

Climate Change and Public Health: Impacts, Mechanisms, and Strategic Responses

Eleftheria Stamati

BSc Department of Biomedical Science - Medical Laboratory Technologist, University of West Attica – Greece - MSc Department of Molecular and Applied Physiology – School of Medicine - MSc Department of Geology and Geo-environment - PhD candidate, National and Kapodistrian University of Athens, Greece

***Corresponding author:** Eleftheria Stamati, PhD Candidate, National and Kapodistrian University of Athens, Greece, MSc Climate Crisis, Environmental Management, and Governance - Department of Geology and Geo-Environment, Greece.

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Abstract

Climate change is one of the most pressing global health challenges of the 21st century. Its effects are already being observed through rising temperatures, extreme weather events, the shifting range of infectious diseases, and the exacerbation of chronic illnesses. This article reviews the main pathways through which climate change affects human health, explores biological and socio-economic vulnerability factors, and proposes strategic responses in the context of clinical epidemiology and public health. Addressing climate change requires coordinated, multisectoral action rooted in equity and resilience.

Keywords: Climate Change, Public Health, Epidemiology, Extreme Weather, Infectious Diseases, Health Systems, Vulnerability, Adaptation.

Introduction

Anthropogenic climate change, primarily driven by greenhouse gas emissions, is transforming natural and human systems globally. Among the most vulnerable systems is human health. The World Health Organization has identified climate change as a major threat to global health, particularly for low-income populations and those already burdened by disease [1]. Understanding and addressing the health impacts of climate change is crucial for public health planning, risk reduction, and health equity.

Health Impacts of Climate Change

Extreme Weather Events:

Increased frequency and intensity of heatwaves, floods, hurricanes, and droughts are linked with excess mortality and morbidity [2].

Infectious Disease Patterns:

Climate variability alters ecosystems and vector habitats. Diseases such as malaria and dengue fever are expanding into new regions [3].

Air Pollution and Chronic Illness:

Rising temperatures contribute to increased ground-level ozone and PM2.5, worsening conditions like asthma and cardiovascular diseases [4].

Food and Water Security:

Climate disruptions in agriculture and water quality elevate the risks of food insecurity and waterborne diseases [5].

Mental Health Impacts:

Disasters and displacement contribute to PTSD, anxiety, and depression [6].

Vulnerability and Social Inequities

The health impacts of climate change are unequally distributed.

Vulnerable populations—including children, the elderly, individuals with chronic conditions, and marginalized communities—face disproportionate risks [7]. Socioeconomic inequality compounds the effects. According to local risk assessment must include socio-environmental vulnerability indices to prioritize protective measures [8].

Strategic Responses and Public Health Adaptation Surveillance and Early Warning Systems

Establishing and enhancing climate-sensitive disease surveillance and meteorological early warning systems can significantly reduce morbidity and mortality from extreme weather events and outbreaks. These systems enable timely public health interventions, such as heatwave alerts, vector control, and resource mobilization for affected areas [9]. Integrated monitoring platforms can combine environmental, epidemiological, and social data to produce accurate risk forecasts.

Health System Strengthening

Climate-resilient health systems must have the capacity to prepare for, respond to, and recover from climate-related shocks. This includes infrastructural upgrades to withstand extreme weather, ensuring continuity of care, and equipping healthcare workers with training on climate-sensitive conditions. Primary health care should be at the center of response strategies, with an emphasis on prevention and risk communication [10].

Emission Mitigation and Health Co-Benefits

Mitigation efforts such as reducing fossil fuel use, promoting clean energy, and increasing urban green spaces not only lower greenhouse gas emissions but also deliver immediate health benefits. Reduced air pollution leads to fewer respiratory and cardiovascular diseases. Active transportation (e.g., cycling and walking) improves physical and mental health while decreasing emissions [3].

Urban Planning and Infrastructure

Cities play a central role in adaptation through climate-smart urban design. Implementing green roofs, permeable surfaces, and expanded public transport networks enhances both environmental sustainability and public health outcomes. Heat action plans and urban cooling initiatives help mitigate heat stress, especially in low-income neighborhoods.

Interdisciplinary and Intersectoral Collaboration

Effective public health adaptation requires collaboration across sectors such as environment, transport, housing, agriculture, and education. Policy coherence and coordinated governance can amplify impact and avoid siloed responses. Climate-health action plans must incorporate input from diverse stakeholders, including community organizations and vulnerable populations, to ensure relevance and equity [7].

Education and Public Engagement

Raising awareness about the health impacts of climate change and promoting sustainable behaviors is vital for long-term adaptation. Public education campaigns, inclusion of climate-health

topics in school curricula, and community engagement initiatives build social capital and empower individuals to contribute to climate resilience.

Conclusion

Climate change is not solely an environmental issue; it is a public health emergency. The magnitude and complexity of its health impacts demand urgent, evidence-based, and equity-focused interventions. As clinicians, researchers, and public health practitioners, we must reframe climate change as a central health issue and prioritize actions that protect the most vulnerable populations. Building climate-resilient health systems is a critical step toward safeguarding global health in the decades to come.

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