

REVIEW ARTICLE

Climate Change and Human Health in India: Preventive Public Health Strategies for Emerging Health Risks

Rahul Saxena¹, Suyash Saxena²

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ABSTRACT

Climate change has emerged as one of the largest public health challenges of the twenty-first century, with India being particularly vulnerable due to its diverse climatic conditions, high population density, fast urbanization, and socioeconomic inequality. Rising temperatures, irregular rainfall, frequent floods, droughts, cyclones, and decreasing air quality are significantly influencing the prevalence and distribution of climate-sensitive diseases while compounding existing health inequities. This study synthesizes existing information on the relationship between climate change and human health in India, stressing its direct and indirect implications on communicable and non-communicable diseases, nutritional status, mental health, occupational health, and maternity and child health. The review also evaluates the disproportionate burden borne by vulnerable people, including children, older persons, pregnant women, economically disadvantaged communities, and individuals dwelling in climate-sensitive locations. Particular attention is placed on preventative public health interventions that can increase resistance against developing climate-related health concerns. These include climate-informed disease surveillance, early warning systems, climate-resilient healthcare infrastructure, health promotion, community engagement, environmental risk communication, multisectoral collaboration, and the integration of digital technologies and the One Health approach into public health practice. The assessment also addresses the existing policy landscape in India, highlights significant implementation obstacles, and outlines future research goals for establishing sustainable and evidence-based solutions. By integrating scientific knowledge with public health views, this review highlights the critical need to incorporate climate adaptation and mitigation into national health strategy.

AUTHOR'S AFFILIATION:

¹ Professor, Department of Biochemistry, School of Allied Health Sciences, Sharda Hospital, Sharda University, Greater Noida, Uttar Pradesh, India.

² Associate Professor, Department of Biochemistry, School of Allied Health Sciences, Sharda Hospital, Sharda University, Greater Noida, Uttar Pradesh, India.

CORRESPONDING AUTHOR:

Rahul Saxena, Professor, Department of Biochemistry, School of Allied Health Sciences, Sharda Hospital, Sharda University, Greater Noida, Uttar Pradesh, India.

E-mail: rahul.saxena@sharda.ac.in

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Strengthening preventative public health systems through coordinated policy action, capacity building, and community-centered initiatives will be vital to safeguard population health and promote climate resilience in India.

KEYWORDS

• Climate Change • Human Health • Preventive Public Health • Climate Resilience
• India

INTRODUCTION

Climate change has become one of the leading social determinants of health in the twenty-first century, contributing to the burden of heat waves, extreme weather events, changes in precipitation regimes and agricultural yields, natural disasters, deteriorating air quality, and ecosystem disruptions. According to The Lancet Countdown on Health and Climate Change 2024, there is an urgent need to address escalating climate-related health risks and vulnerabilities at the global level since heat stress, air pollution, and the impact of climate-sensitive infectious diseases pose a significant threat to human health. Moreover, climate change impacts are projected to be most severe in low- and middle-income countries due to higher exposure to environmental hazards and the challenges associated with adapting to new climatic conditions. This article aims to provide an in-depth understanding of the effect climate change can have on the population's health in the future.¹

India is one of the countries that are most vulnerable to climate change due to its diverse environments, large population, and climate-sensitive economies. Extreme temperatures, heatwaves, flooding, cyclones, draughts, and air pollution contribute to the high incidence of heat-related illnesses and diseases, including respiratory and cardiovascular problems, vector-borne infections like dengue and malaria, water-borne diseases, malnutrition, and psychological issues. Recent studies indicate a significant relationship between air pollution and premature mortality in India. In addition, climate change and the environment have a considerable impact on non-communicable diseases. It affects the most vulnerable groups, including children, the elderly, pregnant women, outdoor workers, poor people, and those with pre-existing medical conditions, thereby aggravating social inequalities.²

Given these challenges and threats, public health preventive measures will play a

significant role in decreasing the health burden related to climate change, as well as promoting adaptation and resilience processes. Climate-informed disease surveillance and early warning systems, health promotion, risk communication strategies, adaptive health systems, multisectorial approaches, and community-based adaptation initiatives have the potential to reduce negative health impacts considerably. The present paper aims to analyze the effects of climate change on human health in India, review the status of climate-sensitive disease burdens, public health adaptation strategies, policies, and the challenges related to them. The review article will also consider the gaps and propose future directions for building climate-resilient health systems to ensure public health security and adapt to climate change processes. The study's results will contribute to understanding the complexity of climate change effects on human health and provide evidence for policymakers and public health officials to develop appropriate responses to the challenges.³

Climate Change and Human Health in India

India is one of the country's most vulnerable to climate change due to its diverse ecosystem, high human density, rapid urbanization, and high reliance on climate-sensitive sectors like agriculture. The impacts of climate change such as rising temperatures, extreme weather events like heat waves, erratic monsoon patterns, flooding, droughts, cyclones, and rising air pollution levels are beginning to take a toll on the population across the country. Ecosystems are under threat, putting severe strain on food and water security and exposing populations to various environmental hazards (Figure 1). Climate change affects both public and environmental health through complex mechanisms. It can have direct effects such as heat-related injuries or damage to the environment and indirect effects such as disruption to air quality, ecological systems, agricultural production, and socio-economic systems.⁴

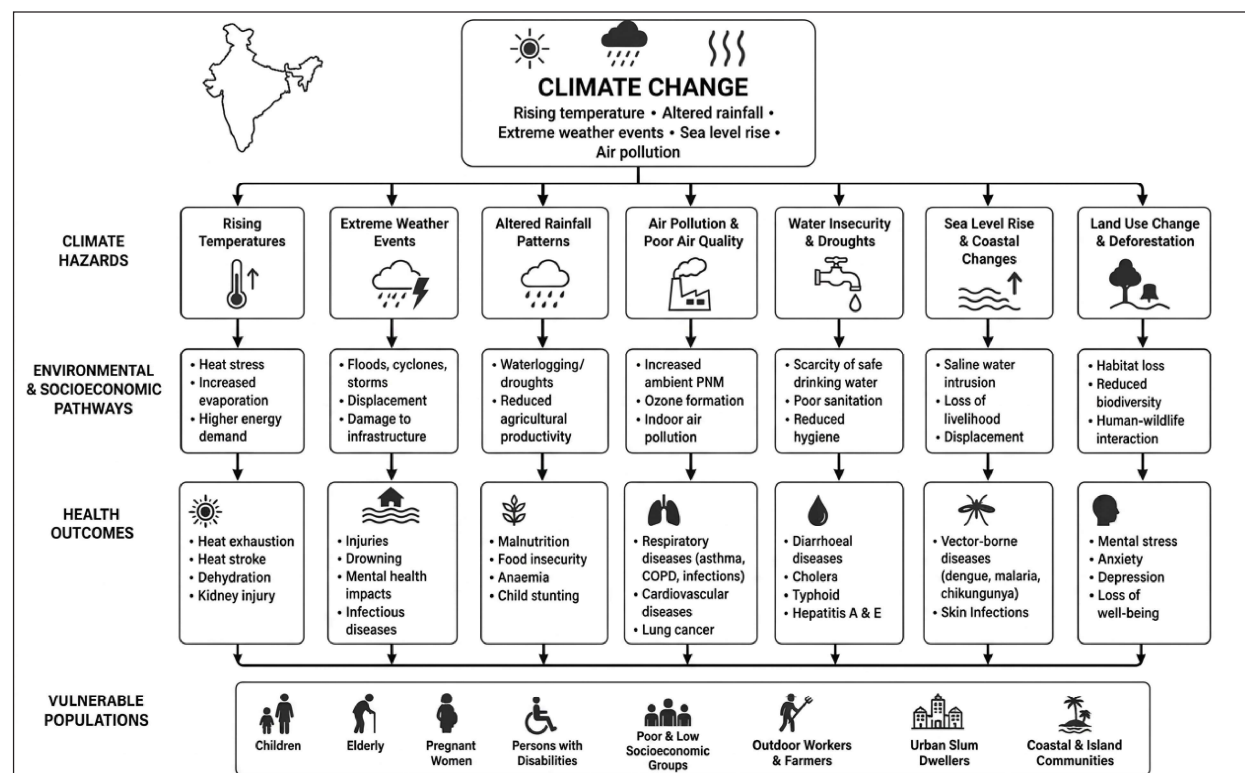


Figure 1: Pathways linking climate change to human health outcomes in India

The health impact of climate change is multifaceted and has extensive repercussions in India. The country is witnessing an increased occurrence of heatwaves which lead to dehydration, heat stress, heatstroke, acute kidney injury and deaths especially in outdoor workers and the elderly. Rising concentrations of particulate matter and ozone are linked to higher rates of asthma, chronic obstructive pulmonary disease, cardiovascular accidents and deaths. Shifting temperatures and rainfall patterns are facilitating the expansion of vector-borne diseases such as dengue, malaria, chikungunya, and Japanese encephalitis. Flooding, stagnant water and water contamination is resulting in higher diarrheal diseases, cholera, typhoid and other water-borne illnesses. Reduced agricultural productivity, impacting food security, nutrition and leading to malnutrition and micronutrient deficiencies especially in children and pregnant women. Displacement, loss of livelihood and loss of personal assets during extreme weather events are factors which exacerbate anxiety, depression, post-traumatic stress and other mental health disorders.⁵

The most vulnerable populations are children, the elderly, pregnant women,

patients with chronic diseases, tribal groups, urban slums, and rural agricultural workers. The health status of these communities is significantly compromised due to a lack of access to health care resources, social and economic security, safe and healthy living conditions, and opportunities for adaptation. It is essential to strengthen climate-resilient health systems, surveillance mechanisms, early warning signals, and community-based approaches to adapt to the environment in order to reduce vulnerability and protect population health in India.⁶

PREVENTIVE PUBLIC HEALTH STRATEGIES

Preventive public health strategies are essential for reducing the health effects of climate change in India. We need to shift our focus from reactive healthcare to proactive risk reduction. Health promotion should emphasize climate-sensitive actions like heat-health action plans, better nutrition, safe water and sanitation, vaccination, vector control, and awareness campaigns that encourage adaptive behaviours during extreme weather events. At the same time, we must strengthen climate-resilient healthcare systems by ensuring continuous essential services, building climate-

proof infrastructure, integrating renewable energy, preparing for emergencies, and creating supply chains that can operate during floods, cyclones, droughts, and heatwaves. Recent assessments show the importance of including climate risks in regular health system planning and infrastructure development throughout India.⁷

Robust disease surveillance and early warning systems are vital for detecting and responding to climate-sensitive diseases in a timely manner. By integrating weather, environmental, and health data, we can predict outbreaks of dengue, malaria, diarrheal diseases, and heat-related illnesses. This integration helps in planning effective public health interventions. Community-based adaptation improves resilience by involving local governments, community health workers, and civil society groups in risk communication, behavioral change, and disaster preparedness. Digital health tools, artificial intelligence (AI), remote sensing, geographic information systems, and predictive analytics can further improve surveillance, allocate resources efficiently, identify vulnerable populations, and support informed decision-making during climate emergencies. Ultimately, a One Health approach recognizes the link between human, animal, and environmental health. This approach offers a framework for climate resilience by encouraging collaboration among sectors, integrated surveillance, prevention of zoonotic diseases, conservation of ecosystems, and sustainable management of the environment. Strengthening these interconnected strategies will enhance India's readiness for new climate-related health risks while promoting universal health coverage and long-term public health resilience.^{8,9}

POLICY FRAMEWORK, CHALLENGES, AND FUTURE DIRECTIONS

India has progressively integrated climate change into its public health agenda through national and state-level efforts targeted at enhancing climate resilience. The National Action Plan on Climate Change (NAPCC), the National Programme on Climate Change and Human Health (NPCCHH), the National Disaster Management Plan, and the National Clean Air Programme (NCAP) provide a strategy framework for tackling climate-sensitive health concerns. Several states have

also established Heat Action Plans and climate adaption plans suited to local risks. These projects stress surveillance, capacity building, early warning systems, public awareness, and enhancing health infrastructure to reduce morbidity and mortality related with heatwaves, vector-borne diseases, air pollution, and extreme weather events. Despite these gains, implementation remains inconsistent between states due to disparities in institutional capacity, financial resources, and technical knowledge.¹⁰

Significant policy gaps continue to hinder the effectiveness of climate-health solutions. Weak integration of climate data with health surveillance systems, weak intersectoral coordination, insufficient climate-health research, and limited availability of district-level vulnerability assessments restrict evidence-based decision-making. Future goals should be on establishing integrated climate-health information systems, expanding climate-sensitive disease predictions utilizing artificial intelligence and geospatial technologies, and gathering high-quality longitudinal data to analyze health implications across varied populations. Strengthening collaboration among the health, environment, meteorology, agricultural, urban planning, disaster management, and academic sectors is crucial for establishing comprehensive adaptation methods.¹¹ Furthermore, persistent investments in climate-resilient healthcare infrastructure, workforce training, community participation, and equitable resource allocation should be prioritized. Embedding climate factors into regular public health planning, backed by strong governance, ongoing monitoring, and policy evaluation, will improve India's readiness for new climate-related health threats. This effort will also help achieve sustainable, resilient, and fair health systems in the future.¹²

CONCLUSION

Climate change is developing as a major public health concern in India, influencing heat-related illnesses, respiratory and cardiovascular disorders, vector-borne infections, water-borne diseases, malnutrition, and mental health consequences. This analysis demonstrates that preventative public health measures—including climate-sensitive surveillance, early warning systems,

community awareness, health promotion, and robust healthcare infrastructure – can dramatically lower the burden of climate-related diseases. The findings underline that climate change functions like a “threat multiplier,” increasing existing socioeconomic and health imbalances, particularly among children, older individuals, low-income populations, and rural communities. Policymakers should prioritize climate-health integration within national health programmes, strengthen intersectoral collaboration, and invest in research and digital health technology. Healthcare providers should incorporate climate risk assessment, preparedness, and patient education into everyday practice. Looking ahead, India’s shift toward climate-resilient health systems will require continuous political commitment, adaptive governance, and innovation to preserve public health in an increasingly unpredictable climatic future.

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