eISSN 2583-6986
IDEALISTIC JOURNAL OF ADVANCED RESEARCH IN PROGRESSIVE SPECTRUMS (IJARPS)
A MONTHLY, OPEN ACCESS, PEER REVIEWED (REFEREED) INTERNATIONAL JOURNAL
Volume 03, Issue 12, December 2024

Effect of Climate Change on Public Health in India

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Received: 24 Oct 2024 Accepted & Reviewed: 25 Oct 2024, Published : 31 Dec 2024

Abstract

Climate change and the increased climate variability are expected to worsen global health disparities. It is crucial to conduct additional research, especially in developing nations, to better predict the anticipated impacts and to develop effective interventions. There is overwhelming evidence that climate change poses increasing threats to public health security, ranging from extreme weather-related disasters to the broader spread of vector-borne diseases like malaria and dengue. The health impacts of climate change will not be evenly distributed across the globe. India, a large developing nation, exemplifies this vulnerability. The country is home to the Great Himalayas, the world's third-largest ice mass in the north, and a 7,500 km densely populated coastline in the south. Nearly 700 million of India's over one billion people live in rural areas and rely directly on climate-sensitive sectors like agriculture, forests, fisheries, and natural resources such as water, biodiversity, mangroves, and coastal zones for their livelihoods. The country frequently experiences heatwaves, floods (both inland and coastal), and droughts, while diseases like malaria, malnutrition, and diarrhea are already significant public health concerns. Any projected increases in weather-related disasters and their health consequences could further overwhelm India's already strained public health infrastructure. Therefore, it is crucial to act urgently. Addressing the health risks of climate change requires both mitigation and adaptation strategies. These approaches can work in tandem, significantly reducing the risks posed by climate change.

Keywords: -Climate, Health, Vulnerability, Disease.

Introduction

The effects of climate change on human health are becoming increasingly evident as global temperatures rise, weather patterns change and extreme weather events become more frequent and severe. Climate change impacts health both directly and indirectly, with consequences ranging from heat-related illnesses and respiratory problems to the spread of infectious diseases and mental health challenges. These health risks disproportionately affect vulnerable populations, including the elderly, children, and low-income communities, and are expected to worsen as climate change accelerates. Understanding these links is crucial for public health preparedness and developing effective strategies to mitigate and adapt to these growing health threats. Climate change is a significant and emerging threat to public health. Hence, it is finding an increasingly central position on the international agenda as governments, organizations, and health agencies recognize the need for urgent action to mitigate its impacts and protect vulnerable populations. This growing awareness drives efforts to integrate climate resilience into health systems, develop adaptation strategies, and prioritize policies to reduce greenhouse gas emissions to safeguard global health. The impact of climate change on health in India is becoming increasingly severe due to the country's geographic location, large population, and high vulnerability to extreme weather events. India faces a complex interplay of environmental, social, and health challenges, all of which are being exacerbated by climate change. In designing public health responses, several critical factors must be considered, such as the population's age structure, socioeconomic conditions, baseline prevalence of climate-sensitive diseases, public awareness of health risks, the built environment, existing infrastructure, available public health services, and the autonomous actions that

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households and communities may take to cope with the health impacts of climate change (McMichael et al. 2004). Furthermore, adaptation strategies to address climate variability and change must be tailored to the specific temporal and spatial contexts relevant to India. Proactively adjusting to current climate variability and integrating modifications into existing programs to address anticipated climate impacts will enhance the effectiveness of future adaptation efforts (Ebi et al. 2006). Effective public health planning requires a comprehensive understanding of these factors and coordinated efforts across sectors to build resilience and ensure long-term sustainability. Furthermore, limited research has been conducted on the combined effects of weather, climate variability, and rising air pollution levels in India (Agarwal et al., 2006 and Karar et al., 2006).

Our study aims to investigate the detailed description of the health impacts of climate change in India, with a particular focus on the effects of climate change on human health, including extreme heatwaves, food security, malnutrition, air pollution, respiratory diseases, and mental health outcomes

2. Effect Of Climate Change On Human Health:- Climate change triggers the emergence of new zoonotic diseases by depriving primary food sources, thereby driving humans towards wildlife for food and thus, indirectly facilitating the risk of new diseases (Kassie et al. 2015). Climate change has emerged as a critical factor affecting human health globally, and its effects are particularly pronounced in developing countries like India. With a population of over 1.4 billion people, India's geographical and socioeconomic diversity makes it highly susceptible to the varied impacts of climate change. The rising temperatures, changing precipitation patterns, and increasing frequency of extreme weather events threaten to exacerbate existing health challenges and introduce new risks to human well-being. This review paper examines how climate change impacts health outcomes in India and discusses the country's preparedness and adaptive measures.

2.1 Heatwaves and Temperature Extremes:- In recent decades, India has experienced a sharp increase in the frequency, duration, and intensity of heatwaves. Heatwaves, characterized by prolonged periods of excessively high temperatures, pose significant risks to human health, particularly in northern, western, and central India. Prolonged exposure to high temperatures can lead to heat-related illnesses such as heat exhaustion, heatstroke, and dehydration. Vulnerable populations, including the elderly, children, and outdoor workers, are particularly at risk. According to the Indian Meteorological Department (IMD), the frequency of heatwaves has increased by 2.5 times between 1981 and 2020. In 2022, India experienced one of the hottest summers on record, leading to over 24,000 excess deaths. Cities like Delhi, Mumbai, and Kolkata experience the urban heat island effect, where urban areas are significantly warmer than surrounding rural areas. Poor urban planning, lack of green spaces, and heat-absorbing infrastructure contribute to this effect. Several Indian states have developed Heat Action Plans (HAPs) to mitigate the effects of heat waves. Ahmedabad, for example, was the first Indian city to implement a HAP in 2013, which includes early warning systems, public awareness campaigns, and access to cooling centers. Several Studies suggest that the Ahmedabad HAP has led to a 25% reduction in heat-related mortality since its implementation.

2.2 Vector-Borne Diseases:- Climate change is altering the distribution and transmission patterns of vector-borne diseases, including malaria, dengue, chikungunya, and Japanese encephalitis, which are transmitted by mosquitoes. Rising temperatures, changes in rainfall, and humidity levels create more favorable conditions for mosquito breeding and increase disease transmission. It is also known to be a major driving force for infectious and vector-borne diseases across the world (Khan et al. 2019). India has approximately 2 million confirmed cases of malaria per year (Kumar et al. 2007). Malaria transmission is shifting to higher altitudes and latitudes due to warmer temperatures. States like Himachal Pradesh and Uttarakhand, which were previously considered low-risk areas, are now reporting malaria cases. Dengue cases in India have surged,

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with over 193,245 cases reported in 2022 alone, up from 129,166 cases in 2015. Warmer temperatures and erratic rainfall are expanding the geographical range of Aedes mosquitoes. India accounts for over 85% of malaria cases in South Asia, and the rise in vector-borne diseases poses a significant challenge to the healthcare system. Increased transmission not only leads to higher morbidity and mortality but also strains public health resources, particularly in rural areas with limited access to healthcare.

2.3 Water-Related Diseases and Flooding:- Climate change has led to more erratic monsoon patterns in India, resulting in both floods and droughts. Flooding increases the risk of waterborne diseases, such as cholera, diarrhea, typhoid, and leptospirosis, as contaminated water becomes a breeding ground for pathogens. The 2023 floods in Assam and Bihar led to significant outbreaks of waterborne diseases, with over 500,000 people affected by diarrhea and gastroenteritis. Poor sanitation infrastructure and lack of access to clean drinking water further exacerbate the spread of these diseases, particularly in slums and rural areas. It aggravates the risk of waterborne diseases, diseases spread by mosquitoes, ticks and infectious diseases like leptospirosis, campylobacter infections and cryptosporidiosis (Rossati, 2017) and also results in higher risk of typhus, cholera, malaria, dengue, WestNile, and Zika virus infections (Ryan et al. 2021) and Franchini and Mannucci (2015).

2.4 Drought and Water Scarcity:- Droughts, on the other hand, contribute to water scarcity, leading to poor hygiene practices and the consumption of unsafe water, further increasing the risk of disease transmission. States like Maharashtra and Rajasthan have seen severe droughts, which have not only affected agricultural output but also led to water stress-related illnesses.

2.5 Food Security and Malnutrition:- Climate change impacts agricultural productivity in India by altering rainfall patterns, increasing the frequency of droughts, and reducing soil fertility. This has a direct impact on food security, as India's agricultural sector is highly dependent on the monsoon. Reduced agricultural output can lead to food shortages, driving up food prices and reducing access to nutritious food for low-income populations. Climate change also affects crop yields and livestock production, which are critical for meeting the protein and micronutrient needs of the population. According to the World Food Programme, 194 million people in India are undernourished, and climate-induced food insecurity is expected to worsen this situation. Malnutrition remains a critical issue in India, with 35.5% of children under the age of five being stunted (NFHS-5, 2019-2021). Climate change exacerbates this by reducing access to food and worsening nutritional outcomes, particularly for women and children.

2.6 Air Pollution and Respiratory Diseases:- India's air quality has been deteriorating, with climate change exacerbating the issue. Rising temperatures and increased levels of particulate matter contribute to poor air quality, particularly in urban areas. Air pollution, especially in cities like Delhi, is linked to respiratory and cardiovascular diseases, including asthma, chronic obstructive pulmonary disease (COPD), and lung cancer. According to the Global Burden of Disease report, air pollution is responsible for over 1.67 million deaths in India annually. Rising temperatures also increase the formation of ground-level ozone, which worsens respiratory conditions.

2.7 **Mental Health Impacts:-** Climate-related events such as heatwaves, floods, droughts, and crop failures have a significant impact on mental health in India. Farmers, who are particularly vulnerable to climate variability, often experience heightened anxiety, depression, and stress due to crop failures and water shortages. A study found that rising temperatures are linked to a 4% increase in suicide rates among Indian farmers, who face economic stress due to failed crops and food insecurity.

3. Public Health Responses And Adaptation Strategies:-

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3.1 Government Initiatives:- India has begun implementing a range of public health interventions to address the health impacts of climate change. The important initiatives are summarized below.

(i) Heat Action Plans: The **heat action plans are referred to as HAPs.** Early warning systems, public awareness campaigns, and cooling centers to reduce heat-related mortality.

(ii) National Action Plan on Climate Change: The national action plan on climate change is referred to as NAPCC. Launched in 2008, the NAPCC includes initiatives like the National Mission on Sustainable Agriculture and the National Water Mission, which aim to improve climate resilience in critical sectors.

(iii) National Water Mission: The national water mission (referred to as NWM) focuses on addressing the impacts of water scarcity and contamination by promoting water conservation techniques such as rainwater harvesting and efficient irrigation systems. It also ensures safe drinking water for both rural and urban populations to reduce waterborne diseases like cholera and diarrhea, which often increase during floods or droughts. Additionally, the NWM is building climate-resilient water management systems to ensure sustainable water availability and improved sanitation.

(iv) Community-Based Adaptation Programs: The government, in partnership with NGOs and international organizations, has implemented several **community-based adaptation programs.** These initiatives focus on enhancing the resilience of rural and tribal communities through climate-smart agriculture, improved water management, and localized health interventions. They also provide climate change education to help communities understand health risks and adopt adaptive measures, such as using heat protection methods and maintaining hygiene during floods.

(v) Indian Council of Medical Research: The **Indian Council of Medical Research (referred to as ICMR)** and other research institutions are actively working to understand the links between climate change and health. Their focus includes conducting epidemiological studies to track the spread of climate-sensitive diseases, developing climate-resilient health technologies such as vaccines and diagnostics for diseases like dengue and malaria, and studying the impact of extreme heat, air pollution, and water scarcity on public health to inform policy responses.

3.2 Challenges:-

Despite these initiatives, significant challenges remain, including limited financial resources, inadequate infrastructure, and lack of public awareness about the health impacts of climate change. Strengthening healthcare systems, improving disease surveillance, and enhancing climate resilience in vulnerable communities will be essential to mitigate future risks. Among other challenges, the impact of climate change on health is also significant.

(a) Overburdened Infrastructure: India's healthcare system is already stretched, particularly in rural areas where access to quality healthcare is limited. Climate change exacerbates the burden on the system by increasing the frequency of disease outbreaks, trauma from natural disasters, and chronic illnesses.

(b) Resource Allocation and Preparedness: Addressing climate-related health impacts requires significant investment in healthcare infrastructure, disease surveillance, emergency preparedness, and public health education. However, resource constraints often hinder the ability to respond effectively to the growing health challenges posed by climate change.

4. Conclusion:- The health impacts of climate change in India are vast and interconnected, affecting millions of people, particularly vulnerable populations such as the poor, elderly, women, and children. Effective adaptation strategies, investment in healthcare infrastructure, and public health interventions are essential to mitigate these impacts. Furthermore, climate-resilient policies and practices must be integrated into development planning to protect public health and promote sustainable growth in the face of ongoing

environmental changes. Climate change poses a substantial and growing threat to human health in India, particularly among vulnerable populations. From heatwaves and vector-borne diseases to food insecurity and mental health issues, the effects of climate change are widespread and complex. While India has made progress in developing adaptation strategies, more comprehensive and coordinated efforts are needed to protect public health in the face of a changing climate.

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