# How is climate change affecting the spread of vector-, water- and food-borne diseases?

Povsic M<sup>1\*</sup> and Armitage EL<sup>1</sup> <sup>1</sup>AMICULUM, Bollington, Cheshire, UK. \*Email: manca.povsic@amiculum.biz

#### Findings

We found that climate change has increased the geographical spread of vector-, water- and food-borne diseases as well as the risk of acquiring these diseases. Of the identified studies, most reported on the effect of climate change on vector-borne diseases, with fewer describing the impacts on waterand food-borne diseases. This is unsurprising given the current increase in the frequency of diseases such as dengue; however, as global temperatures are expected to rise further and the burden of these diseases is likely to increase, more research is needed to quantify the impact this will have in the future.

#### Introduction

### Methods

Scan the QR code for the Supplementary Material



In the past decade, global temperatures have risen by ~1°C relative to preindustrial times,<sup>1–3</sup> leading to rising sea levels, extreme weather events and potential displacement of populations.<sup>3–5</sup> The incidence of vector-, water- and food-borne diseases is exacerbated by climate change, particularly due to rising temperatures and extreme weather events.<sup>1–21</sup> Vector-borne diseases are those spread by arthropod vectors, such as mosquitoes and ticks, while water- and food-borne diseases are caused by ingesting pathogens via contaminated water and food.<sup>17</sup> This review aims to understand how climate change has influenced the spread of vector-, water- and food-borne diseases in recent years and explore the human burden associated with the rise in these diseases.

A literature review was conducted to investigate how climate change impacts vector-, water- and food-borne diseases. We searched MEDLINE for reviews published within the last 5 years. The search strategy used a combination of keywords such as 'climate change', 'global warming', 'vector-borne', 'water-borne' and 'food-borne'. Abstracts and full articles were assessed for eligibility.

Eligible articles contained data relating to the geographical spread of disease, the increased risk of disease, the impact of extreme weather events on these diseases, and the humanistic, societal and economic burden that these diseases present.

#### Objective

To explore how climate change has increased the spread of vector-, water- and food-borne diseases and understand how this could impact these diseases in the future as global temperatures continue to rise.

#### Results and interpretation

In total, 21 studies were eligible for inclusion, reporting on a range of vector-, water- and food-borne diseases associated with climate change (Figure 1). All studies noted the substantial influence climate change exerts on these diseases,<sup>1–21</sup> with one study reporting that 58% of infectious diseases worldwide have been exacerbated by climate change.<sup>3</sup>

Fifteen studies reported on the increased geographical spread and risk of vector-, water- and food-borne diseases due to climate change,<sup>2-14,20,21</sup> while eight studies described the impact of extreme weather events on these diseases.<sup>3,5,8,12,13,15,16,21</sup> Only five studies reported on the disease burden caused by the rise in climate-sensitive diseases, focusing on how they are predicted to increase mortality (Figure 2).<sup>7,17-19,21</sup> Vector-borne diseases were particularly sensitive to rising temperatures,<sup>1</sup> which increased vector abundance, lengthened the transmission season in endemic areas and allowed vectors to spread to regions they had not previously inhabited.<sup>4,7,12-14</sup> Extreme weather events such as flooding provided additional breeding sites for vectors, increasing the spread of vector-borne diseases.<sup>13,16</sup> These events also led to the contamination of drinking water supplies, increasing the spread of vector-borne diseases.<sup>13,16</sup> These events also led to the contamination of drinking water supplies, increasing the spread of vector-borne diseases.<sup>13,16</sup> These events also led to the contamination of drinking water supplies, increasing the spread of water-borne diseases.<sup>3,15-17</sup> Overall, there was a shortage of studies on this topic, compounded by the fact that reporting of climate events and/or disease incidence is not standardized and is lacking in many countries.

Figure 1: Percentage of studies reporting the impacts of climate change on vector-, water- and food-borne diseases.



48%

Food-borne

Vector-borne

Figure 2: Eligible studies that contained data relating to geographical spread and risk of disease, the impact of extreme weather events on diseases and the human burden caused by climate-sensitive diseases.

Water-borne Eight studies Dengue is the most rapidly (38%) In Malawi in 2022, spreading mosquito-borne A significant link has been disease, with a 30-fold increase cyclone-induced identified between the El Niño reported on flooding led to in global incidence over the climate phenomenon and dengue the impact of cholera outbreaks<sup>3</sup> past 50 years, partly because of epidemics in South America and extreme weather rising temperatures<sup>4</sup> Southeast Asia<sup>13</sup> events<sup>3,5,8,12,13,15,16,21</sup> Five studies In Uganda in 2013, Fifteen studies extreme flooding increased (24%) malaria risk by 30%<sup>15</sup> (71%) reported on It is estimated that 36% of deaths reported on increased mortality in young children worldwide are increased caused by the rise linked to changes in environmental geographical spread in climate-sensitive factors. Outbreaks of cholera, and risk<sup>2-14,20,21</sup> diseases<sup>7,17–19,21</sup> fatal malaria, diarrhoea or dengue fever are all strongly influenced by

Climate change has expanded the range of ticks, increasing the probability of Lyme disease in areas of Canada where these vectors were absent before<sup>4,7,13</sup> Outbreaks of vector-borne diseases, such as dengue and chikungunya, are being recorded in previously unexposed regions, including the USA, France and Italy<sup>12-14</sup>

Climate change is predicted to cause 250,000 additional deaths annually between 2030 and 2050, with 48,000 deaths expected to be due to diarrhoeal diseases, 60,000 due to malaria and the remaining due to malnutrition and heat stroke<sup>18</sup>

#### References

- 1. Baharom M et al. Int J Environ Res Public Health 2021;18:11117.
- 2. Khatib A. Curr Infect Dis Rep 2023;25:77-85.
- 3. Kim CL et al. Front Public Health 2023;11:1252910.
- 4. Caminade C et al. Ann N Y Acad Sci 2019;1436:157–73.
- 5. Mahmud A et al. Curr Environ Health Rep 2020;7:384–91.
- 6. Adepjou O et al. Curr Trop Med Rep 2023;10:47–70.
- 7. Chala B et al. Front Public Health 2021;9:715759.
- 8. Khan M et al. Int J Environ Res Public Health 2019;16:2799.
- 9. Leal Filho W et al. Int J Environ Res Public Health 2022;19:893.
- 10. Rocklov J et al. Nat Immunol 2020;21:479–83.
- 11. Salvador C et al. Annu Rev Public Health 2023;44:213-32.
- 12. Semenza J et al. Lancet Reg Health Eur 2021;9:100230.
- 13. Semenza J et al. Infect Dis Ther 2022;11:1371–90.
- 14. Tidman R et al. Trans R Soc Trop Med Hyg 2021;115:147-68.
- 15. Fouque F et al. Infect Dis Poverty 2019;8:51.
- 16. Aune K et al. Int J Environ Res Public Health 2021;19:165.
- 17. Cissé G et al. Acta Trop 2019;194:181–8.

climatic change<sup>19</sup>

- 18. Ahmed T et al. Int J Environ Res Public Health 2019;16:3165.
- 19. El-Sayed A et al. Environ Sci Pollut Res Int 2020;27:22336–52.
- 20. Miranda LS *et al. Biology* 2024;13:182.
- 21. Zain A et al. Singapore Med J 2024;65:211–9.

## AMICULUM®