



Environmental Health Meets Chronic and Infectious Disease Management: Tackling the Impact of Climate Change on Public Health Risks

Andrew W. Taylor-Robinson^{1,2,*}

¹College of Health Sciences, VinUniversity, Gia Lam District, Hanoi 100000, Vietnam.

²Center for Global Health, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA 1904, USA.

Article Info

Received: November 20, 2024

Accepted: November 25, 2024

Published: November 29, 2024

***Corresponding author:** Prof. A.W. Taylor-Robinson, College of Health Sciences, VinUniversity, Gia Lam District, Hanoi 100000, Vietnam.
Center for Global Health, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA 1904, USA.

Citation: Andrew W. Taylor-Robinson. (2024) "Environmental Health Meets Chronic and Infectious Disease Management: Tackling the Impact of Climate Change on Public Health Risks." International Journal of Epidemiology and Public Health Research, 5(4); DOI: 10.61148/2836-2810/IJEPHR/0101

Copyright: © 2024. Andrew W. Taylor-Robinson. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract:

The intersection of environmental health and disease management amid climate change poses significant challenges and opportunities. This relates to both chronic and infectious diseases. Integrating public health considerations into climate policies, enhancing education and training for health professionals, and prioritizing research on climate-related health impacts are crucial for developing effective strategies to safeguard populations from existing global health threats and to prepare for the emergence of new ones. This is particularly pertinent in rapidly developing urban areas, where climate change effects are often intensified. A collaborative One Health approach, which unites public health, environmental science, and policy, is essential for fostering healthier and more resilient environments in the face of climate change. By addressing these interconnected issues, stakeholders can better prepare for and mitigate the health risks associated with climate change, ultimately improving public health outcomes and enhancing community resilience.

Keywords: Environmental health; chronic disease; infectious disease; pollution and health; vector-borne disease; disease control and prevention; public health management

Running title: Impact of Climate Change on Public Health

Introduction:

The nexus between environmental health and the management – control and prevention – of chronic (metabolic) diseases and infectious diseases is increasingly critical in the context of the rapid escalation of climate change. In other words, long-term shifts in temperatures and weather patterns, the main driver for which are ‘man-made’ (anthropogenic) activities. Such changes increasingly challenge human life on Earth and therefore pose significant threats to global health. This opinion article explores various dimensions of this intersection, highlighting the importance of addressing climate change when revising and implementing public health strategies, especially those that relate to environmental pollution and infectious disease transmission. As the various negative impacts of climate change escalate, it is imperative that health professionals and policymakers remain vigilant and proactive in addressing the associated health threats.

1. The Challenge

Climate change is expected to increasingly impact climate-sensitive health outcomes, so enhanced preparedness necessitates the delivery of appropriate public health programs within a climate-resilient health system [1]. The impacts are two-fold. Firstly, climate change is related to major forms of environmental pollution – of air, water soil, among others – that are harmful to human health and adversely affect water and food security.

Secondly, climate change continues to alter meteorological patterns, to increase the frequency of extreme weather events, and to affect ecosystems, it also influences the transmission dynamics of infectious diseases. This concerns not only air-borne and water-borne pathogenic microorganisms but also those causative agents of disease that are transmitted by vectors, such as biting arthropods, notably mosquitoes and ticks.

1.1. Direct Challenges

A principal way climate change impacts human health and quality of life is through its direct effects on the environment. For instance, as ambient temperatures continue to rise, populations at higher elevations will become increasingly exposed to extreme heat, which can exacerbate chronic health risks as well as those associated with infectious diseases [2]. This highlights that increasing morbidity and mortality from heatwaves and other extreme weather events – notably river plain or coastal flooding after intense or extended rainfall – necessitates modifications to current public health programs to prepare for climate-sensitive health outcomes [3].

1.1.1. Air pollution

Air pollution is becoming increasingly hazardous in many parts of the world as urbanization underpins the economic growth of low- and lower middle-income countries (LMIC). In metropolitan areas, respiratory conditions such as asthma and chronic obstructive pulmonary disease are aggravated by high pollution levels of ambient air due to burning industrial and domestic waste, traffic congestion and unregulated construction. Moreover, deterioration of air quality due to climatic factors can further exacerbate pre-existing health conditions like hypertension and diabetes, as well as increase the risk of coronary artery disease and stroke, leading to increased morbidity and mortality rates [4,5]. Poor indoor air quality (IAQ) resulting mainly from unventilated cooking using the burning of fossil fuels can lead to respiratory infections and, as with ambient air pollution, be a major predisposing factor for other chronic health issues related to the inhalation of fine particulate matter such as soot [6].

1.1.2. Water pollution

The pollution of water bodies from flooding and soil runoff can cause harm to the atmosphere and hinder plant growth. The impact of climate change on water resources is particularly concerning in LMIC, where infrastructure may be less resilient to environmental flux [7]. This emphasizes the need for comprehensive strategies that address these interconnected issues [8,9].

1.2. Indirect Challenges

Climate change can be an indirect actor by making conditions favorable for pathogen transmission.

1.2.1. Air- and water-borne transmission of pathogens

The COVID-19 pandemic highlighted the importance of maintaining good IAQ, as air-borne transmission of SARS-CoV-2

has been linked to environmental factors [10]. In addition to air quality, climate change can also affect water quality and availability, which are critical for preventing water-borne diseases. Extreme weather events, such as floods and droughts, can compromise water supplies and sanitation systems, leading to outbreaks of enteric bacterial diseases like cholera and typhoid.

1.2.2. Arthropod-borne transmission of pathogens

Rising temperatures and changing precipitation patterns can create conditions conducive to the proliferation of insect vectors that transmit diseases like malaria, dengue, and borreliosis [11]. Furthermore, the increasing incidence of vector-borne diseases is linked to climate variability, as warmer temperatures can expand the habitats suitable for these vectors [12]. When increased range brings vectors into more intimate proximity with humans, as occurs with peridomestic mosquitoes such as *Aedes* that carry dengue and other arboviruses, residents of areas into which there is encroachment need to be educated as to the risk of transmission and the prevention measures to take [13]. The One Health concept, which emphasizes the interconnectedness of human, animal, and environmental health, is particularly relevant to understanding the dynamics of vector-borne diseases against the backdrop of climate change [14,15].

2. (Seeking) the Solution

Public health adaptation strategies are key to reducing vulnerability to climate-related health impacts [3]. As the COVID-19 pandemic exemplified, public health professionals need to be sufficiently flexible in their approach to pivot in response to real-time demands of infectious disease outbreaks [16]. Equally, public health considerations should be integrated into climate change policy and planning in order to mitigate risks to human health related to environmental pollutants [17,18]. Furthermore, there is a pressing need for research in underrepresented regions to address the confluence of climate change and infectious diseases [19].

2.1. A Comprehensive Strategy

In order to effectively combat the health impacts of climate change, it is crucial to adopt a multi-faceted approach that includes both mitigation and adaptation strategies. Understanding the geographic and demographic factors influencing vulnerability to climate-related health risks is essential for developing effective adaptation strategies [20]. Equally, the importance of building resilient health systems that can withstand the uncertainties associated with climate change is recognized [21].

2.2. Research Priorities

Public health agencies must prioritize research on the health implications of climate change [22]. While public health professionals recognize the seriousness of climate change's health impacts, there is often a gap between national research and local needs [23]. This highlights the necessity for tailored research that addresses specific vulnerabilities within communities and informs effective interventions [24]. Research efforts should also focus on understanding the long-term health impacts of climate change and

developing strategies to mitigate these effects. There is a need for health professionals to adopt innovative interventions, such as health promotion and disease prevention strategies, to address the impacts of climate change on public health [25].

2.3. Health Professionals Training

Education and training for public health practitioners are also vital in preparing them to respond to the health outcomes resulting from climate change. It is important to incorporate climate and health curricula into graduate public health education to equip future professionals with the knowledge and skills needed to address these emerging challenges [26]. This educational focus can enhance the capacity of public health systems to respond to climate-related health threats effectively. Moreover, it has been proposed that mental health concerns pertaining to climate change-related infectious disease risks may have the largest impact worldwide, necessitating proactive public health decisions and adaptive strategies [27].

2.4. Impact Mitigation

Local health departments play a crucial role in preparing for climate change-related health threats. While many agencies acknowledge climate change as a public health risk, there is often a lack of comprehensive planning and resources to address it [28]. This underscores the need for increased collaboration between public health officials, policymakers, and researchers to develop effective strategies for mitigating the health impacts of climate change [29]. By prioritizing climate change in public health agendas, we can better prepare for and mitigate the health impacts of this global challenge.

2.5. Recognizing Social Determinants of Health

The challenges posed by the impacts of climate change, both direct and indirect, on human health are significant and require urgent attention from public health practitioners [30]. In this context, it is imperative to consider the social determinants of health. Understanding the geographic and demographic factors that influence vulnerability to climate-related health risks is crucial for developing effective adaptation strategies [31]. This includes recognizing the disparities in health outcomes that can arise from socioeconomic status, access to healthcare, and environmental conditions [32,33]. Population displacement, frequently driven by extreme weather events, can make people particularly vulnerable to public health threats.

2.6. Public Engagement

The role of communication in public health is paramount. Informing and empowering populations at risk, as well as the health professionals who serve them, is essential for developing effective climate change adaptation programs [34]. Effective engagement strategies can help mobilize public support for climate initiatives and encourage individual behavior changes that contribute to improved health outcomes [35].

The importance of widely disseminating the health risks associated

with climate change to both the public and policymakers is well established [36]. This involves framing climate change as a pressing public health issue and highlighting the co-benefits of climate action for health [37,38]. This paves the way for implementing policies that promote sustainable practices and reduce anthropogenic greenhouse gas emissions including carbon dioxide and methane, generated from the burning of fossil fuels like coal, oil and natural gas [12].

3. Conclusion

In the context of climate change, the convergence of environmental health with the management of chronic and infectious diseases presents both challenges and opportunities. By integrating public health considerations into climate change policies, enhancing education and training for health professionals, and prioritizing research on climate-related health impacts, we can develop effective strategies to protect populations from emerging global health threats. This is particularly relevant to urban areas where the effects of climate change are often exacerbated [39,40]. A One Health collaboration between public health, environmental science, and policy will be essential in creating healthier and more resilient urban environments in the face of climate change.

Declarations

Author contribution: AWT-R – article conception; literature search; interpretation of information; writing, draft and final manuscript.

Funding: The preparation of this paper did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest: The author declares no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements: None.

References

1. Walter T.G., Bricknell L.K., Preston R.G. & Crawford E.G.C. (2024). Climate change adaptation methods for public health prevention in Australia: an integrative review. *Current Environmental Health Reports*, 11(1): 71–87.
2. Howe P.D., Marlon J.R., Wang X. & Leiserowitz A. (2019). Public perceptions of the health risks of extreme heat across us states, counties, and neighborhoods. *Proceedings of the National Academy of Sciences*, 116(14): 6743–6748.
3. Awuor L. & Meldrum R. (2020). Institutional engagement practices as barriers to public health capacity in climate change policy discourse: lessons from the Canadian province of Ontario. *International Journal of Environmental Research and Public Health*, 17(17): 6338.
4. Wang M., Han X., Fang H., Xu C., Lin X., Xia S., Yu W., He J., Jiang S. & Tao H. (2018). Impact of health education on knowledge and behaviors toward infectious diseases among students in Gansu province, China. *BioMed Research International*, 2018: 6397340.

5. Neo E.X., Hasikin K., Mokhtar M.I., Lai K.W., Azizan M.M., Razak S.A. & Hizaddin H.F. (2022). Towards integrated air pollution monitoring and health impact assessment using federated learning: a systematic review. *Frontiers in Public Health*, 10: 851553.
6. Pillarisetti A., Ye W. & Chowdhury S. (2022). Indoor air pollution and health: bridging perspectives from developing and developed countries. *Annual Review of Environment and Resources*, 47: 197–229.
7. Shuai Y., Lou Y., Zhu L., Chen W. & Jiang T. (2023). Oral complications related to tropical infectious diseases: an introduction and analysis of survey data. *BMC Oral Health*, 23(1): 788.
8. Hopkins S.R., Jones I.J., Buck J.C., LeBoa C., Kwong L.H., Jacobsen K., Rickards C., Lund A.J., Nova N., MacDonald A.J., Lambert-Peck M., De Leo G.A. & Sokolow, S.H. (2022). Environmental persistence of the world's most burdensome infectious and parasitic diseases. *Frontiers in Public Health*, 10: 892366.
9. Kayacan Z.Ç. & Akgül Ö. (2022). Climate change and its extensions in infectious diseases: south-eastern Europe under focus. *South Eastern European Journal of Public Health*, special volume 2022(1): 1–12.
10. van der Valk J.P.M. & in 't Veen J.C.C.M. (2021). SARS-CoV-2: the relevance and prevention of aerosol transmission. *Journal of Occupational and Environmental Medicine*, 63(6): e395–e401
11. Rocklöv J. & Dubrow R. (2020). Climate change: an enduring challenge for vector-borne disease prevention and control. *Nature Immunology*, 21(5): 479–483.
12. Hathaway J. & Maibach E. (2018). Health implications of climate change: a review of the literature about the perception of the public and health professionals. *Current Environmental Health Reports*, 5(1): 197–204.
13. Singh A. & Taylor-Robinson A.W. (2017). Vector control interventions to prevent dengue: current situation and strategies for future improvements to management of *Aedes* in India. *Journal of Infectious Disease and Pathology*, 2(1): 1000123.
14. Shaheen M.N.F. (2022). The concept of one health applied to the problem of zoonotic diseases. *Reviews in Medical Virology*, 32(4): e2326.
15. Sperança M.A. (2023). One health concept applied to zoonoses and infectious diseases transmitted by arthropods. *International Journal of Medical Parasitology and Epidemiology Sciences*, 4(1): 1–2.
16. Łukasik M. & Porębska A. (2022). Responsiveness and adaptability of healthcare facilities in emergency scenarios: COVID-19 experience. *International Journal of Environmental Research and Public Health*, 19(2): 675.
17. Fox M.A., Zuidema C., Bauman B., Burke T.A. & Sheehan M.C. (2019). Integrating public health into climate change policy and planning: state of practice update. *International Journal of Environmental Research and Public Health*, 16(18): 3232.
18. van Wijk M., Naing S.Y., Franchy S.D., Heslop R.T., Novoa Lozano I., Vilà J. & Ballesté-Delpierre C. (2020). Perception and knowledge of the effect of climate change on infectious diseases within the general public: a multinational cross-sectional survey-based study. *PLoS One*, 15(11): e0241579.
19. Van de Vuurst P. & Escobar L.E. (2023). Climate change and infectious disease: a review of evidence and research trends. *Infectious Diseases of Poverty*, 12(1): 51.
20. Cvetković V.M. & Grbić L. (2021). Public perception of climate change and its impact on natural disasters. *Journal of the Geographical Institute Jovan Cvijic, SASA*, 71(1): 43–58.
21. Thomson D., Varangu L. & Webster R.J. (2023). A climate resilience maturity matrix for Canadian health systems. *Healthcare Management Forum*, 36(4): 217–223.
22. Zain A., Sadarangani S.P., Shek L.P. & Vasoo S. (2024). Climate change and its impact on infectious diseases in Asia. *Singapore Medical Journal*, 65(4): 211–219.
23. Dupraz J. & Burnand B. (2021). Role of health professionals regarding the impact of climate change on health – an exploratory review. *International Journal of Environmental Research and Public Health*, 18(6): 3222.
24. Wang W., Liu Y., Zhang L., Ran L., Xiong S. & Tan X. (2021). Associations between indoor environmental quality and infectious diseases knowledge, beliefs and practices of hotel workers in Wuhan, China. *International Journal of Environmental Research and Public Health*, 18(12): 6367.
25. Portela Dos Santos O., Melly P., Joost S. & Verloo H. (2023). Climate change, environmental health, and challenges for nursing discipline. *International Journal of Environmental Research and Public Health*, 20(9): 5682.
26. Arora M., Comrie A.C. & Ernst K.E. (2023). Assessing climate and health curriculum in graduate public health education in the United States. *Frontiers in Public Health*, 11: 1124379.
27. Dennis S. & Fisher D. (2018). Climate change and infectious diseases: the next 50 years. *Annals of the Academy of Medicine, Singapore*, 47(10): 401–404.
28. Roser-Renouf C., Maibach E.W. & Li J. (2016). Adapting to the changing climate: an assessment of local health department preparations for climate change-related health threats, 2008–2012. *PLoS One*, 11(3): e0151558.
29. Jiang Y., Dou X., Yan C., Wan L., Liu H., Li M., Wang R., Li G., Zhao L., Liu Z., Zhao X. & Wan, K. (2020). Epidemiological characteristics and trends of notifiable infectious diseases in China from 1986 to 2016. *Journal of Global Health*, 10(2): 020803.
30. Bell E.J. (2010). Climate change: what competencies and which medical education and training approaches? *BMC Medical Education*, 10(1): 31.
31. Birkmann J., Jamshed A., McMillan J.M., Feldmeyer D., Totin E., Solecki W., Ibrahim Z.Z., Roberts D., Kerr R.B., Poertner H.O., Pelling M., Djalante R., Garschagen M., Leal Filho W., Guha-Sapir D. & Alegría A. (2022). Understanding human vulnerability to climate change: A global perspective on index validation for adaptation planning. *Science of the Total Environment*, 803: 150065.
32. MacIntyre E., Khanna S., Darychuk A., Copes R. & Schwartz B. (2019). Evidence synthesis – evaluating risk communication during extreme weather and climate change: a scoping review. *Health Promotion and Chronic Disease Prevention in Canada*, 39(4): 142–156.
33. Baker R.E., Mahmud A.S., Miller I.F., Rajeev M., Rasambainarivo F., Rice B.L., Takahashi S., Tatem A.J.,

- Wagner C.E., Wang L.F., Wesolowski A. & Metcalf C.J.E. (2021). Infectious disease in an era of global change. *Nature Reviews Microbiology*, 20(4): 193–205.
34. Thaker J. & Cook C. (2021). Experience or attribution? Exploring the relationship between personal experience, political affiliation, and subjective attributions with mitigation behavioural intentions and COVID-19 recovery policy support. *Journal of Environmental Psychology*, 77: 101685.
35. Aji B. (2019). Creating awareness about climate change impacts on human health: an online mass media analysis in Indonesia. *Annals of Tropical Medicine and Public Health*, 22(11): 115–122.
36. Hosking J. & Campbell-Lendrum D. (2012). How well does climate change and human health research match the demands of policymakers? A scoping review. *Environmental Health Perspectives*, 120(8): 1076–1082.
37. Cardwell F.S. & Elliott S.J. (2013). Making the links: do we connect climate change with health? A qualitative case study from Canada. *BMC Public Health*, 13(1): 208.
38. Sweileh W.M. (2020). Bibliometric analysis of peer-reviewed literature on climate change and human health with an emphasis on infectious diseases. *Globalization and Health*, 16(1): 44.
39. Araos M., Austin S.E., Berrang-Ford L. & Ford J.D. (2015). Public health adaptation to climate change in large cities: a global baseline. *International Journal of Health Services*, 46(1): 53–78.
40. Gill G. (2022). Eco-epidemiology of infectious diseases and climate change. *Health Problems of Civilization*, 16(1): 15–30.