

An Umbrella Review of The Impacts of Climate Change on Maternal Health and Birth Outcomes

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Background

- Climate change, or long-term shifts in weather patterns, presents a basic threat to the health of humans.^{1,2}
- Regions that contribute the least to global emissions (low-income countries, small island developing states) will be most affected by the hazardous climate-driven events such as floods, droughts, heat waves, tropical storms, wildfires and rising sea levels.^{1,2}
- Pregnant women and newborns are vulnerable to changes in temperature due to poor regulation of core body temperature, and therefore require special attention.³
- There is increasing evidence that climate-related exposure during pregnancy is associated with adverse outcomes for both mother and baby, including preterm birth, low birth weight, and stillbirth, but the research is limited.⁴

Objective

- This umbrella review aimed to provide an overview of available qualitative and quantitative evidence on the impact of climate change-related events on maternal, fetal, and newborn health.

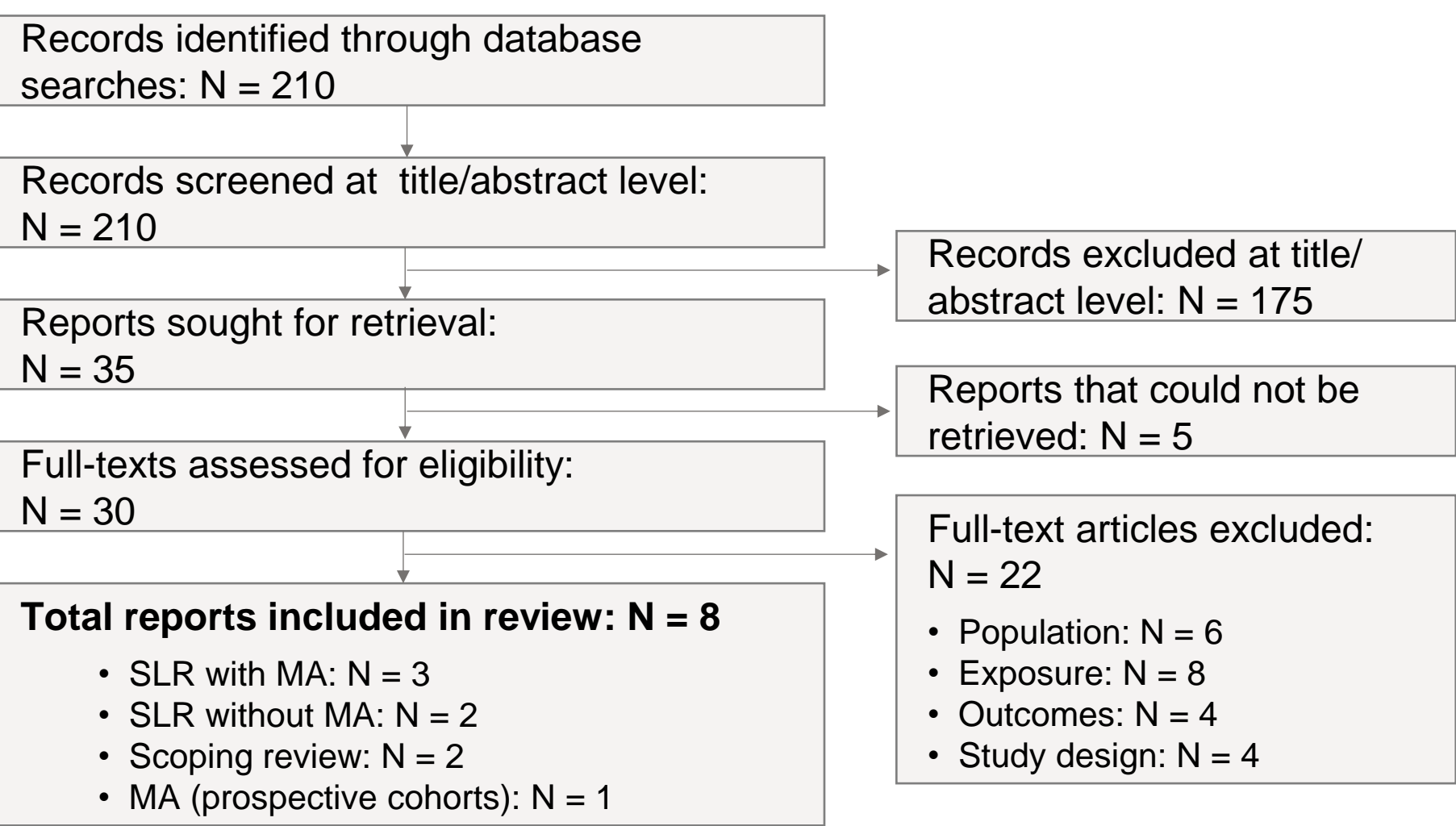
Methods

- This umbrella review was conducted according to the 2022 Preferred Reporting Items for Overviews of Reviews statement.⁵
- The MEDLINE and Embase databases were searched on June 25, 2024, to identify relevant English-language, peer-reviewed systematic literature reviews (SLR), meta-analyses (MA), scoping and umbrella reviews published in the past 10 years.
- The initial search was further refined by expanding the pregnancy search terms and focusing on review literature and MAs only, which resulted in 210 final search hits.
- The studies were manually screened at the title/abstract and full-text levels by two reviewers independently.
- The population, exposure, comparators, outcomes, and study design criteria were tailored to select evidence on how atypical environmental processes (e.g., extreme weather events or temperatures) potentially related to climate change impact the health of maternal or newborn human populations across the world.
- Literature on air pollution was excluded, as pollutants can be a health threat independent of climate change.
- The methodological quality of included reviews was independently assessed by two reviewers using AMSTAR 2.⁶
- Data were extracted by one researcher using a pre-designed template and independently validated by a second reviewer.

Results

- Seven systematic reviews (five SLRs, two scoping reviews) and one MA based on prospective cohorts were eligible for inclusion (**Figure 1**).
- Most studies were considered of high or moderate quality.
- All five SLRs had a global focus; three provided meta-analyzed evidence. Low- and middle-income countries (LMIC) were covered only by one scoping review. Two studies were dedicated to a single country each, Ireland (scoping review) and China (MA).
- While the LMICs study focused on extreme weather events, all other studies investigated the impact of high and/or low temperatures.
- Significant heterogeneity in definitions of heat and cold were found. Mostly, heat was defined as <5th to 10th percentile of the mean temperature and cold as >90th to 95th percentile. Definitions of exposure time windows also varied greatly.
- The temperature threshold resulting in significant effects varied by climate since women in each region have acclimatized to a relative threshold for extreme heat.⁷
- Investigated health outcomes mostly followed World Health Organization definitions, where stated: preterm birth (before 37 gestational weeks), low birthweight (<2,500 g), stillbirth (death of fetus at >20 gestational weeks). An overview of results is shown in **Figure 2**.

Figure 1. Literature attrition diagram



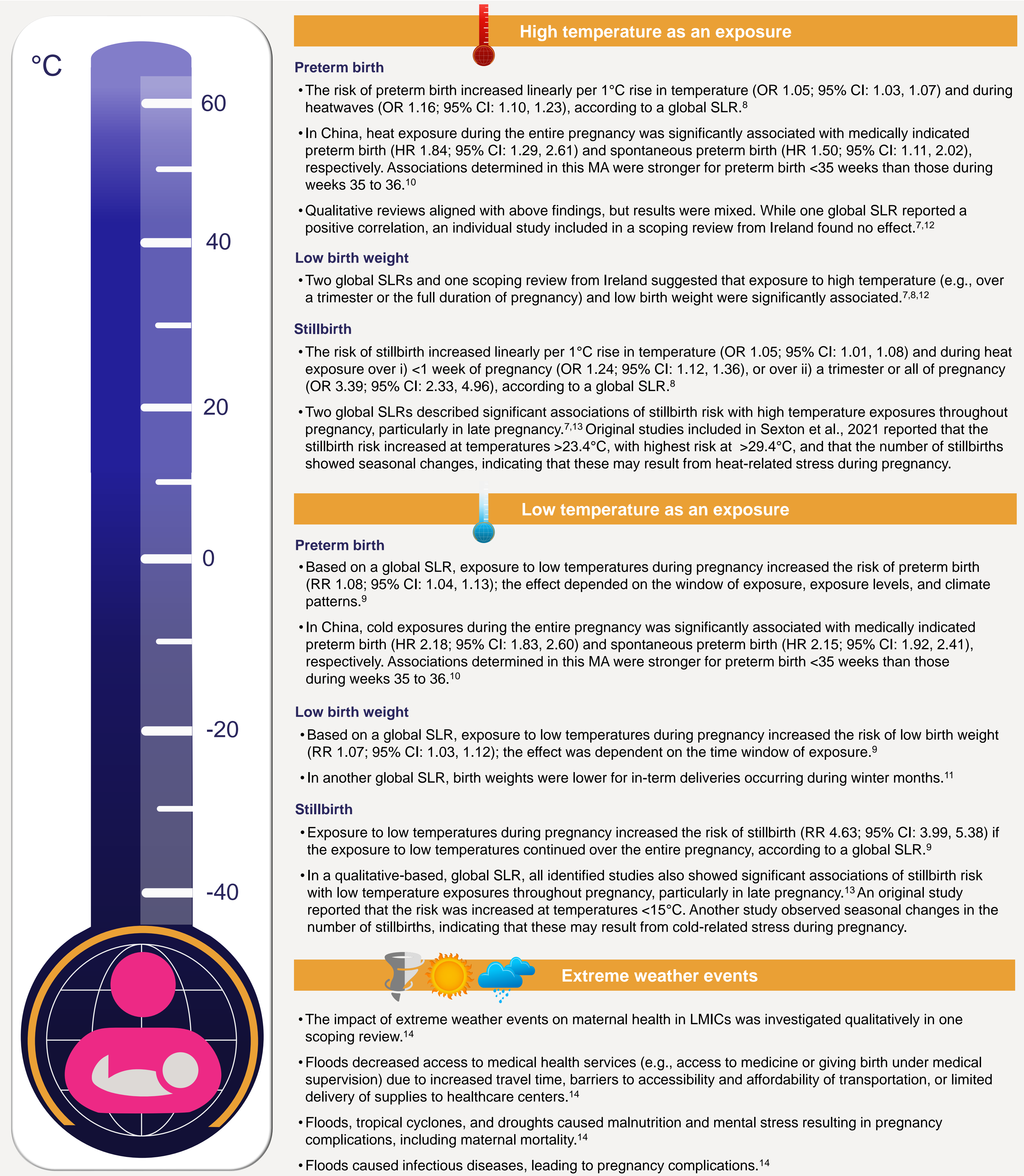
Abbreviations: MA, meta-analysis; SLR, systematic literature review

Limitations

- Confounding by air pollution, adaptation strategies (e.g., air conditioning), and other risk factors (malnutrition, infections) was not considered.
- Publication bias, multiple testing, and selective reporting of positive associations might have been common, as with all observational research.

Results

Figure 2. Maternal, fetal, and newborn health outcomes related to climate change



- Climate change and health equity considerations**
- Some evidence was identified on the relationship between observed health impacts and socio-demographics:
 - Associations between heat exposures and adverse pregnancy outcomes were largest among women in lower socioeconomic groups, at age extremes (e.g., <25 years old, >35 years old), and in the US, for women of Black or Hispanic race and ethnicity (vs. White).⁸
 - The observation (based on worldwide data) that cold exposure during pregnancy increased the risk of preterm birth was more pronounced in women of Asian and Black race and ethnicity compared with White race and ethnicity.⁹
 - In China, higher GDP per capita and more hospital beds per 1,000 persons were protective factors for the increased risk of preterm birth due to heat or cold extremes exposure during the entire pregnancy.¹⁰
 - Associations between health outcomes and socioeconomic status align with the commonly acknowledged notion that the impact may be largest in LMICs.

Abbreviations: CI, confidence interval; GDP, gross domestic product; HR, hazard ratio; LMICs, low- and middle-income countries; MA, meta-analysis; OR, odds ratio; RR, risk ratio; SLR, systematic literature review; US, United States

Conclusions

- Independent of climate zones and study differences, all identified evidence showed that exposure to extreme temperatures was significantly correlated with increased risk of pre-term birth,^{7-10,12} low birth weight,^{7-9,11,12} and stillbirths,^{7-9,13} with impacts being worse for women in lower socioeconomic groups.^{8,9,10}
- No quantitative systematic reviews were identified for climate-driven events like floods, droughts, heat waves, tropical storms, wildfires and rising sea levels, and qualitative evidence was sparse.¹⁴
- Standardization of methods and definitions used to assess the impacts on health is urgently needed. Mechanisms by which events driven by climate change affect maternal, fetal, and newborn health, especially in socioeconomically vulnerable regions, must be researched. Research should be conducted in defined climate zones and consider potential confounders.

References

1. World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>; 2. World Economic Forum. https://www3.weforum.org/docs/WEF_Quantifying_the_Impact_of_Climate_Change_on_Human_Health_2024.pdf; 3. Call to action by World Health Organization. <https://www.who.int/news/item/21-11-2023-climate-change-is-an-urgent-threat-to-pregnant-women-and-children>; 4. Ha S. Curr Environ Health Rep. 2022 Jun;9(2):263-275; 5. Gates M, et al. BMJ. 2022; 378:e070849; 6. Shea BJ, et al. BMJ. 2017; 358:j4008; 7. Kuehn L, et al. Int J Environ Res Public Health. 2017;14(8):853; 8. Chersich MF, et al. BMJ. 2020;371; 9. Ruan T, et al. Chin Med J. 2023;136(19):2307-2315; 10. Ren M et al. Lancet Reg Health West Pac. 2022;24:100496; 11. Beltran AJ, et al. Int. J. Environ. Res. Public Health 2014, 11, 91-172; 12. Paterson SK, et al. Global Health 2020 Mar 30;16(1):29; 13.Sexton J, et al. Environ Res 2021 Jun;197:111037; 14. Pappas A, et al. BMJ Open 2024 Jun 3;14(6):e079361.

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