Impacts of climate change on water-related vector borne diseases in temperate regions: A systematic review of literature and meta-analysis

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Background: Vector borne diseases are climate-sensitive diseases as they depend on the state of the local environment which is inherently tied to climatic conditions. However, there is limited evidence on effects of climate change on vector borne diseases in temperate and cold regions. Accordingly, this review assesses the current state of knowledge on the mechanisms through which climate change impact on water-related vector borne diseases in temperate regions.
Methods: A systematic review was conducted using PubMed, Scopus, Web of Science, and Embase databases. The WWH (who, what, how) framework was applied to develop the research question. Scope (climate change and vector borne diseases), region (temperate), article type (peer-reviewed), publication language (English), and publication years (since 2015) were criteria applied to identify articles. Title, abstract, and full-text article screening was undertaken using the inclusion criteria. A data extraction matrix was developed and thematic analyses identified the mechanisms through which climate change affects vector borne diseases.
Results: A total of 44 articles were included in the final analysis. Climate mechanisms identified included: warmer climates could increase pathogen development, climate change could provide suitable breeding sites, climate change extends the disease transmission season, climate change increases the geographic spread of vectors/pathogen, warmer climate increases vector development, warmer climate affects the behavior of vectors, climate change could influence abundance/behaviors of hosts, climate change could reduce the abundance of vector predators, and climate change could damage vector control measures. Moreover, the analysis of six articles indicated that a one-degree Celsius increase in monthly average temperature in the natural transmission period in temperate regions increased the risk of human West Nile Virus infection by 58% (IRR = 1.58, 95% CI: 1.35, 1.86), I^2 = 78.2%).
Conclusion: Although climate change does not directly create new vector borne diseases, it could intensify pathogen development and infectivity, create favorable vector breeding habitats, make the temperature suitable for vectors development and abundance, increase geographic distribution of vectors, and increase vectors-to-hosts contact or exposures. Reducing climate driven risk factors of vector borne diseases such as mitigating greenhouse gas emission to limit global warming is important. Moreover, research should be strengthened to understand the effect of climate drivers on the fundamental biological processes and mechanisms involved in transmission dynamics.