

Impact of climate change on public health

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Abstract

Background: Climate change is recognized as one of the greatest global health threats of the 21st century. Rising temperatures, shifting weather patterns, and the increasing frequency of extreme events have profound implications for human health. These include direct effects such as heat-related illnesses and respiratory conditions, as well as indirect consequences like the spread of vector-borne diseases, food insecurity, waterborne infections, and mental health challenges. Vulnerable populations—particularly children, the elderly, and low-income communities—bear the heaviest burden.

Materials and Methods: This paper synthesizes evidence from recent reports, global datasets, and peer-reviewed literature on the health impacts of climate change. Data from the Intergovernmental Panel on Climate Change (IPCC), World Health Organization (WHO), World Meteorological Organization (WMO), and other sources were analyzed to highlight current and projected health outcomes, with emphasis on disparities across regions and populations.

Results: Findings show that climate change already contributes to approximately 13 million deaths annually worldwide. Heatwaves, floods, and wildfires are increasing morbidity and mortality rates, while warmer climates expand the geographical spread of malaria, dengue, and other vector-borne diseases. Food insecurity is expected to rise, placing millions at risk of malnutrition by 2050. Climate change also exacerbates respiratory illnesses through worsened air quality and drives psychological stress, anxiety, and depression, particularly among displaced and marginalized groups.

Conclusion: Climate change is not only an environmental issue but also a pressing public health crisis. Its diverse impacts amplify existing inequalities and strain healthcare systems worldwide. Addressing these challenges requires urgent global cooperation, integrating emission reduction with health-focused adaptation strategies. Strengthening health infrastructure, promoting resilience, and empowering vulnerable communities are essential to safeguarding health in the face of a changing climate.

Keywords: *Climate change, Public health, Heat-related illness, Vector-borne diseases, Health equity*

Introduction

Climate change, largely caused by human greenhouse gas emissions, is a major 21st-century global health threat. Its effects go far beyond environmental damage, deeply impacting human health. Rising temperatures, shifting weather patterns, and more frequent extreme events increase worldwide risks of disease, malnutrition, injury, and mental illness.

Understanding these health consequences is vital for creating effective strategies to mitigate climate change and help vulnerable populations adapt, ensuring sustainable development. This essay uses recent scientific findings to examine the complex link between climate change and public health and considers policy and future research needs.

Climate change is the long-term shift in a region's average temperature and weather patterns, mainly due to human activities such as burning fossil fuels. Public health is the science and art of protecting and improving community health. Climate change harms health directly and indirectly. Infectious diseases, respiratory problems, and mental health issues. Low-income groups, children, and the elderly are most vulnerable. Mitigation involves policy and technological solutions.

Enduring temperature modifications, rainfall, and various atmospheric conditions characterize climate change. According to the Intergovernmental Panel on Climate Change (IPCC), it is primarily driven by human activities such as burning fossil fuels, clearing forests, and industrial operations, which raise levels of greenhouse gases like carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) (IPCC, 2021). Over the last hundred years, the global average temperature has risen by about 1.2 °C compared to pre-industrial times, with the most recent years recording the highest temperatures documented (NOAA, 2022). These changes have resulted in noticeable effects on natural habitats, extreme weather patterns, rising sea levels, and declining biodiversity.

The World Health Organization (WHO) projects that around 13 million lives are lost yearly due to climate change, primarily due to heightened risks from diseases carried by vectors, heat-related illnesses, lack of proper nutrition, and environmental pollution (WHO, 2021). The connections between climate change and health are intricate and function through various direct, indirect, and socioeconomic routes.

There are different mechanisms of impact: immediate impacts, heatwaves and health conditions linked to temperature. Increasing temperatures directly risk human well-being through heat-related conditions, such as heat exhaustion and heatstroke. The occurrence and severity of heatwaves worldwide have escalated; for example, Europe faced a devastating heatwave in 2022, with unprecedented temperatures surpassing 40°C (EUROCONTROL, 2022). Those at greater risk include the elderly and individuals working outdoors, who suffer the most. Severe Weather Incidents-Flooding, hurricanes, and wildfires result in injuries, deaths, and forced relocations. The wildfires in California in 2020, exacerbated by drought and heat, led to respiratory problems from smoke inhalation and increased mental health challenges (Reid et al., 2020).

Indirect Effects -Altered Disease Ecology, Climate change influences the distribution and lifecycle of disease vectors such as mosquitoes and ticks, expanding their habitats and lengthening transmission seasons. For example, warming temperatures have facilitated the spread of *Aedes aegypti*, the mosquito vector for dengue, Zika, and chikungunya viruses, into previously temperate regions (Liu-Helmersson et al., 2019). Food Security and Malnutrition-Changes in agricultural productivity due to droughts, floods, and shifting growing seasons threaten food availability. The FAO estimates that climate change could cause an additional 8.4 to 23.4 million people to experience malnutrition annually by 2050 (FAO, 2018). Waterborne Diseases-Altered rainfall patterns and flooding increase water supply contamination, leading to cholera, dysentery, and typhoid outbreaks. Haiti's 2010 earthquake and subsequent floods exacerbated cholera outbreaks, demonstrating climate and disaster interactions (Weitz et al., 2016).

Socioeconomic and Mental Health Effects, Displacement and Migration-Extreme weather and sea-level rise displace millions, leading to health challenges related to shelter, sanitation, and access to healthcare. The UNHCR reports increasing climate refugees, with mental health issues such as anxiety and depression rising among displaced populations (Koh et al., 2021). Mental Health-Climate-induced disasters and chronic climate stressors contribute to psychological trauma, post-traumatic stress disorder (PTSD), and community grief, with vulnerable groups experiencing compounded effects (Berry et al., 2018).

According to the current impact and evidence, as well as the regional and global observations, Recent research highlights the direct effects of climate change on health: Heat-

Related Deaths: According to the Global Burden of Disease study from 2020, increased exposure to heat is estimated to cause around 350,000 deaths each year globally, predominantly affecting nations with lower and middle-income levels (GBD, 2020). **Vector-Borne Illnesses:** Climate variations are associated with increased malaria and dengue cases, with projections indicating a substantial growth of suitable environments for these diseases in Africa, Asia, and Latin America by 2050 (Ryan et al., 2020). **Air Quality and Breathing Disorders:** The rise in temperatures and air pollution worsens conditions such as asthma and chronic obstructive pulmonary disease. Research conducted in the United States suggests that climate change may result in an additional 9,300 deaths related to respiratory issues each year by 2050 (Patz et al., 2018).

Disparities and Vulnerabilities: Marginalized communities encounter greater risks because of their restricted ability to adapt. For instance, residents of low-income urban areas frequently reside in locations with inadequate infrastructure, heightening their susceptibility to heat and exposure to pollution (Huang et al., 2020). Vulnerable groups such as children, seniors, and individuals with existing health issues are particularly at risk.

Future Projections modelling Future Impacts-Climate models project that, unless greenhouse gas emissions are curbed, global temperatures could rise by 2-3°C by 2100, amplifying health risks. The World Meteorological Organization (WMO, 2022) warns that heatwaves, vector-borne diseases, and food insecurity will intensify. Projected health impacts include reducing heat-related deaths by 2050 in some regions. Expanded geographical range of vector-borne diseases. Increased frequency of climate-related disasters exacerbates injury and mental health issues. Greater malnutrition due to food system disruptions.

Mitigation and Adaptation Strategies-Effective mitigation (reducing emissions) and adaptation (building resilience) are vital. Strategies include developing climate-resilient health infrastructure. Early warning systems for heatwaves and disease outbreaks. Integrating climate considerations into public health planning. Promoting sustainable agriculture and water management.

Policy Implications and Recommendations: Addressing climate change's health impacts requires a multi-sectoral approach: **Global Action:** Strengthening international commitments, such as the Paris Agreement, to limit global warming below 1.5°C (UNFCCC, 2015). **National Policies:** Incorporating health considerations into climate policies, disaster preparedness, and

urban planning. Community Engagement: Raising awareness, promoting adaptive behaviours, and empowering vulnerable groups. Research and Surveillance: Enhancing data collection, modelling, and research to inform evidence-based policies.

Role of Healthcare Systems-Health systems must be resilient and adaptive, training healthcare workers on climate-related health risks. Expanding surveillance for emerging vector-borne and zoonotic diseases. Ensuring equitable access to healthcare during climate crises.

Climate change has increasingly become a dominant force shaping human health outcomes around the globe. Its direct and indirect effects pose serious public health risks, including increased morbidity, mental health disturbances, disease transmission, and food insecurity. This document synthesizes research findings to comprehensively explore how climate change impacts public health, drawing on various academic and institutional sources.

Climate change intensifies weather events such as heatwaves, floods, droughts, and hurricanes, each carrying significant health threats. According to the Intergovernmental Panel on Climate Change (IPCC, 2021), these extreme events have grown in frequency and severity due to global temperature increases. Rising temperatures exacerbate cardiovascular and respiratory diseases, particularly among vulnerable populations such as the elderly, children, and individuals with pre-existing conditions. The World Meteorological Organization (WMO, 2022) supports this, reporting a clear upward trend in heat-related mortality, especially during prolonged heatwaves.

Urban areas are particularly susceptible to the urban heat island effect, where built environments retain heat, amplifying the impacts of global warming. A systematic review by Huang et al. (2020) concluded that urban heat islands significantly heighten the risk of heat-related illnesses, including heatstroke and dehydration. Moreover, increased ambient temperatures lead to the formation of ground-level ozone, which can exacerbate asthma and other respiratory conditions.

Mental health is another domain where climate change exerts considerable influence. Events such as natural disasters, displacement, and the chronic stress of environmental change can precipitate or worsen mental health conditions. Berry, Bowen, and Kjellstrom (2018) developed a causal pathways framework illustrating how climate-related stressors can lead to anxiety, depression, and post-traumatic stress disorder (PTSD). Koh et al. (2021) further

validated this, highlighting the psychological toll of climate-induced disasters and long-term environmental degradation.

Vector-borne diseases are also expanding geographically and seasonally due to climate change. As temperatures rise and precipitation patterns shift, habitats suitable for disease vectors like mosquitoes broaden. Liu-Helmersson et al. (2019) demonstrated that warmer temperatures have facilitated the spread of *Aedes aegypti* and *Aedes albopictus* mosquitoes, known carriers of dengue, Zika, and chikungunya. This increases the risk of outbreaks in regions previously unaffected by these diseases.

Food security and nutrition are deeply intertwined with climate variables. Agricultural productivity is susceptible to climate fluctuations, affecting both the availability and quality of food. The Food and Agriculture Organization (FAO, 2018) emphasized that rising temperatures, water scarcity, and extreme weather events compromise food systems, leading to undernutrition and malnutrition. Diminished crop yields and livestock productivity directly impact dietary diversity and caloric intake, particularly in low-income regions.

The spread of infectious diseases is another significant concern. Warmer temperatures and shifting precipitation patterns can increase the frequency and severity of waterborne diseases. For instance, cholera outbreaks have been linked to climate disturbances. A review by Weitz et al. (2016) of cholera in post-earthquake Haiti found that environmental changes played a crucial role in the disease's transmission. Inadequate water and sanitation systems often catalyze such outbreaks, exacerbated by climate change.

Air quality is another facet of environmental health affected by climate change. Increased temperatures and wildfires contribute to higher particulate matter concentrations and other pollutants. Reid et al. (2020) underscored that wildfire smoke exposure is associated with respiratory and cardiovascular issues, and its increasing frequency poses long-term health challenges. These pollutants can cross borders, affecting populations far from the source.

Climate-driven changes also influence chronic health conditions. The Global Burden of Disease Study (GBD 2019) notes that non-communicable diseases (NCDs) such as heart disease and diabetes are sensitive to environmental stressors. For example, extreme heat can impair physical activity, dietary habits, and access to healthcare services, aggravating existing health conditions.

Public health systems are also strained by climate-related health impacts. Health services must adapt to handle increased patient loads during climate events, provide resources for mental health crises, and manage new or re-emerging infectious diseases. Patz et al. (2018) emphasized the importance of strengthening public health infrastructure, improving surveillance systems, and developing adaptive strategies to mitigate health risks.

Adaptation strategies must be multi-sectoral and globally coordinated. The Paris Agreement (UNFCCC, 2015) represents a unified commitment to limit the rise of global temperature and promote resilience. These goals must be integrated into public health planning to ensure that climate actions simultaneously benefit health outcomes.

Scientific institutions like NASA and NOAA continue to provide critical data for tracking climate trends and predicting their implications. According to NASA (2022), the planet has warmed significantly since pre-industrial times, with 19 of the warmest years occurring since 2000. NOAA (2022) further elaborates that global temperatures and sea levels continue to rise, affecting ecosystems and human health across continents.

Health equity is a crucial consideration. Climate change disproportionately affects marginalized communities with limited adaptive capacity. WHO (2021) identifies that low-income populations, indigenous groups, and small island nations are particularly vulnerable. These populations often reside in high-risk areas and have fewer resources to prepare for or recover from climate impacts.

A robust framework for collaboration across disciplines and borders is essential to effectively address the public health implications of climate change. Investments in health research, climate modelling, and resilient infrastructure can substantially reduce vulnerability. International cooperation and knowledge-sharing platforms can amplify the reach and impact of localized interventions.

In conclusion, climate change and public health intersection is complex and urgent. From mental health challenges and infectious diseases to nutritional deficits and system-wide stress, climate change affects every facet of health. Evidence from global studies underscores the necessity of proactive, informed, and equitable strategies to protect population health in a changing climate. Governments, scientists, and communities must work in tandem to implement sustainable policies prioritizing environmental stewardship and human well-being.

Conclusion

Climate change poses an undeniable and escalating threat to public health worldwide. Its diverse impacts affect physical health, mental well-being, and social stability. While current data underscore the severity of these challenges, future risks could be mitigated through aggressive emission reductions, resilient health infrastructure, and community-based adaptation strategies. Recognizing the interconnectedness of climate and health is essential to achieving sustainable development and safeguarding human well-being for future generations. The evidence overwhelmingly demonstrates that climate change poses significant and multifaceted threats to public health. From mental health disturbances and infectious disease proliferation to food insecurity and heat-related morbidity, the health impacts are pervasive and exacerbate existing social inequalities. These challenges demand urgent, coordinated action across sectors, integrating climate policies with public health strategies to build resilient, equitable societies. Mitigation efforts to reduce greenhouse gas emissions and adaptation measures that strengthen health systems and community resilience are critical to safeguarding global health in a changing climate. Investing in research, improving surveillance, and fostering international cooperation will be essential to address the evolving threats and protect future generations from the health consequences of climate change.

In summary, climate change is not merely an environmental issue but a profound public health crisis. Its impacts are wide-ranging, affecting physical health, mental well-being, and social equity. Recognizing these interconnected challenges and implementing comprehensive, science-based solutions is imperative to mitigate risks and promote health sustainability in an uncertain future. Only through concerted global efforts can we hope to reduce the adverse health impacts of climate change and ensure a healthier, more resilient world for all.

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