

Emerging Health Threats Forum

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Climate-health uncertainties untangled

Diarrhoea risk forecasts limited more by sparse data than climate model discrepancies



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By the turn of the century, climate change could raise the risk of diarrhoea by about a third in countries where the condition is already common, according to research published online this month in *Environmental Health Perspectives*. Even conservative estimates suggest a substantial impact, according to the authors, Erik Kolstad and Kjell Johansson.

But like previous estimates, the forecast comes with uncertainty. The authors trace the sources of this uncertainty and show that a dearth of data from direct observation has a big impact on how accurately scientists can make predictions.

“Our research calls attention to how today’s scarcity of empirical studies of climate change impacts [on] health as well as the disagreement between climate models act together to limit the precision of future projections,” write Kolstad and Johansson, from research institutions in Bergen, Norway.

Worldwide, diarrhoea is responsible for nearly a fifth of all deaths among children under five years of age. Its statistical relationship with climatic changes, particularly temperature, is well researched, according to the authors. This makes it a good case-study for how uncertainties can be made more explicit in climate-health models.

A study by the World Health Organization (WHO), the only quantitative assessment of the link, estimated that the risk of diarrhoea could increase by 5% for every 1 °C rise in temperature. But it also indicated that the estimate could be off by as much as 10% — undermining confidence in the assumption that climate change would have an effect.

The authors say this variation is down to uncertainties in climate change models, as well as incomplete understanding of how temperature fluctuations affect health risks, and how climate-related changes in disease will be influenced by social and economic measures taken to adapt to the threat.

To capture some of this uncertainty, they came up with a range of predictions using a matrix produced by taking temperature projections from 19 climate models, and combining them with five estimates of temperature-related rise in the risk of diarrhoea, which were derived from empirical studies.

The earlier WHO estimate was based on just one climate model, with two empirical studies used as inputs for predicting the percent rise in risk for each degree change in temperature.

In developing countries currently affected by high rates of diarrhoea, the WHO study had predicted an 8–9% increase in risk by 2030. Kolstad and Johansson estimate a similar increase — by 8–11%, averaged across years 2010–2039.

“Later in this century, for the periods 2040–2069 and 2070–2099, the mean of our projection matrices gives risk increases of 15–20% and 22–29%, respectively,” they write, adding that increases of this scale would be “disastrous”.

Alert to the uncertainty surrounding these estimates, the authors looked at how widely the projections varied across the matrix and spotted a pattern: differences between climate change models contributed to the variation in their estimates, but did so to a lesser extent compared with differences in the empirical data used to quantify the effect of temperature on diarrhoea incidence.

This suggests that models based on just one value for each variable may be misleading, they caution. “But perhaps the most important insight to be gained... is that the part of the variance that originates from inter-model discrepancies is relatively small.”

Although the WHO considers climate change a **real and urgent threat**, debates over model predictions and the role of human activity in climate change were **fuelled in recent months** by allegations that scientific evidence has been mishandled, and by an error in a report authored by the Intergovernmental Panel on Climate Change. The controversies spurred **calls** for scientists to be more transparent about the uncertainties associated with climate change projections.

Warnings about the effect of climate change on human health have relied mainly on expected changes in risk for diseases sensitive to temperature fluctuations, which are prone to the uncertainties highlighted by Kolstad and Johansson.

The authors also note that their findings cast doubt on a common assumption made in models of the relationship between climate change and the risk of diarrhoea — that the increase in risk associated with each degree change is constant for all

temperatures. "An obvious and important item for future work is therefore to develop non-linear regression models for temperature impacts on diarrhoea."

Reference and links

1. Kolstad EW, Johansson KA. Uncertainties associated with quantifying climate change impacts on human health: a case study for diarrhea. *Environ Health Perspect* 2010. doi: [10.1289/ehp.1002060](https://doi.org/10.1289/ehp.1002060)

WHO information on climate change and human health

The Royal Society — **Climate change: A Summary of the Science**

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