dis* 2018; 22:3–7.
10. Cooper MC. The elderly travellers. *Travel Med Infect Dis* 2006; 4:218–22.
11. Sorensen C, Hess J. Treatment and prevention of heat-related illness. *N Engl J Med* 2022; 387:1404–13.
12. Epstein Y, Moran DS. Extremes of temperature and hydration. In: Keystone J, Kozarsky P, Connor B, Nothdurft H, Mendelson M, Leder K (eds). *Travel Medicine*. Philadelphia: Elsevier, 2019, pp. 347–61.