Heatwaves

Although warm conditions affect human health, significant impacts are created by strong and prolonged events. These events, which are codified as 'heatwaves', are generally described as a period of abnormally high and quite often humid weather, usually lasting for a minimum of one day. But heatwaves that cause high or catastrophic impacts generally last considerably longer, sometimes even weeks at a time. The most hazardous conditions to human health are multi-day heatwaves where extreme daytime temperature is combined with high nocturnal temperatures, high-relative humidity and light wind conditions for a period of several consecutive days.

The UK Meteorological Office, among others, defines a heatwave by using criteria based on varying thresholds, dependent upon the region's average temperature conditions. For example, in London, heatwave conditions are declared when temperatures exceed the 32˚C upper threshold, including night-time temperatures of 18˚C or more, for a period of 5 consecutive days. In the Netherlands, a heatwave is defined as a period of five or more consecutive days with temperature above 25˚C, of which at least three days reach temperature above 30˚C ('tropical days'). Belgium uses the same definition. The average temperature conditions, and degree of heat to which people may be exposed is shaped by the geographical features of the urban landscape. An example of this consists of the large urban areas (especially built-up centres) where temperatures are disproportionally higher than in the surrounding areas because of the **urban heat island effect** (**Figure 12.1**).

Heat is particularly a problem for large urban areas containing dense populations, and because of the amplifying effects of the urban heat island as well as atmospheric pollutants. The urban heat island effect is the thermal contrast between urban space and its surroundings, primarily occurring due to non-evaporating surface materials such as asphalt and concrete disturbing the atmosphere surface energy balance (Figure 12.1). It represents the clearest expression of anthropogenic impact of climate at the local level, and may well exacerbate already high temperatures in cities, which can lead to stressful levels during periods of extreme temperature. During the 2003 event, anomalous heat produced nocturnal temperatures in London that reached 6-8 degrees higher than those found in rural environments.

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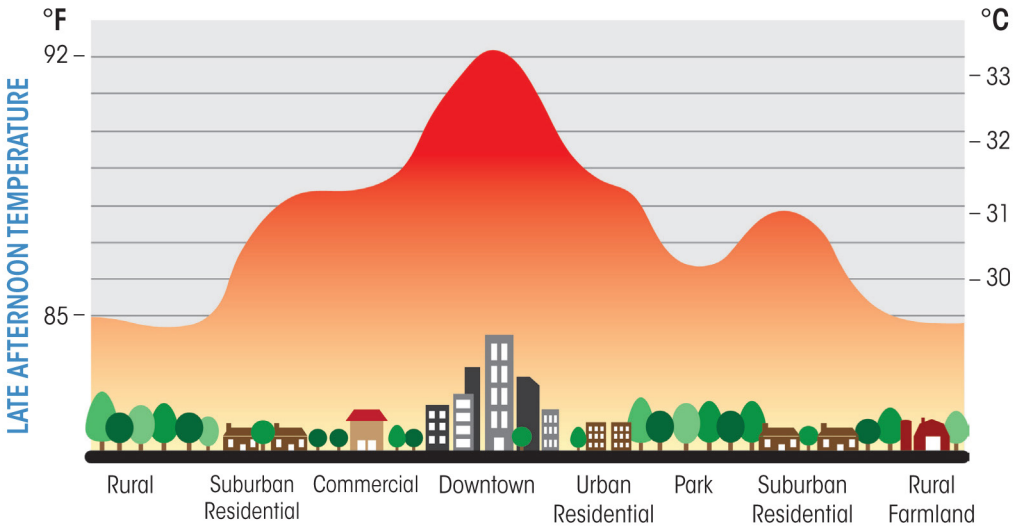
Figure 12.1.
Temperature differences between areas with different levels of built environment.



Heat mortality and morbidity

The impacts of heatwaves on urban populations represent **an emerging environmental health concern**. Recent heat events, in particular the 2003 event, which accounted for up to 80,000 deaths (Robine, 2008) provides a stark example of this health burden across the European continent. From the period 1990-2013 at least 132,523 fatalities have been recorded in Europe due to heat-related health complications (CRED, 2013). Thus far, figures that illustrate heat-related mortality have been deeply alarming. Moreover, such figures are likely to be underestimated because of lack of surveys and misreporting, especially with regards to non-high impact events that generate a reduced societal response.

Even when a heatwave is not technically in progress, warm temperature conditions are still linked to mortality (Kovats & Kritie, 2006). Every year, a significant number of people die and/or require hospitalisation because of the physiological stress imposed by elevated levels of ambient heat. A 'j-shaped' (see **Figure 12.2**) graph often represents the connection between mortality and both cold and warm temperatures. The optimum or 'healthy' temperature is dependent on average temperatures experienced in geographical region (linked to latitude) as well as the implementation and effectiveness of adaptive measures designed to acclimatise populations to warmer or colder temperature conditions.

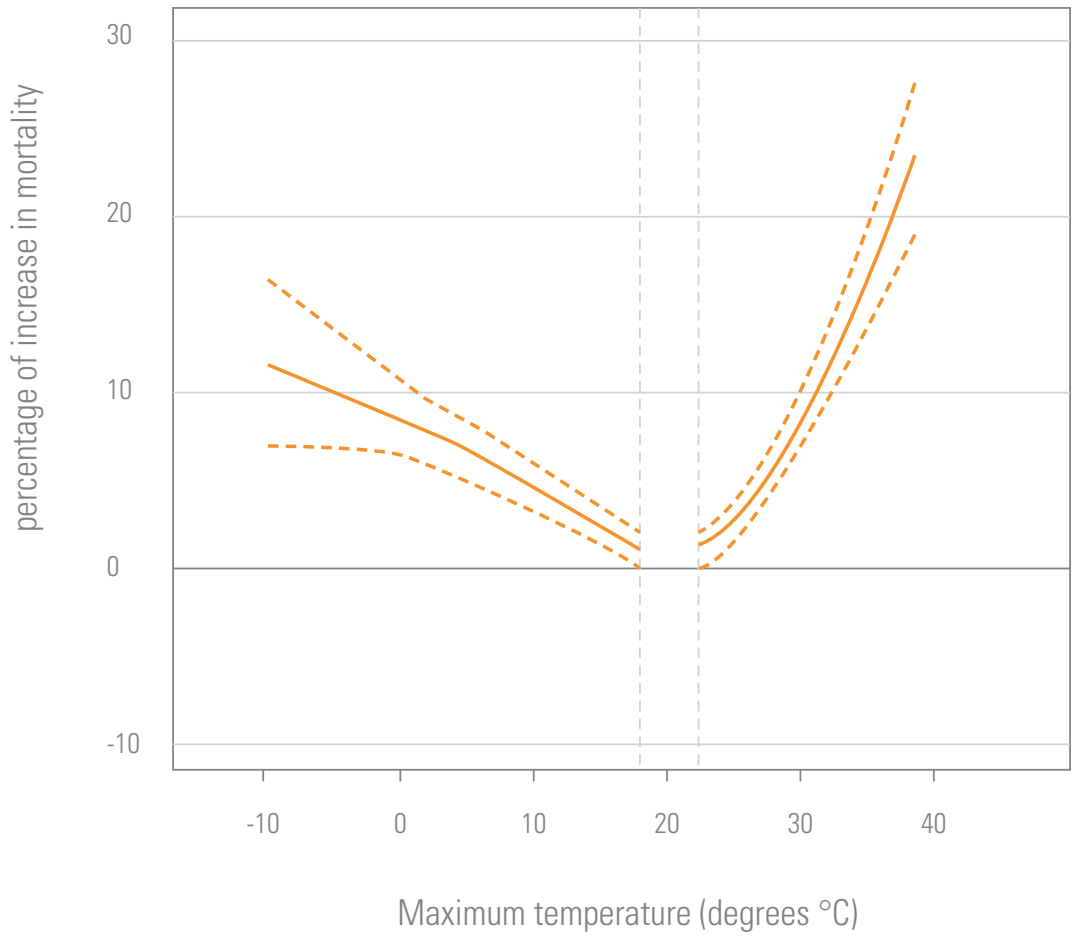
While there is a predominance of research focused on heat-associated mortality in Europe, a significantly smaller number of papers have been preoccupied with **heat-related morbidity**, even though the relationship between elevated temperature and heat-related morbidity is recognised as a serious public health issue (Ye et al., 2012). Studies have shown that the elderly (≥ 65 years of age) are more at risk for detrimental effects of heat and heat waves, including an increase in the number of hospital admissions (Gronlund et al., 2014), such as admissions for respiratory diseases (Michelozzi et al., 2009; Mstrangelo et al.; 2007; Kovats et al., 2004) and for heart diseases (Schwarz et al., 2004). Adverse health conditions that occur also more frequently during a heatwave are dehydration, hyperthermia, malaise, hyponatremia, renal colic and renal failure (Josseran et al., 2009).

Future projections of heat in Europe

Heatwaves are among small clusters of hazards firmly associated with the influences of climate change. The IPCC report 'Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation' (SREX, 2012) highlights that warming trends will probably result in more frequent, intense and persistent heat periods in years to come with the onset of anthropogenic-induced change. Climate change experts and meteorologists agree that the extreme summer of 2003, which was very unusual by historical standards, will become normal by 2050 (SREX, 2012). In terms of daily extremes, climate models suggest that a 1-in-20 hottest day will become a 1-2 year event by the end of the 21st century in most regions.

Figure 12.2.

The exposure-response relationship for temperature-associated mortality. (Source: Li et al., 2013).



Heat as a public health priority

In the United States, extreme heat is known to account for more deaths per annum than the combination of hurricanes, electrical storms, earthquakes and floods (Luber & McGeehn, 2008). In Europe, however, heat as a major hazard was underestimated until the 2003 high temperature event. The 2003 European event was thought-provoking in the sense that it appeared to be a region neither particularly exposed nor vulnerable due to the capabilities of organisations and institutions, technology and infrastructure, as well as financial strength to manage negative impacts (Lass et al., 2011). Yet, the heat experienced in the summer of 2003 serves to underscore that Europe is not invulnerable to suffering extremely high death tolls, the severity of which justifiably drew comparisons to impacts observed in low-income developing nations.

The impact of heatwaves on population health in the context of past impacts and predicted changes in prevalence and intensity is of great concern for health practitioners, policymakers and the hazard management community. Public health concerns regarding heat-mortality and morbidity are likely to increase with the synergistic effects of demographic change, urbanisation, and the climate change induced warming of the atmosphere. However, **notwithstanding the devastating historical impacts and predicted rises in heat-mortality under various scenarios, the adverse effects of extreme heat are largely preventable**. Disaster response strategies are at their most effective when populations, the health sector, emergency planners and responders, care and social services, and public infrastructure are prepared. This gives the best chance in both current and future risk to significantly reduce health-related mortality and morbidity.

One of these strategies consists of the implementation of a so-called **Heat Health Warning System (HHWS)**, which is an approach to protect humans, in particular vulnerable populations, from the detrimental consequences of heatwaves. A HHWS usually describes at least the following items:

- criteria for implementation of the plan
- role of the different stakeholders (including
- collaborations with other stakeholders)
- target groups
- awareness messages.

Following the 2003 heatwave, at least 12 countries in Europe have introduced a HHWS (Lowe et al., 2011). Since a functioning HHWS requires an intensive collaboration between a number of stakeholders, this multi-stakeholder partnership (MSP) requires coordination from one organisation, usually the Ministry of Health or the National Institute of Health. Although the main purpose is to establish the role of professionals (e.g. in elderly care facilities, or general practitioners) during a heatwave, national heat plans also contribute in increasing awareness of heat risks in vulnerable groups and their care providers. The messages are channelled through community professionals and indirectly through the media.

We assessed the MSP within the HHWSs for selected case study locations by performing a desk review and interviewing key informant stakeholders. The two selected locations were Amsterdam (The Netherlands) and Brussels (Belgium).

Multi-sector partnership on heat and health in Amsterdam

The Dutch National Heat Plan (RIVM, 2007) is aimed at managers of a variety of organisations. It offers an overview of the responsibilities and measures in health care during a period of extreme heat. The aim of the heat plan is to improve wellbeing and quality of life of citizens and reduce illness and disease due to extreme heat. One important aspect of the heat plan is to increase knowledge and raise awareness on the adverse health effects of heat, in risk groups as well as in their direct environment. This environment consists of institutes, health providers and volunteers with whom the risk groups are in contact with. Awareness and knowledge are prerequisites for an adequate response during a period of ongoing heat. The plan describes the actions that are taken in the short term to increase the sense of urgency and the willingness to undertake action, and it is described in the form of a communication plan.

Different levels of alertness within the HHWS

To distinguish between periods with different heat intensities, different levels of alertness are described in the HHWS:

(1) Watchfulness phase – This phase lasts the whole summer period (1st of June to 1st of September. It means that all involved stakeholders should prepare for the summer period and check whether all plans are still up to date. In addition, organisations should raise awareness among employees.

(2) Pre-warning phase – The second phase starts when the odds of a period with at least five days with temperatures above 27˚C are above 20%. A limited number of organisations are informed by RIVM in this stage, including stakeholders such as VWS, GGD-NL, NRK and regional health inspection departments, GGDs. The reason for this is that these organisations should be in a higher state of alertness from that point onwards, in case there will actually be a hot period. The general public is not yet informed in this stage.

(3) Warning phase – The third phase starts when the odds of a period with at least five days with temperatures above 27˚C are above 90%. Again, a message is sent out to all partner organisations of RIVM, but this time with another message. A press release is issued by RIVM and KNMI (Netherlands Meteorological Service), to inform the general public on the increased risk. Stakeholders will take pre-determined measures, e.g. an elderly care institute will launch its own heat plan. GGDs will take on their roles as regional information points. There is no explicit signal to end this phase, but this depends on stakeholders' own observation.

Multi-sector partnership

The aim of the plan is to reach a stage where involved stakeholders will take responsibility, cooperate in carrying out measures and organise their organisation in such a way that they can optimally deal with periods of ongoing heat. Below is a description of the organisations that have a role in the heat plan:

- Ministry of Health, Welfare and Sport (VWS) organises the collaboration that is aimed at making and evaluating the heat plan in a yearly cycle.
- Royal Netherlands Meteorological Institute (KNMI) monitors the weather predictions and calculates the odds of a period of ongoing heat.
- Branch of Municipal Health Services in the Netherlands (GGD-NL) is responsible for the national agreements with representatives of organisations of professionals and branch organisations that are involved in care of risk groups for heat.
- The Dutch Red Cross (NRK) maintains contact with organisations of volunteer care. They emphasise the heat plan and their contribution therein. These tasks are also fulfilled towards NRK's direct followers.
- Health care institutes – This category consists of hospitals as well as elderly care institutes.

The flow of communication goes from KNMI (responsible for monitoring weather predictions) to RIVM. RIVM informs regional contact points (GGDs) in all regions of the Netherlands, 25 in total. These contact points are mainly responsible for: providing information to the public on behalf of RIVM; serve as an information point for professionals; agree on collaborations with various care institutes. Other stakeholders that GGDs are informing in their region include volunteer organisations, home care, child care centres, municipalities, general practitioners, hospitals, and elderly care centres.

Multi-sector partnership on heat and health in Brussels

In Belgium, there are different heat plans for the different regions (Flanders, Wallonia, and Brussels). The plans for the different regions are almost identical, but the organisations and their responsibilities differ quite a lot. Since our case study primarily assesses cities, we focussed on Brussels.

Brussels has a **combined plan for heatwaves and ozone**. It starts with a description of some terminology, e.g. a heatwave and an ozone peak. After, it describes symptoms and health effects related to exposure to heat or ozone. The main risk groups are described, namely children, the elderly, socially isolated individuals and individuals who perform a lot of physical effort. In addition, it describes which factors can induce health effects due to heat (e.g. taking certain types of medication). The next section describes how to prevent or treat health effects in each of the risk groups.

Different levels of alertness within the HHWS

There are three levels of alertness described in the plan, each associated with different actions and activities:

(1) Watchfulness phase – In this phase, the general public is sensitised about the risks of heat and ozone, and they are encouraged to help family members, neighbours and other potential sensitive individuals. General information is brought forward by the health care sector and social partners. The leaflet 'Heatwaves and ozone peaks' is spread to a large number of awareness raising organisations.

(2) Warning phase – The second phase starts when a heatwave is predicted during a period of two days. Activities that are started during this phase are informing the Minister of Health and other actors in the health sector. A media campaign will start with clear preventive and curative messages for risk groups and individuals who take care of them.

(3) Alert phase – This phase is activated when the threshold is reached and when the measures that have already been taken need to be intensified. This can include further media campaigns, announcing an alert and possibly organising a risk-control cell. This cell would be able to take concrete measures, e.g. cancelling certain events.

Multi-sector partnership

Several stakeholders are specifically listed in the plan, although most of their roles are not described in detail:

- FOD is the organisation for Public Health, Food Safety and Environment, and is in charge of the heat plan and upscaling the plan to a different level.
- KMI is responsible for temperature measurements, and provides FOD with temperature predictions.
- IRCELINE is the KMI equivalent for ozone measurements.
- Minister of Health is the first one to be informed in case of an expected heat event, and the activation of the warning phase.
- Health sector consists of general practitioners, emergency rooms and other departments of hospitals, who are being informed during the warning phase.
- Social sector provides elderly care and home care through partner organisations, which are also informed during the warning phase.

In contrast to the heat plan in the Netherlands, the plan in Brussels does not provide a schematic overview of how the communication between the different stakeholders is organised. Instead, the plan seems rather top-down, where the FOD Public Health, Food Safety and Environment are solely responsible for informing all stakeholders on the activation of the alert phase.

Key informant interviews

Interviews were held in Amsterdam and Brussels. The interview outline was created in such a way that it provides an optimal perspective on the stakeholders' views on heat and health, mainly on existing collaborations with other stakeholders. We specifically asked for the opinions of the interviewees on some topics (e.g. the importance of heat as a public health priority), even though they might not always reflect the exact views of their stakeholder organisations. Since we are evaluating whether national heat plans work in daily practice, we also asked interviewees to name what they considered to be strengths and weaknesses of the plan.

Amsterdam

This section describes a compilation of the key informant interviews that were held in the Netherlands. Most of the stakeholders were aware of the National Heat Plan, although this was not the case for the elderly care organisation and the hospital. Some key informants have also provided input for the new plan that was launched in 2015. When the warning phase is indicated, many intermediaries of risk groups, such as general practitioners, pharmacies and volunteer organisations, receive a message. This does not include health care and elderly care institutes, since they should be contacted by the branch organisation for the health care sector. However, in practice this is not the case.

Most key informants feel that heat in general is an important public health priority, especially in cities. This is due to the fact that there is a relatively large impact, especially on vulnerable populations (elderly and lonely individuals), and there are easy measures to cope with this impact. Heat during big events (e.g. concerts) is also a particular area of interest, since it affects large segments of the community. The organisations that deal directly with risk groups (elderly care and hospitals) saw heat as a lower priority, especially compared to other health problems (such as infections).

It is unclear how the messages from the heat plan are perceived by the majority of the professionals who provide services, let alone by the risk groups themselves. To be able to evaluate this would require a survey among these professionals, which would lead to important insights. The message that is sent is quite non-committal, and that applies also to the roles and tasks of the different stakeholders. However, the advice that is given, e.g. on stickers that are used to inform the public, is perceived by the key informants to be quite clear. The communication link between the general population and authorities is considered to be quite passive and effort should therefore be made to intensify this contact, e.g. in the form of press releases.

With respect to partnerships with other organisations, most interviewees feel that the roles of the stakeholders could be fully clarified and more enforced. Currently it is not difficult for stakeholders to avoid responsibility and some collaborations are non-existent or still need major development. None of the stakeholders are really considering yet how partnerships should evolve in the future, due to the impact of climate change and the accompanying increase in extreme heat events.

Brussels

The Belgian heat plan was initially implemented on a federal level, within the National Environmental Health Action Plan (NEHAP), but now it works on a regional level. There is generally more interest from social organisations (e.g. elderly care) than from medical organisations, partly because the system is also more oriented at social activities. Within the plan, key informants are responsible for providing information to the general population, preparing the watchfulness phase and providing information to professionals through an email list of a large group of stakeholders. However, our interview highlighted the fact that not all organisations are aware of the Belgian heat plan.

Targeting at-risk individuals work indirectly through a cascade. Most key informants feel that the messages within the heat plan are clear for at-risk individuals, although it is important to continue improving. In addition, they are often repeated, since they are broadcasted e.g. during the weather forecasts on television. An important point of the key informants was that people who are institutionalised, according to them, are more likely to follow the recommendations than people living alone or homeless individuals.

Different organisations are in contact with each other, and several stakeholders meet once a year, when the watchfulness phase of the heat plan starts. Most key informants felt that the responsibilities of different stakeholders are not clearly described: when there is an extreme event, stakeholders do not know which tasks belong to whom. Partly this is inherent to the Belgian political system, which is divided in three regions (Flanders, Wallonia and Brussels). Communication in general is good, but less so between the social sector and the health sector. On a national level, the number of stakeholders is sufficient, but on a regional level this needs to expand further. This is particularly true for Brussels, for which the regional implementation of the heat plan started only in 2015. Some key informants feel that it might be necessary to meet more often, when there is an expected increase in extreme heat events due to climate change, although most stakeholders are most likely not willing to invest more time.

In conclusion, the existence of a heat plan is an undoubted strength, and it provides a platform for stakeholders from the health and environment sectors to meet. Weak points include a low engagement at the regional level and lack of clarity in responsibilities.

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