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Commentary

Impact of Climate Change on the Geographical Spread of Vector-Borne Diseases

Sarah L. Whitmore*

Department of Environmental Health Sciences, London School of Hygiene & Tropical Medicine, London, United Kingdom

DESCRIPTION

Climate change is increasingly recognized as one of the most significant threats to global public health in the 21st century. Among the myriad consequences it brings, the geographical spread of Vector-Borne Diseases (VBDs) such as malaria, dengue, chikungunya, Zika virus, Lyme disease and West Nile virus stands out as an urgent and complex challenge. Vectors, particularly mosquitoes and ticks, are highly sensitive to environmental conditions. As temperature, precipitation patterns and humidity levels change, so too does the ecological suitability for these vectors to survive, reproduce and transmit pathogens. Traditionally, VBDs have been confined to tropical and subtropical regions due to the climatic requirements of their vectors. However, rising global temperatures are enabling disease-carrying vectors to expand into previously inhospitable regions, including parts of Europe, North America and East Asia. For example, Aedes albopictus, a mosquito species responsible for transmitting dengue and chikungunya, has been reported in southern Europe and as far north as Germany. Similarly, the range of Ixodes scapularis, the tick responsible for Lyme disease, has extended further into Canada and the northern United States in recent years.

Temperature plays a critical role in vector development and pathogen replication. Warmer temperatures accelerate mosquito breeding cycles and reduce the incubation period of pathogens within vectors, making transmission more efficient. At the same time, climate change affects rainfall and humidity, both of which influence the availability of breeding sites. In some regions, excessive rainfall creates stagnant water pools ideal for mosquito larvae, while in others, drought conditions may force communities to store water, inadvertently creating breeding habitats. Altitude is another factor now undergoing transformation. Areas that were once too cold or elevated to support vector populations such as the highlands of East Africa and the Andes in South America are witnessing an uptick in vector-borne disease transmission. Malaria, for instance, has been observed at higher elevations in Ethiopia and Colombia, posing new public health challenges for populations that historically had limited exposure and therefore low immunity.

Beyond the ecological shifts, climate change also interacts with social and economic factors that influence disease spread. Urbanization, migration and land use changes often exacerbated by environmental degradation bring humans and disease vectors into closer contact. Populations displaced by extreme weather events or economic hardship may move into areas where VBDs are prevalent or, conversely, may introduce diseases into naïve communities. In such scenarios, already strained healthcare systems face increased demand with limited resources, especially in low- and middle-income countries. Despite growing evidence of these trends, many high-income countries have been slow to integrate climate data into public health planning. Vector surveillance systems remain fragmented, with gaps in early detection and reporting. Moreover, predictive modelling tools exist but are underutilized at the policymaking level. Proactive planning rather than reactive crisis management is crucial for mitigating the impacts of climate-driven disease expansion. High-income countries have the technological and institutional capacity to lead in this area. Investment in integrated climate and health monitoring, development of adaptive vector control strategies and encouraging international research collaborations are all essential components. For instance, the use of geospatial mapping, remote sensing data and machine learning models can help forecast future hotspots of disease emergence, allowing health systems to pre-position resources and respond more effectively. Additionally, public education and community engagement must not be overlooked. As new regions face unfamiliar threats, awareness campaigns customized to local contexts will be vital in ensuring early recognition, prevention and treatment of vector-borne diseases.

CONCLUSION

The link between climate change and the geographical spread of vector-borne diseases is no longer speculative it is a well-documented reality. As global temperatures continue to rise and weather patterns shift, the habitat ranges of disease vectors are expanding, bringing health threats to regions previously considered safe. These changes challenge traditional assumptions about disease geography and demand new approaches to public health preparedness. High-income countries, equipped with

Correspondence to: Sarah L. Whitmore, Department of Environmental Health Sciences, London School of Hygiene & Tropical Medicine, London, United Kingdom, E-mail: sarahwhitore@lshtm.uk

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resources and technology, have both the capacity and the responsibility to act swiftly and collaboratively. Strengthening surveillance, integrating climate data into public health planning and supporting adaptive control strategies are critical steps. Equally important is supporting lower-income regions that are disproportionately affected by climate-sensitive diseases yet lack the infrastructure to respond effectively.

In the face of a changing climate, protecting global health will require rethinking our strategies, reinforcing our health systems and recognizing that no region is immune to the shifting landscape of infectious diseases. The future of vector-borne disease control hinges on global solidarity, innovation and a commitment to proactive resilience.