



Health after Extreme Cold, Heat, Storms and Floods

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Although the UK has some of the most temperate weather anywhere in the world, even here extremes of weather cause many deaths. In many other countries the extremes of weather are substantially greater and the deaths are higher. Even in the UK thousands of people die due to weather related events in some years. This is a summary of key points covered in this lecture about the health effects of extreme weather rather than a direct transcript.

We should start with the extremes of temperature. These have their greatest effect at the extremes of life; babies and the youngest children and elderly adults are at by far the greatest risk of most temperature-related illness and mortality. The world in general, and high income countries in particular, expend a lot of energy and money keeping the temperature range we live in at the comfortable, and therefore medically safe, range. During cold periods indoor spaces are heated by central heating, we use warm clothing, insulation and efficient fires. In very hot climates air-conditioning, cool clothing and plentiful rehydration are essential. Money and engineering therefore reduce the risk of weather-related ill-health but do not eliminate it, and in consequence the poorest in every community are most at risk.

Those who live in the extremes of temperature have generally adapted cultural responses which are practical and reduce the risk. From Inuit families in the coldest north through to those who live in desert or humid tropical environments, clothing, behaviours, and architecture tend to have adapted to minimise the health risks of the extremes of climate. Even with the maximum adaptation however weather and climate-related risks to health are substantial.

This lecture will not cover droughts and consequent famines. These are important but much slower onset weather- and climate related risks to health.

Cold

Cold external temperatures cause severe illness on its own, and makes many other diseases more likely. In the UK every year there is an excess of deaths in the winter. This excess has reduced significantly over the last 70 years, due to multiple factors including better housing, central heating, socio-economic improvements, preventive medicine and better medical treatment. Excess winter deaths however remain at over 20,000 a year.

Cold weather makes many health conditions worse or more likely. Examples include infections such as pneumonia, influenza and Covid-19; cardiovascular diseases including heart attacks and strokes; slips and trips on ice including fractures, which in the elderly can end up being fatal or highly disabling.

Below around 15°C older people are steadily more likely to have major cardiovascular events; the colder the temperature and the longer the exposure the greater the risk will be. The more clinical risk factors we have the greatest this effect; for example if we have hypertension or cardiovascular disease the risk goes up. There is a complex interaction because air pollution tends to increase in colder climates during winter, and infections are also risks.

Frostbite is a specific disease of the cold. This can be early, intermediate or severe. In severe frostbite people may lose fingers, toes and limbs. First aid for frostbite includes moving to a warmer place, replacing wet coverings with dry ones, and very gradual rewarming.

Hypothermia is where the core temperature drops below 35° with the body unable to compensate. This is much more common in the elderly, babies and those with a number of medical conditions. People with hypothermia become increasingly confused and are usually unaware that hypothermia is setting in. Those with possible or likely hypothermia should be moved indoors, and warmed slowly but in a controlled way. Deaths from hypothermia are usually age-related but also include external factors including higher risks in rural areas and a strong association with relative poverty.

Reducing the risks of cold-related disease and death requires a systematic approach. Some of it is common sense, for example layers of clothes, and heating spaces where older people live. For the risks from respiratory infections, vaccinations are important including against influenza and pneumococcal disease. Reducing the risk of cardiovascular disease requires a systematic approach to primary and secondary prevention including reductions of smoking, air pollution, and reducing individual risks such as hypertension and high cholesterol. Reducing the environmental risks such as slips and trips is possible with a systematic approach to ice clearing. Fuel poverty is a major driver of death due to cold that needs to be addressed in multiple ways. The UK housing stock is old and inefficient at reducing heat loss compared to most of our continental neighbours.

Heat

Environmental heat can cause multiple forms of illness including dehydration, heat syncope, heat cramps, heat exhaustion and heat stroke. Very hot days lead to significantly increased mortality. In 2022 the UK experienced record temperatures for a number of days; there were around 2800 excess deaths in those over 65 years old as a result. Very hot days are getting more common in the UK and elsewhere globally. Greatest health effects were in the elderly and babies. There are specific and direct effects including heat exhaustion and heat stroke but also important indirect effects including dehydration and impacts on cardiovascular disease.

Heat exhaustion occurs when the effect of heat has a significant health impact but the body is still responding appropriately. It is important to intervene early as this can head off much more serious problems. Symptoms include sweating profusely, headache, nausea, vomiting, cramps, clammy, weak and a fast pulse or breathing. First aid for heat exhaustion includes moving to a cool place, removing outer clothing, cool water or other drinks, spraying or sponging with cold water, a fan, and cold packs if available. People with heat exhaustion should be better within 30 minutes; if they are vomiting or still unwell an hour later get medical help.

Heat stroke (sunstroke) is a medical emergency. There are exertional and non-exertional forms. Exertional heat stroke, which tends to occur in otherwise fit younger people who have been undertaking substantial exercise in high heat and can affect anyone, has a relatively low but non-trivial mortality. Non-exertional heatstroke has a very high mortality; over 50% in severe cases and in the elderly even with treatment. In heat stroke the body ceases to respond appropriately to the high temperature. There is a loss of thermoregulation. Multiple parts of the body malfunction; this includes inflammation and clotting. The brain, heart,

kidneys and muscle can be damaged. In severe cases fitting and cardiac arrest may occur.

Heat stroke is usually diagnosed with a core body temperature over 40°. There may be mental changes with confusion, slurred speech, seizures and severe cases of coma. The skin will be hot but dry. There is likely to be nausea, vomiting, headache, fast pulse and breathing.

First aid for heatstroke is to get people into a cool place and put them in the recovery position due to vomiting. Then call for emergency care; this is a medical emergency and deterioration is likely. Remove outer clothing and cool the patient down ideally with a wet sheet over the body (not mouth and nose).

In contrast to cold weather risks, high temperature excess mortality is concentrated in urban areas and less driven by socio-economic factors in the UK. In high income hot countries where air conditioning is widely used, poverty remains a risk factor. As with cold temperatures, we can learn from countries with hotter climates than we have.

Wind and storm

There are multiple causes of very high winds at different times of year. On land, direct risk to life and limb from wind usually is caused by flying debris and falling objects related to wind speed. There are however indirect effects due to loss of power and water among other factors. There are many ways of measuring the risk from wind. In the UK the Beaufort scale (Force 0-12) is widely understood. Damage sufficient to cause injuries is rare below gale force 8. This corresponds to a wind speed between 62 and 74 kmh. The top end of the Beaufort scale is a hurricane force 12 with wind speeds above 118 kmh (73mph). This is rare inland in the UK but can cause significant damage. Storms of this severity in the UK tend to be concentrated in the autumn and winter months.

Very severe wind storms are however much more common in many other parts of the world and severe tropical cyclones are thought to have cost around 2 million lives since 1900 through combined wind and flooding. Hurricanes tend to peak in late summer and come in off major oceans. Major hurricanes are very destructive. At the top end of the scale (well above Beaufort force 12) there will be complete destruction of most buildings and potentially substantial loss of life.

Tornadoes (also known as whirlwinds or twisters among other names) occur worldwide including in the UK. Very severe tornadoes however are much more geographically concentrated particularly in the USA and Canada where they occur inland in late spring and early summer in particular. They cause very localised but substantial damage and are unpredictable in their starting point and timing.

Floods

Floods are a significant risk to health. Floods are the natural hazard that affects most people worldwide. Risks include drowning, physical trauma in rapidly flowing water, exposure to sewage in floodwater, destruction of sanitation, destruction of electricity infrastructure including electrical hazards and carbon monoxide poisoning, and psychological trauma.

There are many possible causes of significant flooding. These include storm surge, fluvial (river flooding onto the floodplain, more common in winter), pluvial and flash flooding (more common in summer), dam burst, tsunamis, groundwater rise.

The most obvious immediate impact of flooding is drowning. First aid for training includes initial CPR chest compressions, calling for medical help and then repeated cycles of two breaths and 30 chest compressions to maintain oxygenation. If the patient vomits, put them in the recovery position and be aware of hypothermia and treat it as needed.

Floodwater tends to be full of sewage and therefore human faecal bacteria. The sewerage system becomes flooded and ceases to work as planned and in severe cases drinking water

may become contaminated. Minimise contact with floodwater and wash your hands regularly, and you may need to boil water after a major flood before drinking. The psychological effects of flooding are often underestimated by those who have not experienced it and can last for a significant period of time.

For coastal flooding, generally storm surge, and river flooding it is usually possible to predict where flooding will occur and with a short lead time often possible to predict when it will occur. In the UK this tends to be concentrated in late autumn and winter. By contrast in pluvial and flash flooding which tends to occur during summer months, it is much less predictable where and when it will occur.

Climate change and an ageing population

Risks from high and low temperature, wind and flooding have always been with us. There are however several major drivers of change, and in the UK two in particular are important. The first is an ageing population since older people are at greater risk in particular from high and low temperatures. The second is climate change. For those who are interested in the effects of an ageing population in the UK I have recently done a CMO report on health in an ageing society.

In the UK climate change will affect environmental impact on health within the next decades. We have high confidence there will be many more very hot days. Rising sea levels will lead to increased risks of coastal flooding. There will probably be some decrease in mortality from colder days. There is a more complex impact on the probability and severity of major storms and other forms of flooding although it is likely there will be wetter winters. Once climate change has set in it will be irreversible for the predictable future.

In many other countries the effects of climate change will be much more rapid and substantial than in the UK; the impact will be very serious and for the indefinite future. Countries that already have greater extremes of weather already have greater health risks from these extremes and these will generally be exacerbated by climate change.

Summary

Cold, heat, wind and floods can cause significant ill-health. Death and disability are common. Older citizens and the very young are the most at risk but this can occur at any age. High income for individuals and societies and good engineering can reduce these risks but not to zero. The UK has significant variation in health depending on weather and season but many countries have much greater extremes and consequently greater variation in health outcomes. For major weather-related health disasters, it usually seems unlikely until it happens.

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