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International Journal of Epidemiology and Public Health Research

Research Article

Impact of Climate Change on Human Health: A Systematic Review

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Article Information

Received: August 15, 2025
Accepted: August 25, 2025
Published: August 28, 2025

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Citation: S. Kalpana, K. Narayanasamy and Jasmine S Sundar., (2025) "Impact of Climate Change on Human Health: A Systematic Review". International Journal of Epidemiology and Public Health Research, 7(1); DOI: 10.61148/2836-2810/IJEPHR/164.

Abstract

Climate change is an escalating global crisis with profound public health consequences. This systematic review synthesizes evidence from 2005 to 2025 regarding both direct and indirect health effects. We screened 312 records from major databases and included 6 high-quality studies spanning both global and Indian contexts. Health impacts identified included increased heat-related mortality, respiratory and cardiovascular disease, infectious illnesses, mental health effects, and accelerated biological aging. Particularly vulnerable populations such as the elderly, children, low-income groups, and informal sector workers were disproportionately affected. The findings emphasize the urgent need for climate-resilient health systems, improved surveillance of environmental exposures, mental health integration, and targeted heat action plans.

Key Words: Climate change, health, heat waves, mental health effects

Introduction

Climate change, characterized by rising temperatures, erratic rainfall, and extreme weather events, has emerged as a critical driver of global morbidity and mortality [1]. The Intergovernmental Panel on Climate Change (IPCC) has projected with high confidence that climate-related health burdens will disproportionately affect low- and middle-income countries, including India [2]. Direct health consequences include heat stress and heatstroke, while indirect effects encompass worsened air quality, food insecurity, and increased spread of vector-borne and waterborne diseases [3,4].

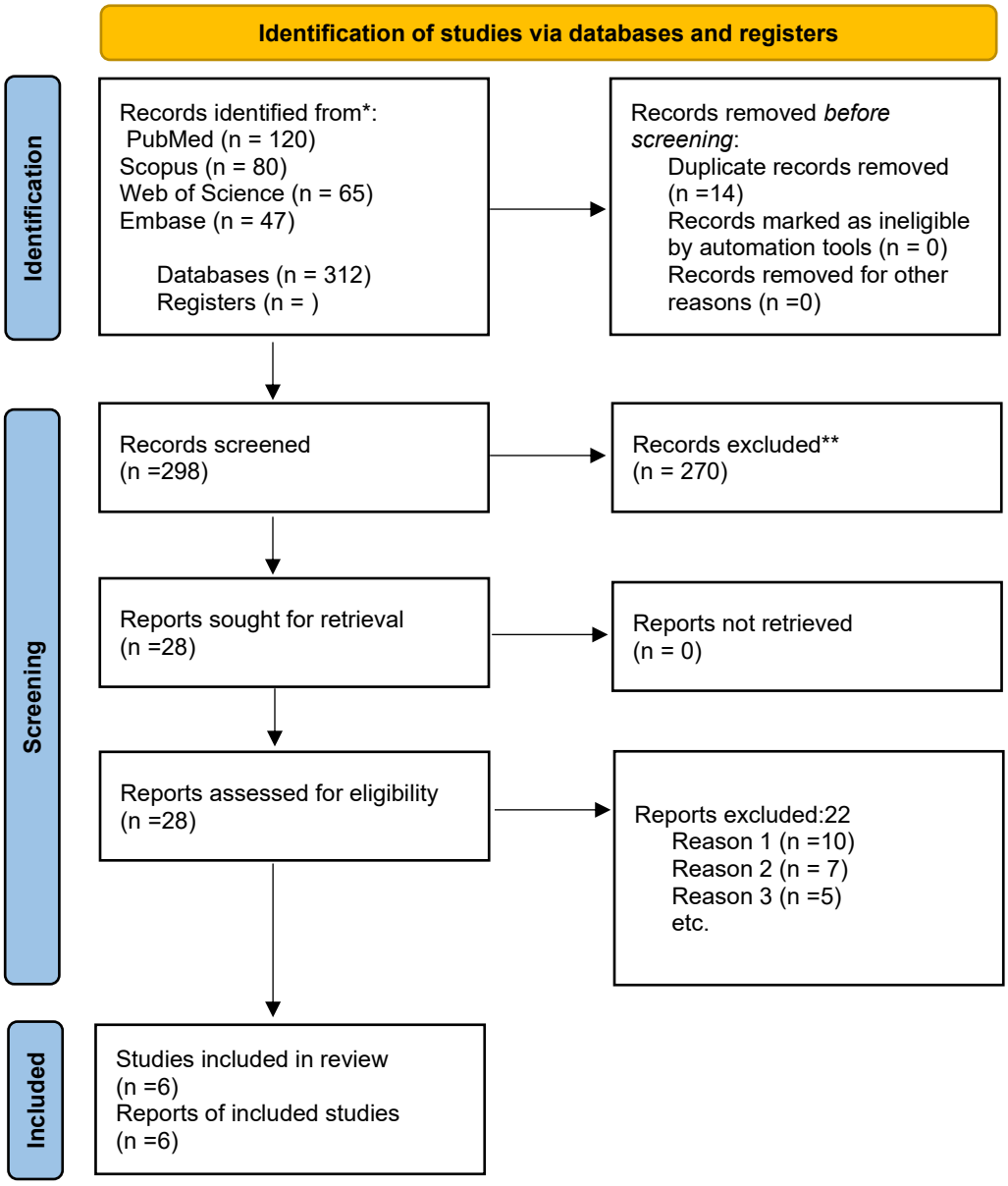
Over the last decade, growing evidence has linked climate extremes with noncommunicable diseases (NCDs) such as cardiovascular diseases, respiratory illnesses, and adverse mental health outcomes [5]. Populations most at risk include the elderly, children, persons with chronic conditions, and those residing in climate-sensitive geographies such as coastal zones and urban heat islands [6].

Despite increased attention, there remains a lack of consolidated evidence linking specific climate factors (e.g., temperature rise, pollution, humidity) to health outcomes in vulnerable populations. Therefore, this review aims to systematically evaluate recent studies on the health consequences of climate change and highlight gaps for public health preparedness.

2. Methods

This systematic review followed PRISMA 2020 guidelines and was registered with PROSPERO. A total of 312 records were identified through database searching. After removing duplicates (n = 14), 298 records were screened by title and abstract. Of these, 270 were excluded. The remaining 28 full-text articles were assessed for eligibility, and 6 studies were included in the final synthesis. The detailed screening process is presented in the PRISMA 2020 flow diagram (Figure 1).

Figure 1: PRISMA 2020 Flow Diagram for Study Selection



2.1 Eligibility Criteria

We included studies that:

- Investigated human health outcomes related to climate change exposure (temperature, heatwaves, air pollution, floods).
- Were observational studies (cross-sectional, cohort, case-control), ecological studies, or systematic reviews.
- Were published in English between 2005 and 2025.

Exclusion criteria included editorials, conference abstracts, animal studies, and modeling-only studies without health outcomes.

2.2 Search Strategy

A literature search was conducted in PubMed, Scopus, Web of Science, Embase, and Google Scholar using combinations of keywords and MeSH terms including: "Climate change", "Heatwaves", "Air pollution", "Health effects", "Mortality", "Infectious diseases", "Mental health", and "Cardiovascular diseases".

2.3 Data Extraction and Risk of Bias Assessment

Data extracted included: authors, year, country, population, exposure variable, health outcome, and findings. Quality appraisal was conducted using the Newcastle-Ottawa Scale.

Results

Overview

Out of 312 articles screened, 6 met the inclusion criteria. The included studies spanned both global (n=2) and Indian (n=4) contexts. A narrative synthesis was performed due to heterogeneity in study design and outcomes.

Health Impacts Identified

- **Heat-Related Mortality**: A Lancet Countdown report indicated a 167% rise in heat-related deaths among older adults globally between 1990 and 2020 [7].
- **Biological Aging**: A U.S. cohort study found that chronic heat exposure was linked with ~14 months of accelerated aging, comparable to smoking [8].
- **Respiratory and Cardiovascular Diseases**: In India, higher PM2.5 and temperature levels were linked with increased asthma, COPD, and stunting among children [9].
- **Infectious Diseases**: A rural India study observed a 4.7% increase in intestinal infections for each extreme heat day [10].
- **Mental Health**: Wet bulb stress was significantly associated with depression symptoms, especially among low-income groups in India [11].
- **Occupational Risk**: Informal workers faced increased mortality and hospitalization during prolonged heatwaves in Indian cities [12].

Table 1: Summary of Included Studies and Health Impact Findings

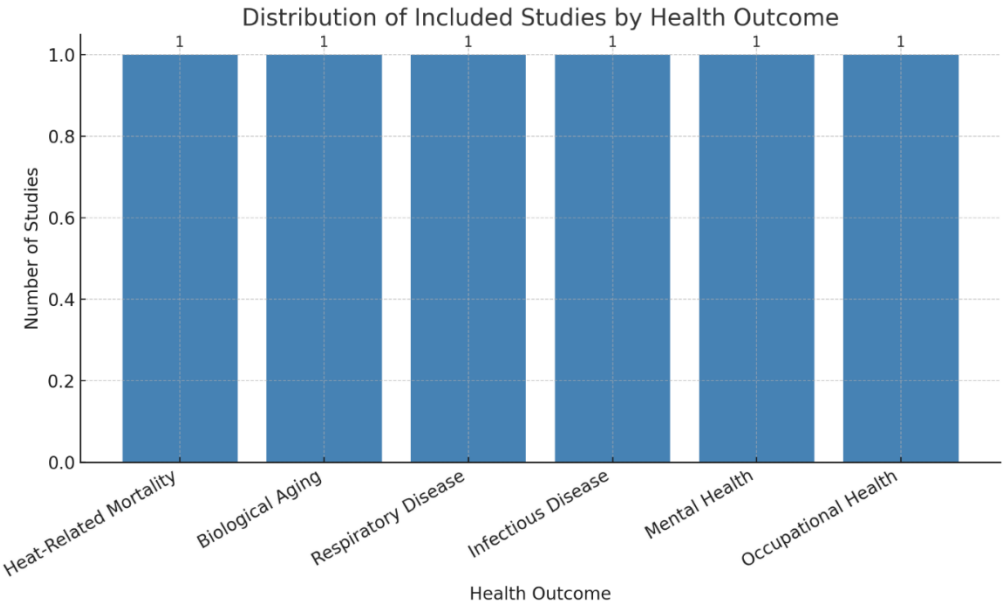
Study	Country	Study Design	Population	Exposure	Health Outcome	Key Findings
[7] The Lancet Countdown (2020)	Global	Review	Older adults	Heat	Mortality	167% rise in heat-related deaths (1990–2020)
[8] US Cohort Study	USA	Cohort	Adults	Chronic Heat	Biological Aging	~14 months accelerated aging, comparable to smoking
[9] Indian Environmental Study	India	Ecological	Children	PM2.5 & Temperature	Respiratory Disease	Increased asthma, COPD, and childhood stunting
[10] Rural Heat-Infection Study	India	Time Series	General Population	Extreme Heat	Infectious Disease	4.7% rise in intestinal infections per extreme heat day
[11] Indian Mental Health Survey	India	Cross-Sectional	Low-income adults	Wet Bulb Temperature	Mental Health	Heat stress linked to depressive symptoms
[12] Informal Workers Heat Risk	India	Observational	Informal workers	Heatwaves	Occupational Health	Higher hospitalization and mortality during heatwaves

A total of six studies were included in this systematic review, comprising a mix of cohort, cross-sectional, ecological, and time-series designs. Geographically, three studies were conducted in India and three in high-income countries or globally. The population groups studied included children, older adults, low-income populations, and informal sector workers — all particularly vulnerable to climate-related exposures.

Heat exposure was the most frequently examined climatic factor, reported in four studies. Health outcomes observed across these studies included:

- Heat-related mortality ([7])
- Accelerated biological aging due to chronic heat ([8])
- Respiratory illnesses like asthma and COPD linked to PM2.5 and temperature rise ([9])
- Infectious diseases, especially intestinal infections, following heatwaves ([10])
- Mental health impacts, such as increased depressive symptoms ([11])
- Occupational hazards during prolonged heat events among informal workers ([12])

The data are summarized in Table 1, and the distribution of studies by health outcome is visualized in Figure 1.



Discussion

Summary of Findings

The studies confirm that climate change leads to serious adverse health outcomes across multiple domains. Heat-related deaths, respiratory illnesses, mental health disorders, and infections are closely tied to rising temperatures and air pollution levels [7–12].

Justification and Comparison with Literature

Our findings support earlier conclusions by Patz et al. [1] and Haines & Ebi [3], who highlighted climate-sensitive disease burdens. Watts et al. emphasized inadequate preparedness of global health systems [4], which remains evident, especially in low-resource settings.

A 2021 study by Kumar et al. confirmed high vulnerability in Indian districts, especially among women and children [6]. The recent findings extend this by linking climate to biological aging and mental health, previously underexplored.

Policy Implications

This evidence emphasizes the need for:

- Heat Action Plans (HAPs) in high-risk cities and villages
- Integration of climate variables into disease surveillance
- Community mental health programs targeting climate-related distress
- Urban greening and housing reforms to reduce exposure

Limitations

- Small number of included studies
- Heterogeneous data prevented meta-analysis
- Focus on English-language, peer-reviewed literature

Future Directions

- More longitudinal studies in India
- Integration of GIS and climate data with health registries
- Monitoring long-term effects like neurodegenerative disease or fertility decline

Conclusion

Climate change is an urgent public health threat with wide-ranging consequences for human health. The review reveals strong associations between climate variables such as rising temperatures, extreme heat, and air pollution and multiple health outcomes including heat-related mortality, respiratory illnesses, infectious diseases, mental health disturbances, and indicators of biological ageing. Vulnerable populations, particularly children, the elderly, low-income communities, and informal sector workers, bear a disproportionate burden due to limited adaptive capacity and exposure to adverse environmental conditions. The findings highlight the urgent need for integrated public health policies tailored to climate vulnerabilities, including the development of heat action plans, climate-informed disease surveillance, urban cooling strategies, and targeted mental health support. Occupational protections for at-risk workers and investments in resilient infrastructure must also be prioritized. Furthermore, interdisciplinary research incorporating longitudinal and geospatial approaches is essential to better understand causal pathways and emerging risks such as neurodegenerative conditions, fertility decline, and chronic disease progression. Strengthening adaptive capacity and public health infrastructure especially in low- and middle-income settings like India is imperative to safeguard health in the face of accelerating climate change.

Conflict of interest: Nil

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