

Impacts of heat on health

Joy Shumake-Guillemot,¹ Virginia Murray,² Sari Kovats³

¹ WMO/WHO Joint Climate and Health Office

² Public Health England

³ London School of Hygiene and Tropical Medicine

Heat stress is a serious health threat for humans. Heat is a leading cause of weather-related death, and can exacerbate underlying morbidities including cardiovascular disease, diabetes, psychological distress, asthma, as well as increasing the risk of accidents and infectious diseases. Analyses conducted across all six populated continents in recent years clearly demonstrate that high outdoor and indoor temperatures have an impact on mortality.¹ For example, daily mortality spikes can be clearly observed for the heatwave days that occurred in England during the summer of 2016 (see figure).² Single heatwaves can last weeks, occur consecutively and result in significant excess mortality. In 2003, 70 000 people in Europe died as a result of the June–September event.³ In 2010, 55 000 excess deaths occurred during a 44-day heatwave in the Russian Federation.^{4, 5}

MECHANISMS OF HEALTH IMPACTS OF HEAT

Exposure to heat has wide ranging physiological impacts for all humans, with extreme exposures resulting in a cascade of illnesses, including heat cramps, heat exhaustion,

heatstroke and hyperthermia. Heat gain in the human body can be a combination of external heat from the environment and internal body heat generated from physical activity – hence, people working outside are particularly at risk and may not have the option to stop working or have access to appropriate cooling opportunities. High temperatures can also amplify a wide range of existing health conditions leading to a risk of premature mortality or additional hospital admissions. Heatwaves can also affect health indirectly, by altering human behaviour, the transmission of diseases, the capacity for health service delivery, air quality, and the functioning of critical social infrastructure such as energy, transport and water. The scale and nature of negative health impacts of heat depend on the timing, intensity and duration of a temperature event, and how well adapted buildings and behaviour are to the prevailing climate. The precise threshold at which temperature represents a hazardous condition varies by region and over time.

TYPES OF IMPACTS

Heat stress ranks amongst the highest environmental threats to human health due to the combination of direct deaths and derived effects on vulnerable groups during heatwaves and prolonged seasonal heat. Heatwaves can acutely impact large populations for short periods of time, often triggering health emergencies that result in excess mortality, cascading socioeconomic impacts (for example, lost work capacity and labour productivity) and the loss of health service delivery capacity. Power shortages that often accompany heatwaves can disrupt health facilities, energy, transport and water infrastructure, triggering secondary health risks due to lack of access to essential services. For example, in Australia and the United States, tens of thousands were left without power during heatwaves in 2018 as energy demand for cooling exceeded electric grid capacity.⁶ Heatwaves can increase the risk of wildfires, amplifying safety and health risks, such as observed in fires in 2018 in Scandinavia and California, and in the Russian Federation

¹ Gasparri, A., et al., 2015: Mortality risk attributable to high and low ambient temperature: a multicountry observational study. *Lancet*, 386(9991):369–375.

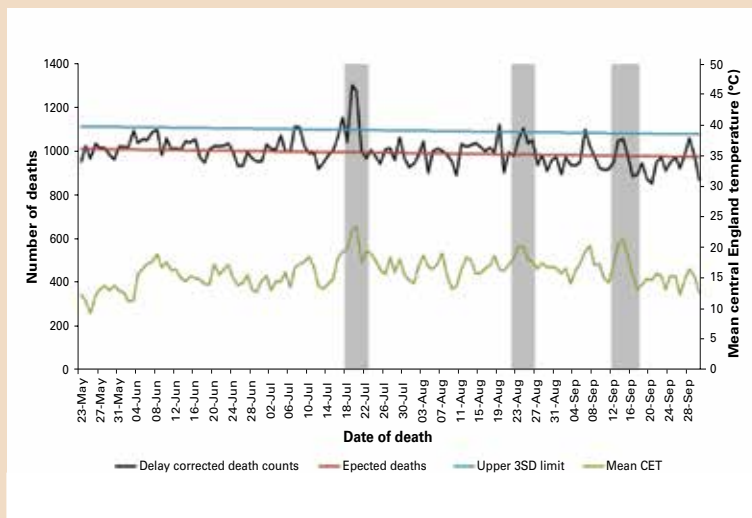
² Public Health England, 2016: *Heatwave Mortality Monitoring Summer 2016*. London, PHE, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714933/PHE_heatwave_mortality_monitoring_report_2016.pdf.

³ Robine, J.-M., S.L.K. Cheung, S. Le Roy, H. van Oyen, C. Griffiths, J.-P. Michel and F.R. Herrmann, 2008: Death toll exceeded 70,000 in Europe during the summer of 2003. *Comptes rendus biologiques*, 331(2):171–178.

⁴ Shaposhnikov, D., B. Revich, T. Bellander, G. Bero Bedada, M. Bottai, T. Kharkova, E. Kvasha, E. Lezina, T. Lind, E. Semutnikova and G. Pershagen, 2014: Mortality related to air pollution with the Moscow heat wave and wildfire of 2010. *Epidemiology (Cambridge, Mass.)*, 25(3):359–364.

⁵ See <http://origin.who.int/globalchange/publications/heat-and-health/en/>.

⁶ See <https://www.reuters.com/article/us-australia-power/heat-wave-leaves-thousands-of-australian-homes-without-power-idUSKBN1F10CO> and <https://www.cnn.com/2018/07/07/us/heat-wave-los-angeles-wxc/index.html>.



Daily mortality in people aged 65 or over in England, summer 2016.
 Source: Public Health England.

in 2010. Extended periods of high day and night-time temperatures create cumulative physiological stress on the human body that exacerbates the top causes of death globally, including respiratory and cardiovascular diseases, diabetes mellitus, and renal disease. Indoor and outdoor workers are particularly exposed to chronic excessive heat exposure, and rising temperatures often make work intolerable or dangerous.⁷ Occupational heat strain directly affects workers' health, elevating the risk of kidney diseases and work accidents. The socioeconomic effects of lost productivity must also be taken into account – considering individual ability to live healthy and productive lives is fundamental to poverty reduction and global health.

INCREASING HEAT EXPOSURE DUE TO CLIMATE CHANGE

No population can avoid exposure to rising ambient temperatures. However, some populations are more exposed to or more physiologically or socioeconomically vulnerable to physiological stress, exacerbated illness and an increased risk of death from exposure to excess heat. These include the elderly, infants and children, pregnant women, workers, athletes and people involved in outdoor recreation (for example, religious events or music festivals), and the poor. In

December 2018, experts from six continents reported to the Global Heat Health Information Network (GHHIN) significant observed shifts in regional climatologies, with a strong trend toward increasing frequency, intensity, and duration of heat events, accompanied by wide-ranging health impacts.⁸

Population exposure to heat is predictably increasing due to the “climate commitment” or expected amount of warming due to GHG levels in the atmosphere today. Heat-related problems for society will be exacerbated by a warming climate for the remainder of the twenty-first century regardless of climate change mitigation pathways. These trends raise alarm bells for the public health community as extreme temperature events are observed to be increasing in their intensity, frequency and duration.

Detrimental health outcomes associated with excessive heat exposure can be markedly reduced if appropriate early warning systems, public preparedness and health interventions are effectively implemented. For example, in Europe the presence of a heat health warning system has been shown to reduce the impact of heatwaves on several populations. GHHIN was established in 2018 to increase collaboration between relevant disciplines to accelerate the sharing of scientific evidence and decision tools to improve global public health heat risk management.⁸

⁷ Sherwood, S.C. and M. Huber, 2010: An adaptability limit to climate change due to heat stress. *Proceedings of the National Academy of Sciences of the United States of America*, 107(21):9552–9555, DOI:10.1073/pnas.0913352107.

⁸ Global Heat Health Information Network First Global Forum on Heat and Health, see www.ghhin.org.