

# Heat Stroke and Heat Exhaustion

## Group F10

Yara Ali Alzahrani	439200173
Mona Hail Alabdely	439200428
Enas Ziyad Bedaiwi	439200255
Dimah Talal Alotaibi	439200035
Esraa Anas sambas	439200398
Bayan Ali Alhazmi	439200343
Nouf Khalid Alburaykan	438201356
Atheer Almutairi	435200083

# Objectives:

1. Define and classify heat stress and its types
2. Define the clinical presentation of each ( symptoms, signs, complications, and investigations)
3. Describe the public health importance of heat stroke and heat exhaustion
4. Explain the distribution ( place, person, time) in the global, regional, and local contexts, including the incidence rate during Hajj.
5. Explain the determinants ( risk factors) of heat stress and its types
6. Explain preventive (1ry, 2ry, 3ry) and control ( treatment) measures, including the MOH device for Hajjis with heat stroke
7. Recall the Ministry of Labor regulations regarding heat stroke.

# Objective 1

## Definition, classification, and types of heatstroke, heat exhaustion:

Heat stress is a buildup of body heat generated either internally by muscle use or externally by the environment<sup>1</sup>, which occur when the body cannot get rid of the excess heat.<sup>2</sup>

Heat stress results from the combined effect of metabolic heat production, environmental factors and clothing requirements.<sup>3</sup>

a novel classification system proposed by The Japanese Association for Acute Medicine Committee simply classify the heat-related illnesses into three stages based on symptoms and management.<sup>4</sup>

Stage I is any minor heat-related illness, including heat cramp and syncope heat cramps are defined as the painful muscle cramps that happen during or after intense exercise and sweating in high heat.<sup>5</sup>

heat syncope refers to the fainting episode that occurs when someone is exposed to high temperatures for an extended period of time, commonly during the first days of heat exposure after suddenly rising from a sitting or lying position.<sup>6</sup>

Stage II is any heat-related illness not covered by Stage I or Stage III, such as heat exhaustion.

heat exhaustion is a condition that result from the body overheating, whose symptoms may include intense sweating and a rapid pulse.<sup>7</sup>it occurs when exposed to hot environments and sweating fail to dissipate the heat generated within the body.<sup>8</sup>

Stage III refers to severe conditions in a patient with hyperthermia who has been under heat stress, such as heat stroke .

heat stroke is a life-threatening condition that causes the body to overheat with a body temperature above 104 degrees Fahrenheit (40 degrees Celsius).<sup>9</sup>

# Objective 1

heat stroke further classify into<sup>8</sup> :

**Exertional heat stroke (EHS)** : This is most common in young people who participate in strenuous physical exercise for an extended period of time in a hot environment.

**Nonexertional heat stroke (NEHS)** : more commonly affects sedentary elderly individuals, people who are chronically ill, and very young people. Classic NEHS occur during environmental heat waves and is more common in locations where prolonged periods of hot weather are not usual.

## Objective 2

### Definition of the clinical presentation:

Heat exhaustion occurs when your body overheats and is unable to cool down. Symptoms may include excessive sweating, lightheadedness, headache, nausea, muscle cramps and others<sup>9</sup>. Recognizing the signs and symptoms is important to detect the heat exhaustion and prevent any further complications. If it was not treated, this can lead to the progression of a heat stroke, which is a life-threatening emergency that requires prompt medical intervention<sup>10</sup>. Investigations may include measuring the body's temperature, as well as ordering blood and urine tests to confirm the diagnosis and rule out heatstroke<sup>11</sup>.

Heat stroke develops when the body's temperature regulation fails. At this stage the person develops a change in mental status, becomes confused, lethargic, and may have a seizure, and the body temperature may exceed 40°C. Other signs & symptoms of heat stroke include<sup>12</sup>:

- No sweating
- hot and dry skin
- flushing.
- body temperature exceeds 40°C.
- rapid, strong pulse.
- Rapid breathing.
- Altered mental state or behaviour state
- Seizures.
- fainting

## Objective 2

### Investigations<sup>13</sup>:

- temperature measurement ( $\geq 40^{\circ}\text{C}$ )
- Blood tests: Hypokalemia, hypophosphatemia,  $\uparrow$ CK, prolonged PT, respiratory alkalosis and lactic acidosis
- Urine test: Myoglobinuria
- Imaging: Acute pulmonary edema

Heatstroke can significantly affect the brain, heart, kidneys, and muscles if left untreated. The longer treatment is delayed, the more severe the damage, raising the chance of serious complications or death. Examples<sup>14,15</sup>:

- Acute respiratory distress syndrome (ARDS).
- Brain swelling.
- Kidney failure.
- Liver failure.
- Metabolic dysfunction.
- Nerve damage.
- Reduced blood flow to the heart and other circulatory problems.

## Objective 3

### Description of public health importance of heat stroke and heat exhaustion:

Over the last few decades, data on the occurrence and severity of disasters has improved, with an increase in data provided to the Center for Research on the Epidemiology of Disasters (CRED), which in turn summarized and ranked disaster trends between 1998 and 2017. The extreme temperature was discovered by the (CRED) to be the fourth most common disaster, with an estimated economic loss of 61 billion dollars. Moreover, a total of 97 million people were affected by extreme temperature disasters, of which 166,346 died.<sup>16</sup>

From another point of view, estimating the public health impact of extreme heat is difficult, as health-care workers are not required to report heat-related diseases. However, there are some numbers in different countries that are believed to be largely under-reported.<sup>17</sup> For example between 2006 and 2010, there were at least 3332 deaths in the United States attributable to heat stroke.<sup>18</sup> In 2010, 2.25 hospitalizations per 100,000 people in the United States were heat-related.<sup>19</sup> In France a study reported the 28-day and 2-year mortality rates for a heat stroke to be 58 and 71 percent, respectively.<sup>20</sup>

Despite the fact that heat-related morbidity is under-reported globally, research demonstrates that patients who are exposed to excessive heat have a higher risk of death and hospitalization from NCDs.<sup>21</sup>

## Objective 3

Heatstroke mortality has been reported to be on the rise as a result of climate change.<sup>18</sup> According to The Intergovernmental Panel on Climate Change (IPCC), the average annual temperature increase is anticipated to be roughly 4°C, with an increase in the number, duration, and intensity of heat waves.<sup>22</sup>

Heat stress at work is set to have a major impact on worldwide productivity and economic losses, particularly in the agriculture and construction sectors as the International Labour Organization states. The agricultural sector is predicted to be the worst affected, with 60 percent of working hours missed due to heat stress in 2030. The impact will be unevenly distributed over the world. The worst-affected areas are predicted to be Southern Asia and Western Africa. economic losses caused by heat stress at work are expected to reach 2,400 billion dollars by 2030, being most pronounced in middle- and low-income countries.<sup>23</sup>

Excessive heat impact on public health:<sup>24</sup>

- **Direct:** Heat gain that occurs quickly as a result of being exposed to hotter-than-average conditions affects the body's ability to regulate temperature and can lead to a cascade of illnesses which exacerbate chronic illnesses such as cardiovascular, pulmonary, and diabetes-related complications.
- **Indirect:** increase risk of accidents, disease transmission(eg. foodborne diseases), negatively affects health service delivery (increased ambulance callouts and hospital admission), and critical social infrastructure such as energy, transportation, productivity, and water can all be affected by extreme heat.



## Objective 4

### Explanation of the distribution:

Temperatures are rising all over the world as a result of climate change. Extreme heat-related events have been observed to increase in frequency, duration, and magnitude; as a result, the number of people exposed to heat waves has increased by approximately 125 million between 2000 and 2016<sup>25</sup>.

Heat strokes are uncommon in subtropical climates, according to the global distribution of heat strokes. As a result, they are uncommon in Japan but common in Saudi Arabia, where they primarily affect pilgrims to Mecca<sup>26</sup>.

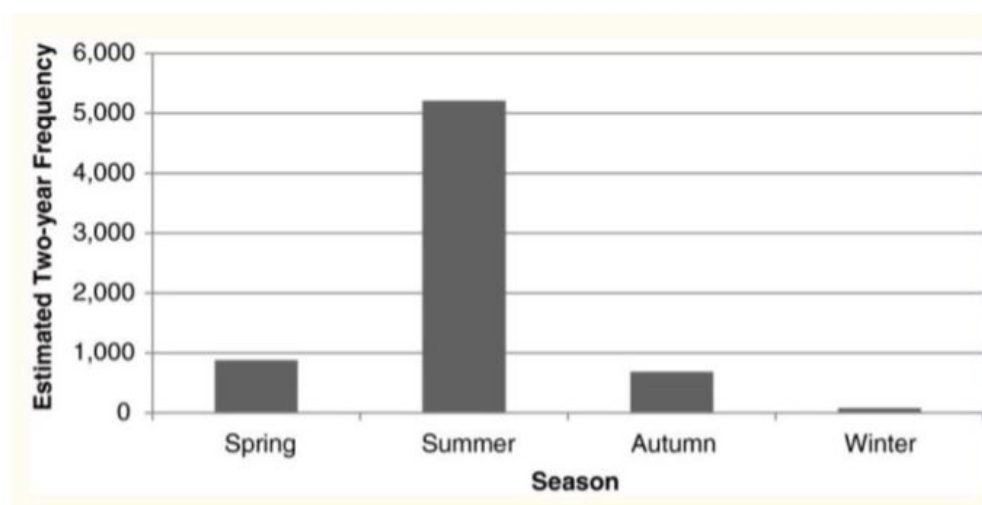
According to a study conducted in the United States that included findings from 20 states, approximately 28,000 hospitalizations due to heat-related conditions were recorded between 2001 and 2010, with an annual rate of 1.8 cases per 100,000 people<sup>27</sup>.

Heatstroke affects both sexes and all races equally when the risk factors are the same and the environmental conditions are the same. However, because of lifestyle and social differences, men have a higher annual incidence rate of heat stroke than women (1.99 per 100,000)<sup>28</sup>(because males are more likely to work outside and in hot conditions), It is higher among blacks than among whites because of social advantages such as the availability of central air conditioning and cooler public spaces<sup>26</sup>.

## Objective 4

Heatstroke is more common in infants, children, and the elderly than in young, healthy adults. In a nationwide US study of ED visits for heat strokes in 2009-2010, adults aged 80+ had the highest incidence (4.45 per 100,000 population) compared to younger demographics, such as 20-29-year-olds, who had an incidence of 1.15 per 100,000 population study<sup>28</sup>. In terms of location, it was found that higher incidence rates for heat strokes was in residents living in the southern region (1.61 per 100,000)<sup>28</sup>.

Heatstroke and heat-related deaths are most common during summers with extended heat waves. The table below summarizes the occurrence of heat-related illness in the United States from 2009 to 2010. It reveals that the majority of ED visits (63.1 percent) occurred during the summer months of June, July, and August<sup>28</sup>.



# Objective 4

## Saudi Arabia (place, person, time):

The graph below represents the predicted temperatures in Makkah during Hajj from 2009 to 2028, which are expected to range between 45 and 55 degrees Celsius<sup>29</sup>.

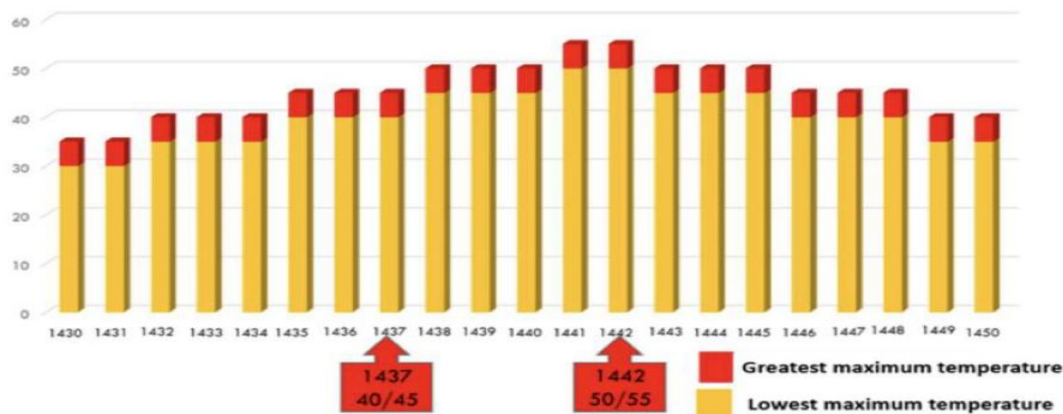


Figure 1: The expected maximum temperature in Makkah during Hajj from 1430 to 1450

Heat-related illnesses are not uncommon during Hajj. Heat strokes and heat exhaustion accounted for 24 percent of hospital admissions during the 2015 Hajj season.<sup>29</sup> The table below also summarizes the rates of heat strokes and exhaustion during Hajj 1980-1985, in which the incidence increases progressively each year from 22 (in 1980) to 250 (in 1985) cases per 100,000<sup>30</sup>.

Year	Date†	No. of pilgrims	Heat stroke		Heat exhaustion	
			Cases	Rate/100,000	Cases	Rate/100,000
1400H (1980)	19 October	813,000	176	22	NA	---
1401H (1981)	8 October	479,000	258	54	NA	---
1402H (1982)	27 September	854,000	1,119	131	5,595	655
1403H (1983)	16 September	1,005,000	1,365	136	5,950	592
1404H (1984)	5 September	920,000	1,058	115	4,337	472
1405H (1985)	25 August	852,000	2,134	251	15,560	1,826

\* Source: Haj Report, 1985. General Directorate of Health Affairs, Western Region, Ministry of Health, Kingdom of Saudi Arabia.

† Gregorian date corresponding to 10 Dhu Al-Hijjah, on which the main event of Hajj occurs.



# Explanation of the determinants (risk factors) of heat stress and its types:

- Heat-related sickness can strike anyone at any time, but some people are more vulnerable than others<sup>32</sup>:
  1. **People aged 65 and up**, because the aging body's ability to adjust to fluctuations in body temperature is reduced.
  2. **Overweight people** carry extra weight, which can interfere with your body's capacity to regulate temperature and cause it to retain more heat.
  3. **People who are physically ill**, particularly those with heart disease or high blood pressure, or who are on certain medications, such as diuretics (which cause dehydration and electrolyte depletion), beta-blockers (which lower skin blood flow), and antidepressants (which reduce skin blood flow) (which increase heat production).
  4. **People who exercise or work too hard.**
  5. **Disabled individuals.**
  6. **People who live in urban regions** think about the impact of urbanization and climate change together.
  7. **Sunburned people's** skin's capacity to release excess heat is greatly slowed.
  8. **People who work at hot environments** such as farmers, factory workers and firefighters

## Objective 5

- **Types of heatstroke<sup>33</sup>:**
  1. **non-exertional heatstroke (classic):** Heatstroke that isn't caused by exercise is more common in newborns, children, and the elderly. It develops over days during environmental heat waves and is more common in locations where protracted periods of hot weather are not typical.
  2. **Exertional Heat stroke:** Heat stroke caused by excessive exercise in a hot climate usually occurs quickly in a young, intensively exercising individual who has not acclimatized to the heat. Changes in the central nervous system, ranging from severe headaches to seizures and collapse, make for a dramatic appearance. The presence of rhabdomyolysis and disseminated intravascular coagulation is common.

## Objective 6

### Explanation of preventive and control measures, including the MOH device for Hajjis with heat stroke:

- **Drink plenty of fluids:** Water, not carbonated drinks, is the greatest way to rehydrate. Alcohol and caffeinated drinks should be avoided during exercise since they increase the risk of hyperthermia.
- **Avoid exercising/doing vigorous outside activities** in the heat and carefully plan your outdoor activities, limiting them to cooler times of the day (mornings and evenings).
- **Acclimatization:** It takes weeks to adjust to a hotter environment. Acclimatization causes the body to become more efficient in terms of work productivity as well as heat dissipation through a variety of processes, including changes in sweat rate, volume, and composition.
- **Light clothing:** Wear light-coloured, loose-fitting clothing made from natural fibres like cotton and linen.
- **Protect yourself** outside by using sunscreen since sunburn reduces the body's ability to cope with the heat; sunglasses and an umbrella are also recommended.
- **Schedule outdoor activities carefully:** Limit your outside activities to the cooler hours of the day (in the mornings and evening).



## Objective 6

- **Keep cool inside:** Stay cool and keep air circulating around you. Draw your blinds or curtains and use a fan or air conditioning if possible.
- **Do not leave children alone in parked cars,** The temperature inside a car can quickly rise. This is one of the most common causes of heat-related mortality among youngsters.
- **Pre-cooling** either with cold water or by ingesting cooled drinks is effective in increasing heat storage capacity.

### Secondary Prevention<sup>34,35</sup> :

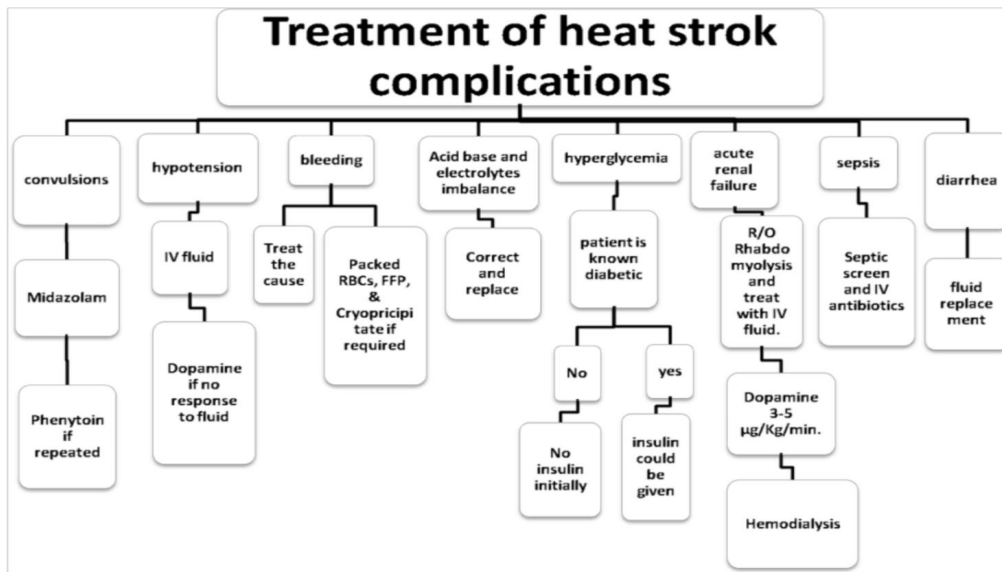
- **Learn how to early monitor those at high levels** by visiting them on a frequent basis and attentively monitoring them for early signs of heat exhaustion or heat stroke.
- **Know how to manage such a person** with heat-related illness by reviewing the treatment and management protocol
- **Trained human resource:** doctors and nurses in emergency departments, as well as ambulance paramedics in the affected cities/rural districts, will be trained in the identification of early warning symptoms and clinical management of heat-related disorders.

### Tertiary Prevention<sup>36</sup>:

If the heat related illnesses are severe, they should be treated in a medical facility using the treatment strategy outlined next page.



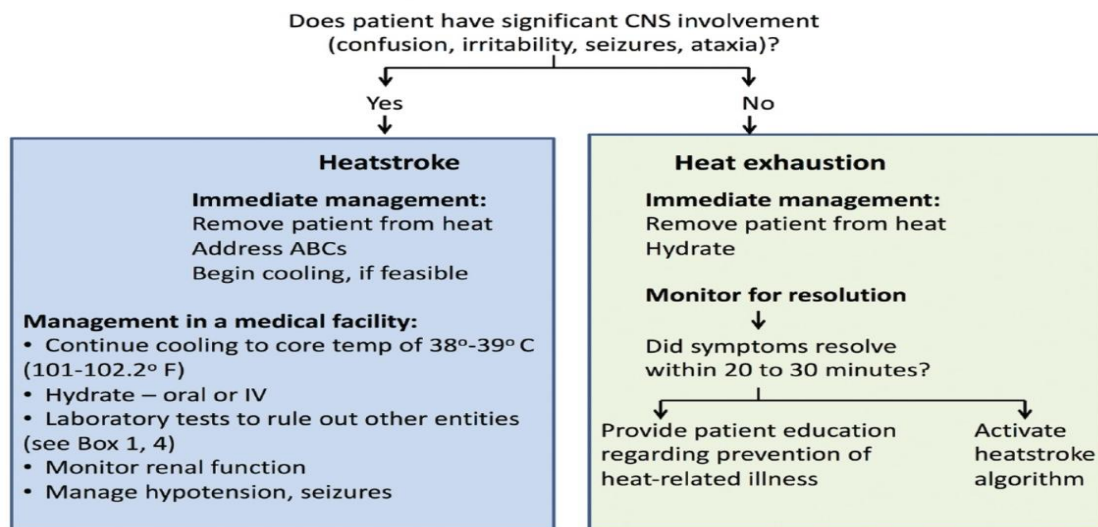
## Objective 6



- **Sepsis:** When the cause of the patient's hyperthermia is unclear at first and infection is still a possibility, empiric antibiotic therapy, followed by the collection of suitable cultures, is advisable while cooling measures are done.
- **Bleeding:** It may be necessary to replace lost blood using packed RBCs and clotting components such as fresh frozen plasma, platelets, cryoprecipitate, and fibrinogen.
- **Hepatic injury:** avoid the hepatotoxic drug.
- **Acute renal failure:** renal function tests and serum electrolyte concentrations should be continuously monitored during the first few days of illness; renal replacement therapy for overload may be required if indicated, as well as acidosis and electrolyte balance correction.
- **Diarrhea:** Only fluid replacement.

# Objective 6

## Treatment of heat-related illnesses <sup>37</sup>:



## The MOH device for Hajjis with heat events <sup>38,39</sup>:

MOH has constructed Heat Illnesses Command and Control Center (HICCC) Which is the leader for extreme heat events and has overall control and responsibility of the following :

- To ensure that a perfect prevention and preparedness approach is adopted by all health agencies serving during Hajj.
- To monitor and supervise The National Hajj Extreme Heat Strategic plan implementation.
- To revise and audit the strategic plan annually through current evidence based medicine ,data collection and analysis.
- To conduct researches designed to study new measures for prevention and management of heat related illnesses annually.
- To ensure that all response actions focus on the protection of life of pilgrims and all of the workers serving them.
- To have a situational awareness of the capability of all government agencies during extreme heat events.

## Objective 6

MOH consider it's important to have preparedness arrangements undertaken to protect the pilgrims, workers, infrastructure and service delivery during extreme heat events. Some of the committee preparations are the following:

1. The Executive Committee Coordinate with the other committees to ensure readiness of hospitals to operate with best infrastructure status this include:
  - Improving heat stroke units.
  - Availability of cooling resources.
  - Adequately equipped emergency departments.
  - Maintenance of air conditioning and climate control.
  - Maintenance of backup power.
2. The technical supervisory committee of hospitals and primary care centers during Hajj play a major role to provide strategies that deliver the highest and safest quality measures of care for patients with heat related illnesses during Hajj. And Provide Hajj extreme Heat booklets, Fact Sheets and Educational materials
3. The Health education and promotion committee coordinate with the technical supervisory committee of hospitals during Hajj to achieve the following<sup>39,40</sup>:
  - Produce printed fact sheets and additional educational information for the pilgrims in different languages.
  - Upload the booklets, fact sheets and additional educational information in website of MOH.<http://www.moh.gov.sa/hajj>
  - Liaise with Media public and SMS to provide health information

# the Ministry of Labor regulations regarding heat stroke:

Since the negative effects and particular occupational diseases caused by long and frequent exposure to direct sunlight and heat stress in the workplace, effort has been done on establishing controls and instructions to ensure the safety and health of workers in the workplace.

In 2014, a ministerial decree (ministerial decree number 3337) was issued to limit work hours on direct sunlight as follows: "A worker may not work in exposed places under direct sunlight from 12:00 pm to 3:00 pm every day from June 15th to September 15th of each year."<sup>41</sup>

Ministerial Decree no. (1/1559) dated 22/6/1431H contains this clause. The Deputy Minister of Labor is responsible for publicizing and carrying out this decree.<sup>41</sup>

Those at gas and petroleum firms, as well as workers in emergency repair departments, are exempt from this rule. Employers must take the appropriate precautions to shield their employees from the harmful effects of direct sunlight in such instances. Another exception to this rule is a handful of governorates in the Kingdom when temperatures are low enough that the above-mentioned working-hours suspension is not necessary. In this scenario, the Ministry will work with the Principalities to establish how far this provision can be implemented in each of their provinces.<sup>41</sup>

# Resources:

- 1- NASD - Heat Stress. (n.d.). Nasdonline.org. Retrieved April 20, 2022, from <https://nasdonline.org/137/d001702/heat-stress.html>
- 2- Heat Stress | Environmental Health and Safety. (n.d.). Ehs.research.uiowa.edu. <https://ehs.research.uiowa.edu/occupational/heat-stress>
- 3- Heat Stress - an overview | ScienceDirect Topics. (n.d.). Www.sciencedirect.com. Retrieved April 20, 2022, from <https://www.sciencedirect.com/topics/engineering/heat-stress>
- 4- Heat Illness: Symptoms, Causes, Treatments. (n.d.). Cleveland Clinic. <https://my.clevelandclinic.org/health/diseases/16425-heat-illness>
- 5- Heat-Related Illnesses (Heat Cramps, Heat Exhaustion, Heat Stroke) - Health Encyclopedia - University of Rochester Medical Center. (n.d.). Www.urmc.rochester.edu. <https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentTypeID=90&ContentID=P01611>
- 6- Heat exhaustion - Symptoms and causes. (2017). Mayo Clinic. <https://www.mayoclinic.org/diseases-conditions/heat-exhaustion/symptoms-causes/syc-20373250>
- 7- CDC - Heat Stress - Heat Related Illness - NIOSH Workplace Safety and Health Topic. (2019). CDC. <https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html>
- 8- Heat Stroke: Background, Pathophysiology, Etiology. (2021). EMedicine. <https://emedicine.medscape.com/article/166320-overview#a4>
- 9- Wedro, B. (2019, October 18). Heat Exhaustion First Aid Tips. MedicineNet; MedicineNet. [https://www.medicinenet.com/heat\\_exhaustion/article.htm](https://www.medicinenet.com/heat_exhaustion/article.htm)
- 10- NHS Choices. (2019). Heat exhaustion and heatstroke. NHS. <https://www.nhs.uk/conditions/heat-exhaustion-heatstroke/>
- 11-Heat Exhaustion: Symptoms & Treatment. (n.d.). Cleveland Clinic. <https://my.clevelandclinic.org/health/diseases/21480-heat-exhaustion>
- 12- Heatstroke and heat exhaustion. (2022). Australian Red Cross. <https://www.redcross.org.au/emergencies/prepare/heatstroke-and-heat-exhaustion/>
- 13- Mandal, A. (2019). Diagnosis and treatment of heatstroke. News-Medical. Retrieved on March 13, 2021 from <https://www.news-medical.net/health/Diagnosis-and-treatment-of-heat-stroke.aspx>
- 14- Mayo Clinic. (2017). Heatstroke - Symptoms and causes. Mayo Clinic. <https://www.mayoclinic.org/diseases-conditions/heat-stroke/symptoms-causes/syc-20353581>
- 15- Heatstroke: What Is It, Symptoms, Causes, Treatment & Recovery. (n.d.). Cleveland Clinic. <https://my.clevelandclinic.org/health/diseases/21812-heatstroke>
- 16- Economic Losses, Poverty & DISASTERS: 1998-2017. (2018). PreventionWeb - Knowledge platform for disaster risk reduction. [https://www.preventionweb.net/files/61119\\_credeconomiclosses.pdf](https://www.preventionweb.net/files/61119_credeconomiclosses.pdf)
- 17- Morris, A., & Patel, G. (2021). Heat Stroke. PubMed; StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK537135/>
- 18- Gaudio, F. G., & Grissom, C. K. (2016). Cooling Methods in Heat Stroke. The Journal of Emergency Medicine, 50(4), 607–616. <https://doi.org/10.1016/j.jemermed.2015.09.014>
- 19- US EPA, O. (2016, July 1). Climate Change Indicators: Heat-Related Illnesses. US EPA. <https://www.epa.gov/climate-indicators/heat-related-illnesses>
- 20- Argaud, L. (2007). Short- and Long-term Outcomes of Heatstroke Following the 2003 Heat Wave in Lyon, France. Archives of Internal Medicine, 167(20), 2177. <https://doi.org/10.1001/archinte.167.20.ioi70147>

# Resources:

- 21- Heat & Health. (n.d.). Global Heat Health Information Network. Retrieved April 20, 2022, from <https://ghhin.org/heat-and-health/>
- 22- F, M.-A. P., & R, B. E. (2018). Heat Waves: Health Effects, Observed Trends and Climate Change. In [www.intechopen.com](http://www.intechopen.com). IntechOpen. <https://www.intechopen.com/chapters/60156>
- 23-Working on a WARMER planet. (n.d.). [https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms\\_711919.pdf](https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_711919.pdf)
- 24-Heat and health. (2018, June 1). [www.who.int](http://www.who.int). <https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health>
- 25-Heatwaves. (2020, January 6). WHO. [https://www.who.int/health-topics/heatwaves#tab=tab\\_1](https://www.who.int/health-topics/heatwaves#tab=tab_1)
- 26-Heat Stroke: Background, Pathophysiology, Etiology. (2021). *EMedicine*. <https://emedicine.medscape.com/article/166320-overview#a6>
- 27-US EPA, O. (2016, July 1). *Climate Change Indicators: Heat-Related Illnesses*. US EPA. <https://www.epa.gov/climate-indicators/heat-related-illnesses>
- 28-Wu, X., Brady, J. E., Rosenberg, H., & Li, G. (2014). Emergency Department Visits for Heat Stroke in the United States, 2009 and 2010. *Injury Epidemiology*, 1(1). <https://doi.org/10.1186/2197-1714-1-8>
- 29-Ministry of Health. (2016). National Hajj Extreme Heat Strategy. <https://www.moh.gov.sa/en/Hajj/PublicationsAwareness/Publications/Documents/National-Hajj-Extreme-Heat-Strategic-Strategy.pdf>
- Ghaznawi, H. I., & Ibrahim, M. A. (1987). Heat Stroke and Heat Exhaustion in Pilgrims Performing the Haj (Annual Pilgrimage) in Saudi Arabia. *Annals of Saudi Medicine*, 7(4), 323–326. <https://doi.org/10.5144/0256-4947.1987.323>
- 31- مديرية الشؤون الصحية بمكة المكرمة.(2016). الاثر الصحي للتغيرات المناخية بين الحجاج و المعتمرين معهد خادم الحرمين الشريفين -31 لبحاث الحج والعمرة <http://hajjresearchrep.com/handle/123456789/306>
- 32-Enfield, C. of P. A. (2020, January 17). Extreme Heat. Port Adelaide Enfield. <https://www.cityofpae.sa.gov.au/community/services/cemp/extreme-heat>
- 33-Onda, H., & Yokota, H. (2012). Nihon rinsho. Japanese journal of clinical medicine, 70(6), 947–951.
- 34-(2021). Retrieved 14 March 2021, from [https://www.wbhealth.gov.in/uploaded\\_files/notice/heat\\_illnesses.pdf](https://www.wbhealth.gov.in/uploaded_files/notice/heat_illnesses.pdf)
- 35-Heat, S. (2021). PHDMC | - Extreme Heat. Retrieved 14 March 2021, Form <https://www.phdmc.org/extreme-heat>
- 36-(2021). Retrieved 14 March 2021, from <https://www.moh.gov.sa/en/Hajj/PublicationsAwareness/Publications/Documents/Heat-Illnesses-Guidelines.pdf>
- 37-View Image. (n.d.). [Www.cmijournal.org](http://www.cmijournal.org). Retrieved April 22, 2022, from [https://www.cmijournal.org/viewimage.asp?img=CurrMedlssues\\_2018\\_16\\_1\\_5\\_231365\\_f1.jpg](https://www.cmijournal.org/viewimage.asp?img=CurrMedlssues_2018_16_1_5_231365_f1.jpg)
- 38-وزارة الصحة السعودية. وزارة الصحة السعودية. (n.d.). الصحة, فريق بوابة وزارة--38 <https://www.moh.gov.sa/Ministry/MediaCenter/News/Pages/News-2021-07-12-006.aspx>
- 39-<https://www.moh.gov.sa/en/Hajj/PublicationsAwareness/Publications/Documents/National-Hajj-Extreme-Heat-Strategic-Strategy.pdf>
- 40-<https://www.moh.gov.sa/Documents/Heat-in-Hajj2019.pdf>
- 41-<https://hrsd.gov.sa/ar/page/الصحة-والسلامة-في-بيئة-العمل>