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Understanding the impacts of extreme heat on maternal and neonatal health outcomes

Climate change is the biggest global threat to our health that we face this century. Numerous UK organisations and professional bodies, including the Royal College of Paediatrics and Child Health (RCPCH) and the Faculty of Public Health, recognise this threat and have declared a climate emergency.^{1,2} Average temperatures around the world are increasing; the hottest 10 years on record in the UK have been since 2003 (FIGURE 1).³ Some climate records were broken in 2022, including being the UK's hottest year on record with some areas in England reaching over 40°C for the first time.^{3,4} We also had our first ever national emergency for a heatwave that was so severe that it had the potential to cause illness and death among people who are healthy (not just those in high-risk groups) as well as overwhelm health and social care.^{3,5,6}

Alongside this, there is increasing evidence that pregnant women and newborns are vulnerable to the health impacts of high outdoor temperatures.⁷⁻¹⁰ However, there is limited guidance to help pregnant women, their families and healthcare staff working with pregnant women and their babies, navigate these potential risks. This is despite calls from the RCPCH and the Royal College of Gynaecologists and Obstetricians (RCOG) for such guidance. Here, we focus on raising awareness among *Infant* readers regarding the impacts of high ambient temperature, such as extreme heat, on maternal and neonatal health.

What is climate change and what's happening in the UK?

According to the Met Office, climate change is 'the long-term shift in average weather patterns across the world'.¹¹ The leading cause of our increasing global temperatures is high levels of greenhouse gases.¹¹ We are seeing increased intensity, frequency and length of extreme heat episodes¹² when summertime weather is either much hotter or more humid than usual.¹³ The Met Office predicts that, across the UK, winters are expected to become milder with hot summers occurring more frequently.¹⁴ Even if we see a rapid decline of global use of greenhouse gases,

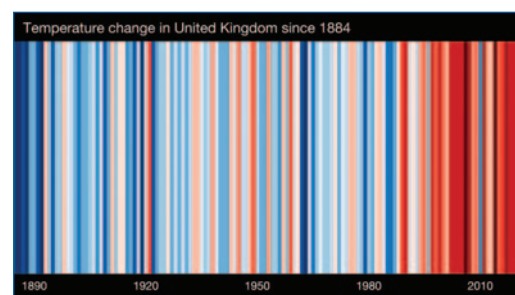


FIGURE 1 Warming stripes produced by Professor Ed Hawkins (University of Reading),¹⁶ which demonstrate the yearly changes in UK temperature since 1884. Each stripe represents the average temperature for that year compared to the average temperature of the whole period reviewed; red stripes indicating years that have been hotter than average with blue indicating years that have been colder than average.

Maternal health outcomes	Fetal and/or neonatal health outcomes
Pregnancy-induced hypertension	Stillbirth
Gestational diabetes	Prematurity
Maternal stress	Low birth weight
Antepartum haemorrhage	Congenital anomalies
Cardiovascular events in labour	Neonatal death

TABLE 1 Summary of a range of associations between high outdoor temperatures, including extreme heat, and maternal, fetal and neonatal outcomes.^{8-10,17}

the UK's climate is still expected to continue to change with increased frequency, duration and intensity of heatwaves until the middle of the century.¹⁵

The potential impacts and concerns for pregnant women and their babies

Increasing evidence suggests that pregnant women and newborns are vulnerable to the effects of extreme heat (TABLE 1).⁷⁻¹⁰ For example, high temperatures are associated with an increase in adverse pregnancy outcomes such as prematurity, low birth weight and stillbirth

(TABLE 1).^{9,10} Also, hot weather, especially when pregnant, can be uncomfortable and potentially may cause anxiety; high temperatures can increase mothers' stress levels during pregnancy.¹⁷

Likely mechanisms

There are several likely mechanisms by which high outdoor temperatures may affect pregnancy and neonatal outcomes. For example, physiological changes occur during pregnancy, which affect how the body regulates its temperature, these changes include increasing maternal weight with an increase in body fat.¹⁸ The evidence is growing that pregnant women can thermoregulate appropriately, however, when exposed to extreme heat, the mechanisms involved with thermoregulation may be overwhelmed.^{19,20} When a pregnant woman is exposed to extreme heat, several pathways that can potentially cause maternal or fetal harm may be activated, such as reduced blood to the placenta, inflammatory changes and dehydration.^{7,20}

Impacts on health care and healthcare staff

There are also impacts to health care and to our healthcare staff working with pregnant women and neonates. Climate change, including extreme heat, can lead to health and care services being disrupted in a number of ways.⁷ The buildings we deliver health care in are generally not designed for the impacts of extreme heat, for example air conditioning is not routinely available on all wards. Overheating of hospitals is already a problem; between 2019-2020, 3,600 instances of overheating were reported in NHS England Trust buildings.²¹ The detrimental impacts linked to overheating of hospitals are numerous and can impact on patients' health and patient safety. This is important particularly for neonates who are less able to regulate their body temperature than an adult, and keeping babies warm is important for their health. Overheating (or becoming too cold) can lead to a range of health problems. For example, it may be difficult to distinguish between a fever and overheating due to environmental causes, particularly during a heatwave, which could lead to unnecessary investigations for possible infection. Also, when babies are too hot, they try to compensate by using up valuable oxygen and energy.²² Ensuring that babies maintain their temperature in the normal range is important, particularly in neonatal units, to help them build up their energy and reserves.²²

There is also an impact on staff health with heat being considered an occupational health hazard.²³ NHS healthcare staff have reported feeling tired, uncomfortable, stressed and less

productive during periods of hot weather in England.²³ This may mean that staff find it harder to cope at work during these times and find it difficult to concentrate, which may lead to making mistakes. Also, the houses in which we live in England are typically not built to cope with high temperatures with very little housing having air conditioning units. Trying to sleep when it's hot outside can be difficult; again, particularly important for people who undertake shift work in the NHS. We know that sleep deprivation can affect performance at work. NHS healthcare workers have reported seeing patients being distressed due to the effects of the high temperatures but having limited ability to help.²³ There were reports of being constrained by the infection prevention control policies regarding use of fans and air conditioning units, which limited options to cool not only the patients, but themselves.²³ The impact of these factors will take a toll on staff mental health.

Another impact to consider is how overheating of hospitals affects drug efficacy and optimal functioning of equipment and IT systems.^{15,24} In fact, NHS employees have reported this already with instances of fridges breaking down, IT systems being disrupted as well as some of the equipment in intensive care units becoming unusable.²³ This is a particular concern for neonatal units.

FIGURE 2 summarises a framework to consider the effects of extreme heat on maternal and neonatal health, as well as healthcare staff health. These impacts are all the more worrying considering

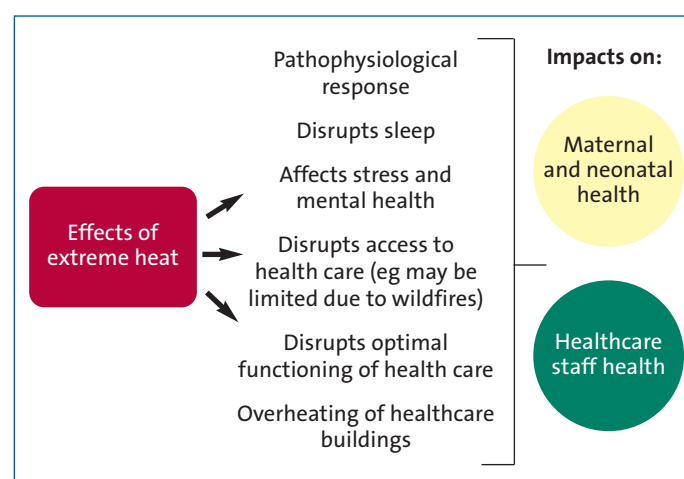


FIGURE 2 A framework to consider the effects of extreme heat on maternal, neonatal and healthcare staff health (partly informed by Roos et al').

Resource	Description	Web link
Weather-Health Alerting System	Forewarns a period of high (or cold) temperature that could affect health	www.gov.uk/government/publications/adverse-weather-and-health-plan
Hot Weather and Health: Supporting Vulnerable People	Practical advice for health and social care professionals about looking after people most at risk during hot weather	www.gov.uk/government/publications/hot-weather-and-health-supporting-vulnerable-people
Heatwave: How to Cope in Hot Weather	Public-facing advice about the steps to take to protect against the risks of hot weather	www.nhs.uk/live-well/seasonal-health/heatwave-how-to-cope-in-hot-weather
Beat the Heat: Hot Weather Advice	Public-facing advice about staying safe during hot weather	www.gov.uk/government/publications/beat-the-heat-hot-weather-advice

TABLE 2 Existing useful resources.

the current NHS situation with a workforce crisis, increasing staff gaps and decline of existing staff morale.²⁵ Looking after our patients and our staff is crucial, including ensuring that we have a healthy workforce and can recruit and retain staff. We need to have the right equipment, guidance and policies to ensure that overheating of hospitals in periods of hot weather is mitigated.

What's already in place?

The recently published Adverse Weather and Health Plan, with its associated documents, provides guidance for health and social care professionals to help prepare, alert and protect people from preventable heat-related harms.²⁶ It brings both the Heatwave Plan for England and the Cold Weather Plan for England into a single document. However, the hot weather section does not include pregnant women as being an 'at risk' group currently, despite the increasing evidence regarding the adverse impact. Generic advice (TABLE 2) about how to cope with the impacts of heat is provided by the NHS²⁷ and by the UK Health Security Agency (UKHSA).²⁸ Although these do include steps to protect babies and children, the guidance does not provide specific advice for pregnant women.

Next steps

Although actions are being taken, there is still no specific guidance for professionals to provide simple and clear advice for pregnant women and their families, parents and parents-to-be. However, to develop this guidance, more research is needed, for example, to identify the levels of heat that increase the risk for mothers' and their babies' health, and to understand the barriers and facilitators of which steps are practically feasible for our healthcare staff to provide to pregnant women, in view of all the other work-related pressures. Our hospitals and trusts will need to have resilient contingency plans in place for periods of hot weather. This includes robust risk assessments, if not already in place, for our neonatal units and maternity wards for both patients and staff.

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