

Heat exposure during pregnancy can lead to a lifetime of health problems

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Climate change is one of the greatest public health threats humanity has ever faced.

Global warming is part of this threat. Increasing temperatures are linked

to deteriorating health, especially in vulnerable populations, including pregnant women and children.

Scientists have previously shown that heat exposure increases the risk of [preterm birth and stillbirth](#). New research continues to uncover worrying links to poor outcomes for mothers and their babies. Congenital abnormalities, hypertension in [pregnancy](#) and [low birth weight](#) are some of the dangers of increasing heat.

One area that has not received as much attention is the long-term effect that heat exposure during pregnancy might have on the baby. To explore this question, we conducted a [systematic review](#) of all the existing research on the effects of heat exposure in pregnancy on health and socioeconomic consequences in later life.

Systematic reviews are designed to provide the highest level of medical evidence, collating and summarizing all the findings of qualifying research, rather than relying on just one study.

Our findings were clear. They showed that people who had been exposed to excessive heat before they were born suffered alarming lifelong effects.

Long-term effects

The most common measure of heat is the average air temperature, but some studies used more complex measures that adjusted for the humidity, and other factors that influence how an individual experiences heat.

How we define dangerous levels of heat for pregnant women is an ongoing focus of our research. The most likely scenario is that it is influenced by location, context and individual vulnerabilities. Different

conditions may also have different harmful thresholds and periods of susceptibility.

We [found](#) 29 studies covering more than 100 years, allowing us to see effects throughout an individual's lifespan. Some studies followed pregnancies closely to observe any ill-effects on the child. Others relied on population registries which recorded date and place of birth, allowing researchers to estimate the individual's in-utero heat exposure.

More than 60% of studies were conducted in [high-income](#) countries in the global north, which often have cooler climates. This research relied on observing naturally occurring differences in heat exposure, rather than controlled trials.

Despite those research limitations, we found the majority of studies linked harmful long-term effects with increased heat exposure during pregnancy.

In particular, we found associations with worse educational performances and lower income in later life.

For example, in the US, annual income at the age of 30 was reduced by US\$56 (2008 equivalent) for every additional day with temperatures above 32°C during the first trimester of the mother's pregnancy.

We also found harmful health effects including increased risk of heart disease and hypertension, as well as childhood asthma and pneumonia.

Childhood pneumonia risks were estimated to increase by 85% for every degree Celsius increase in temperature over the course of the pregnancy.

In Africa, the risk of malnutrition in children went up with increasing heat exposure in pregnancy. In the US, one study found a link with

increasing risk of obesity.

[Many studies](#) also showed links to mental illnesses, including increased risk of eating disorders and schizophrenia. In fact, [previous research](#) has shown the month a baby is born has been long associated with the risk of mental illness. Our research suggests heat exposure could be one of the reasons behind this.

These effects seem to culminate in an association with lower life expectancy, where people who had been exposed to increased heat while in the womb were found to [die younger](#).

We also found that the effects seemed worse for female fetuses in studies exploring sub-group vulnerabilities.

Multiple pathways

Understanding how and why these effects might be seen across completely different body systems was an important part of our research. We drew on our team of experts in human development, on research being conducted into the direct effects of heat on pregnant women, and on animal studies.

We propose that the effects of heat in pregnancy on the unborn baby likely occur through multiple pathways, including:

- worsening the health of the mother through illnesses like [pre-eclampsia](#) and diabetes
- directly affecting the baby's development, especially the nervous system (heat can cause birth defects)
- increasing the risk of preterm birth and other problems at the time of birth
- directly changing the unborn baby's DNA. This is likely to occur

through changes in the [epigenetic signature](#), an evolutionary mechanism that allows us to rapidly adapt to our environment by switching genes on and off.

One study even noted shortening of the unborn baby's [telomeres](#), the biological clock in our DNA that is linked to our limited lifespan.

There is an urgent need to conduct more research into this area and explore how and why these effects occur.

Call to action

Although the research is limited, our findings are worrying and support immediate individual, community and global action to protect [pregnant women](#) and their unborn babies from [heat](#).

It is our duty to speak out for those with no voice, who played no part in causing this public health emergency and who are likely to experience the worst consequences of our inaction.

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