Climate Change and Health – the Risk of Heatwaves

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Heatwaves and health

• Definition
• Dimension
• Repercussions
• Vulnerability: System Level - Individual Level
• Heat stress and complications
• Risks: Age, socio-economic factors, structural factors
• Adaptation and mitigation strategies
How are heatwaves defined?

- There is no universally accepted definition
- In general: Periods of unusually hot and dry or humid weather for a minimum of 2-3 days, relative to a local climate (Kalkstein, 2015).
- “Wet Bulb Globe Temperature (WBGT)” = standard heat index measurement in countries (U.S. Meteorological Society).
Why are heatwaves a public health threat?

• Heatwaves are projected to increase in severity & frequency (Li, 2015; The Lancet Editorial on Heatwaves, 2018).

• Despite the increasing evidence there is limited response by the international community so far.

• Adaptation from humans to increases in temperature is limited. Some projections estimate that a global temperature increase of 7 degrees C will cause several regions to become uninhabitable (Sherwood & Huber, 2010).
  - Example of Japan, where, this summer, 22,000 people had to be hospitalized when temperatures hit 41 degrees C.
  - Example of South Asia: a 146% increase in the probability of heat-related mortality of 100 people or more (Im, Pal & Eltahir et al., 2017 & Mazdiyasni et al., 2018).
Heatwaves 2003 – 2018:

- August 2003- Europe
- August 2006-Europe
- July-August 2006- USA (New York to California) and most of Canada
- May-September 2007- India, Pakistan, Bangladesh, Nepal, Russia, Japan, and China
- July 2007- Southern Europe
- January-February 2009- Australia
- April-June and June-October 2010- Most of the Northern Hemisphere (including USA, Kazakhstan, Mongolia, China, Hong Kong, North Africa, Europe, parts of Canada, Russia, Indochina, South Korea, and Japan)
- July 2010-Russia
- July-August 2011- North America
- Summer 2012- USA (Midwest, South, West)
- December-January 2012-2013- Australia
- July 2013-UK
- July-August 2013- China
- June and July 2015-Europe
- June 2015- India and Pakistan August 2017- Europe
- June-August 2018- North America, Europe, North Africa, Middle East, East Asia (Japan)

Image courtesy of the Nasa Earth Observatory, 2003
Impact

• Heatwaves disrupt economies, transport, agriculture, and utilities

• Exacerbate existing issues like drought and negatively impact health (The Lancet Editorial on Heatwaves, 2018).

• Ecosystems and human systems are extremely vulnerable to heat waves

➔ To protect humans, systems and the environment, proper mitigation and adaption strategies must be implemented (IPCC AR5, 2015).

Image courtesy of Nasa Earth Observatory
Heatwaves and Health: Basics

• 4 general categories of threats:
  1. Risks to health
  2. Risks to systems including disruption of infrastructure and service provision
  3. Risks to food and water security, livelihoods and income.
  4. Risks to ecosystems and biodiversity as well as the natural goods that we all rely on for our livelihoods and that ensure the health of the planet.

Source: IPCC AR5, 2015
Why are we so vulnerable?

Systems Level

- **Relative risk** is rooted in social, economic, and cultural processes that include wealth distribution, demographic composition, migration, access to information and technology, social and governmental structures, and, ultimately, inequality and inequity in economic development.

- Risk is higher for the poor, marginalized, disenfranchised.

- Those living in areas affected by violent conflict are at extreme risk due to destruction of social structures and infrastructure.

Source: IPCC AR5, 2015
Why are we so vulnerable?

Individual level

- **Climate-related factors** (frequency/intensity of heatwaves) and

- **individual risk factors** (medical, behavioural, environmental)

- **Climate factors**, that impact human-heat balance: air temperature, radiant temperature, surface temperature, air humidity, and wind speed (Koppe et al., 2003 and Kalkstein, 2015).

- **Heat-related mortality** correlates with: age, location, and socio-economic status (IPCC AR5, 2015).
What is heat stress?

• Our bodies have an internal thermoregulation system that regulates our body temperature.

• Mechanisms for dissipating excess heat: sweat production and skin blood flow.

• When heat stress occurs, it is important for both systems to function well.

• If the system is overly stressed or cannot meet environmental demands, heat illnesses can occur (Koppe et al., 2003).
What complications are associated with heat stress?

Classic heat-related illnesses:

• Skin eruptions
• Heat fatigue
• Heat cramps
• Heat exhaustion
• Heat stroke

• **Heat stroke**: high risk of mortality.
• Caused by the failure of the body’s thermoregulatory system.
• It causes cell damage and damage to the thermoregulatory system.
• Complications: respiratory distress, kidney failure, and liver failure.
• Prolonged extreme body temperature → increases cardiovascular load, heat vasodilation and dehydration → negatively impact on cardiovascular illnesses (Koppe et al., 2003 and Kalkstein, 2015).
Risk factors for heat-related morbidity/mortality

- Age (elderly and children)
- Impaired cognition (dementia, etc.)
- Pre-existing conditions (cardiovascular, respiratory, renal disease, diabetes)
- Medications (diuretics, psychotropics, anticholinergic)
- Mental illness
- Level of hydration
- Fitness
- Overweight
- Fatigue, sleep deprivation
- Long-term high-level exercise
- Immobility/inability for self-care
- Heavy protective clothing
- Lack of acclimatization
- Sex
- Living alone
- Type, quality, and location of housing
- Air-conditioning
- Lack of access to heat health information
- Lower socio-economic status
- Social isolation/deprivation
- Homelessness

Sources: Hajat et al., 2010; MacIntyre et al. 2018; Koppe et al., 2003; Choudhary et al., 2014; Li, 2015; Kalkstein, 2015.
High Risk of health problems caused by heat exposure

1. People with lower socio-economic status → low-quality housing and lack of air-conditioning (Koppe et al., 2003).

   - Housing with little ventilation, high thermal mass and on the top floors of buildings (Hajat et al. et al., 2010).

3. Association between sustained high temperatures and suicide risk. (Thompson et al., 2018).
4. **The elderly** are more vulnerable: natural changes in the thermoregulatory system; use of drugs that interfere with normal body homeostasis.

- Elderly people who have been institutionalized are also vulnerable to heat-related morbidity and mortality.
- Elderly people are less fit, have more pre-existing conditions and a reduced sweating capacity than younger people.
- Social and physical isolation also increases their risk of dying during a heat wave.
- In countries where the population is ageing special attention should be paid to the dangers of high heat for the elderly (Koppe et al., 2003; Klinenberg, 2002).
Heatwaves and Health Service Provision

• Heatwaves make providing adequate health care difficult because acute demand, consultation requests, and in-patient admissions simultaneously increase.

• Many hospitals were poorly engineered/designed to deal with heat and regularly experience internal heat gains from patients, equipment, and staff, making them ill-prepared for future heatwaves. (The Lancet, 2018)
Heatwaves in LMIC

• Probabilistic modelling: future temperature rise will increase heat-related mortality, especially in low-latitude, LMICountries

• Even moderate increases in mean temperatures may greatly increase heat-related mortality in these regions (Mazdiyasni et al., 2018).

• Exposure is greater because adaptation measures are costly and many people work outdoors (The Lancet, 2018).

• LMIC can have power shortages during heatwaves

• In LMIC the majority of workers are in the informal sector → out of pocket payments for health care (Sauerborn, 2016).
Heatwaves and Occupational Health:

- Climate change and heatwaves have implications for occupational health and safety and heat stress represents an occupational hazard (IPCC AR4, 2007).
- Risks associated with heat exposure affect people who work outdoors, such as laborers or agricultural workers (Hollowell, 2010).
- In California, with a large agricultural sector, heat-related deaths of farm workers occur every year (Sauerborn, 2016).
Heatwaves and Occupational Health:

• Chronic dehydration from working out in the fields → chronic kidney disease in Nicaragua;

• For those working in factories or hot industries, increased heat from heatwaves increases evaporation of some solvents and the risk of chemical exposure (Sauerborn, 2012).

Affected sectors:
• Mining
• Construction
• Agriculture
• Forestry
• Landscaping
• Hazardous waste management
• Firefighting
• Hot industries (e.g. lead smelting)
• Military

Source: (Sauerborn, 2012).
Adaptation and Mitigation Strategies (1)

- **Warning Systems (HHWSs)** → targeted advice and intervention measures:
- **Urban planning** to address bioclimates and reduce the effect of urban heat islands (UHI)
- **Building designs** that reduce indoor air temperatures without relying on air-conditioning (Koppe et al., 2003; Kalkstein, 2015).
- Developing **heatwave policies** at all levels targeted to at-risk populations (Li, 2015).
- Adopt **national and international policies** aligned with the 2015 Paris Agreement (EEA, 2017).
Adaptation and Mitigation Strategies (2)

- **Educate** first responders and doctors

- Build **resilient and responsive** nursing care systems and social networks for the elderly (Herrmann & Sauerborn, 2018).

- Development of more comprehensive and **long-term solutions** (The Lancet, 2018).

Image courtesy of China Daily
Conclusion:

• Regardless of which global mitigation scenario (RCP) we choose, it is very likely that heatwaves and other extreme weather events will increase in frequency, duration, and severity in the future.

• We need comprehensive risk assessments that consider the widest possible range of scenarios and impacts (IPCC AR5, 2015).

• Development of a cross-border strategy for risk communication

• Put health at the centre of our (political) decisions regarding adaptation and mitigation.

• Globally we need to work towards building resilient communities and continue to fight for lower green house gas emissions (The Lancet Editorial on Heatwaves, 2018).
References: