Insight

Extreme heat, hormonal contraception, and thermoregulation: a global health perspective

Hormonal contraceptives are among the most widely used medications globally, with more than 240 million users worldwide. These medications can alter baseline body temperature and thermoregulatory capacity, yet they have largely been ignored in climate and health research. Existing evidence on contraceptive-related thermoregulatory effects has focused primarily on short-term, exercise-related heat exposure measured in controlled laboratories in high-income countries, leaving a substantial gap between the physiological research and real-world heat exposure. These evidence gaps are compounded by a broader lack of research on the lived experiences of contraceptive users and their choices in conditions of extreme heat, including whether and how hormonal contraceptives affect thermal comfort and heat-related health symptoms. As a result, although hormonal contraceptives might play a part in thermoregulation, their consequences for health and wellbeing in the context of rising global temperatures are poorly understood. This evidence gap might be especially important in low-resource contexts, where both heat exposure and social vulnerability to heat are often greatest, and where adaptive capacity is often most limited.

These knowledge gaps reflect longstanding patterns in biomedical and social science research. The burden of contraception, and many of the conditions for which hormonal contraceptives are prescribed (eg, pregnancy prevention, endometriosis, polyendocrine metabolic ovarian syndrome, and menstrual pain), fall disproportionately on women, whose health needs have historically been under-represented in research agendas and underfunded in clinical investigation. Given the scale and duration of hormonal contraceptive use globally, and the unprecedented pace of climate change, failure to understand how these medications might affect reactions to extreme heat could result in adverse consequences for millions of women, with broader implications for public health and sexual and reproductive rights.

Current understanding

Reproductive hormones affect thermoregulation by altering baseline core body temperature and the activation thresholds for heat-loss responses, such as sweating and cutaneous vasodilation. Progesterones have a thermogenic role, increasing thresholds for heat dissipation by 0·3–0·7°C, contributing to the higher core temperatures observed during the luteal phase. Oestrogens, by contrast, promote heat dissipation by enhancing cutaneous vasodilation and sweating responses. Oestrogens might also lower the osmotic threshold for arginine vasopressin (AVP) release, promoting water retention and fluid balance during heat stress, and could further attenuate progesterone-induced increases in body temperature by reducing the thermoregulatory setpoint.

Synthetic hormones in oral contraceptives can, likewise, shift baseline core temperature, with effects that might persist for longer than endogenous hormones. In small, short-term laboratory-based studies, progestin-containing contraceptives were associated with raised core temperature (n=10), elevated sweating (n=9) and vasodilation (n=7) thresholds, increased heart rate (n=10), and augmented resting metabolic rate (n=13). Some studies suggest elevations in core temperature can persist with placebo use, although findings vary by study timing and formulation. In a study in the USA, transdermal oestradiol lowered osmotic thresholds for AVP release and, although not statistically significant, lowered thirst stimulation during hyperosmotic challenge in nine participants, altering homoeostatic setpoints for body fluid and tonicity. Although the findings of these small studies suggest hormonal contraceptives can affect body temperature and thermoregulatory capacity, one laboratory-based study of 36 participants found no effect of progestin-releasing intrauterine devices (IUDs) on heat loss or body heat storage during exercise.

Emerging evidence suggests that heat might affect contraceptive use, preference, and fertility intentions. In an ecological analysis of Demographic and Health Survey data from 820 746 people in 33 low-income and middle-income countries (LMICs), greater exposure to extreme heat in the previous year was associated with both lower odds of modern contraceptive use and of desiring children. Preliminary qualitative evidence from Bangladesh expands on these findings (n=22), similarly suggesting that some women perceive heat as affecting their contraceptive experiences and choices (Schulte C, unpublished). One participant reported feeling "agitated in the heat" when taking the contraceptive pill and therefore switched to condoms; another study participant described women feeling dizzy or unwell when using oral contraceptives in hot conditions, noting that many "cannot tolerate the [contraceptive] pill…because of the heat".

Data gaps

Although sparse, the evidence from these small short-term studies suggests hormonal contraceptives can affect both physiological responses to heat and contraceptive users' decision-making in increasingly hot environments. Yet,

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For more on **temperature regulation and effects of the menstrual cycle** see *Temperature* 2020; **7:** 226–62

For more on **exercise and heat exposure in women** see *J Therm Biol* 2025; **134:** 104335

For more on **climate change and sexual and reproductive health and rights** see *BMJ Public Health* 2024; **2:** e001090

For more on the **effects of reproductive hormones on thermoregulation in women** see *Compr Physiol* 2014; **4:** 793–804

For more on the **effects of ovarian hormones on exercise thermoregulation in females** see *J Physiol* 2019; **597:** 71–88

For the study of **oral contraceptives and core temperature** see *Clin Physiol* 1997; **17:** 401–08

For more on how **oestrogen modifies the temperature effects of progesterone** see *J Appl Physiol* 2000; **88:** 1643–49

For more on the **control of sweating during the human menstrual cycle** see *Eur J Appl Physiol Occup Physiol* 1989; **58:** 890–95

For more on the **effects of contraceptives on resting metabolic rate** see *Contraception* 2016; **93:** 317–22

For more on the **effects of oestrogen on osmotic regulation of AVP and fluid balance** see *Am J Physiol Endocrinol Metab* 2002; **283:** E711–21

For more on **hormonal IUDs and heat exchange during exercise** see *J Physiol* 2024; **602:** 875–90

For more on **climate anomalies and reproductive attitudes and practices in LMICs** see *Front Glob Womens Health* 2025; **6:** 1548648

For more on the **pharmacokinetics of hormones delivered by a contraceptive patch under conditions of heat, humidity, and exercise** see *J Clin Pharmacol* 2001; **41:** 1301–09

For more on **temperature and contraceptive dosage** see *BMC Public Health* 2022; **22:** 300

For more on the **stability of misoprostol tablets and the importance of packaging** see *PLoS One* 2020; **15:** e0238628

For more on the **effects of heat exposure on maternal, fetal, and neonatal health** see *Nat Med* 2025; **31:** 684–94

these studies also highlight the scarcity of both quantitative and qualitative research evaluating health outcomes during real-world or chronic heat exposure.

Existing research focuses largely on healthy adults of reproductive age, with little to no evidence among adolescents, perimenarcheal populations, and women with chronic health conditions. Data from low-resource settings are also scarce, even though heat exposure could be greater in these contexts because of equatorial geographies, limited access to electricity and cooling, weaker workplace protections, and labour-intensive economies. As such, although women in these areas might be disproportionately affected by potential contraceptive-related thermoregulatory challenges, little information is available about their experiences.

In view of mechanistic differences, as well as variation in hormone formulations and doses across contraceptive methods, comparative studies on the thermoregulatory effects of IUDs, oral contraceptives, implants, injectables, and patches would help to inform clinical guidance. Complementary qualitative research is also needed to understand whether and how these differences shape contraceptive preferences and decision-making in the context of extreme heat.

Another consideration is the effect of ambient temperature on medications themselves. Although many steroid hormones used in contraceptives show high thermal stability, little is known about the effect of prolonged heat exposure on contraceptive efficacy, particularly when products are not stored in their commercial packaging. Additional research would enable informed contraceptive-decision making, particularly in low-resource settings, where transport and storage temperatures are most likely to exceed recommended limits. In field studies, researchers should consider whether contraceptive products stored outside of recommended temperature or packaging conditions could obscure potential thermoregulatory associations.

Future research

The evidence gaps make it difficult for public health systems to evaluate the potential risks associated with extreme heat exposure among hormonal contraceptive users and to develop effective clinical guidance and intervention strategies. To be both practically relevant and meaningfully aligned with climate, sexual, reproductive, and gender justice aims, future heat-contraception research should address five key points. First, research should prioritise the study of contraceptive-related thermoregulatory changes under real-world heat exposure, including chronic heat exposure, across different age groups and life stages, including in LMICs. Second, the lived experiences of contraceptive users should be centred through qualitative and participatory research, including meaningful engagement throughout study design, execution, and dissemination, to examine how sociocultural norms, stigma, and misinformation affect contraceptive decision-making, risk perception, and adaptation to climate-related stressors. Third, studies should examine how direct and indirect heat and climate effects interact with contraceptive care-seeking behaviour and the availability and accessibility of contraceptive commodities and services. Fourth, research needs to better integrate climate-health and sexual and reproductive health research to inform inclusive policies and programmes that reflect the experiences and needs of contraceptive users in the context of a rapidly warming climate. Finally, it will be necessary to ensure that potential and existing contraceptive users have continued access to safe affordable contraceptives and adequate information to make informed decisions to protect their health and sexual and reproductive rights.

Concluding remarks

The physical manifestations of the climate crisis are already shaping key elements of reproductive justice, including women's rights to choose whether or not to have children and to raise children in safe and healthy conditions. Extreme heat is already making pregnancy increasingly dangerous for both mother and fetus. The possibility that rising temperatures might also complicate pregnancy prevention because of understudied heat-related contraception risks, with harms potentially concentrated among already at-risk groups, raises serious concerns for climate adaptation, gender equity, and sexual and reproductive health and rights.

Addressing the evidence gaps will require a dedicated research agenda on hormonal contraception, thermoregulation, and extreme heat. The resulting evidence will be vital to strengthen heat-health preparedness, support informed reproductive and bodily autonomy, guide contraceptive development, and ensure adaptation strategies reflect the needs and experiences of contraceptive users. Together with urgent and ambitious emissions reductions, this work will be necessary to advance equitable climate action and protect sexual and reproductive health and rights in a warming world.

The language used in this Insight adheres to the standard set forth by WHO, UNICEF, UNFPA, and the Human Reproduction Programme in their collective November 2023 Call for Action to Protect Maternal, Newborn, and Child Health from the Impacts of Climate Change. Throughout the manuscript, the term "women" is used to refer to all those who identify as women regardless of sex assigned at birth but recognises that there are other gender-diverse individuals who do not identify as women but who have reproductive capacity. The intention is not to exclude their experiences but reflects the current lack of data identifying and/or reflecting the specific experiences of gender-diverse individuals. CS, CB, and SC contributed equally.

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See Online for appendix