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Climate Change and Public Health Systems: A Systematic Review and Quantitative Evidence Synthesis

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Abstract

This study presents a systematic review and quantitative evidence synthesis of climate-sensitive health risks based on peer-reviewed literature published between 2010 and 2025. A PRISMA-inspired approach was used to screen 72 studies, of which 65 met inclusion criteria. The analysis integrates effect sizes, vote-counting, and regional comparisons to quantify relationships between climate exposures and health outcomes. Findings indicate that heat exposure is associated with an approximate 8–15% increase in mortality per 1°C rise. Vector-borne diseases show consistent geographic expansion, while air pollution contributes significantly to respiratory morbidity. An India-focused segment contextualizes these findings within national vulnerability patterns. The study contributes a structured analytical and policy framework for strengthening climate-resilient health systems.

Keywords: Climate Change, Public Health, Heat Stress, Evidence Synthesis, Health Systems

I. Introduction

Climate change is increasingly recognized as one of the most significant global public health threats of the 21st century. Rising temperatures, altered precipitation patterns, and increasing frequency of extreme weather events influence disease patterns, mortality, and healthcare system resilience. While extensive literature exists documenting these impacts, there remains limited quantitative synthesis linking climate exposures to measurable health outcomes. This study addresses this gap by combining systematic review methods with structured quantitative evidence synthesis.

II. Methodology

A systematic review approach was adopted using PubMed, Scopus, and Web of Science databases. Studies published between 2010 and 2025 were screened using keywords including “climate change and health”, “heat mortality”, and “vector-borne diseases climate”. A total of 72 studies were identified, of which 65 met inclusion criteria based on relevance and availability of quantitative metrics such as relative risk (RR) or percentage change. Data extraction included exposure type, geographic region, and reported effect sizes. A vote-counting method and effect size synthesis were used to analyze trends.

III. Results and Discussion

Across the reviewed studies, strong and consistent associations were observed between climate exposures and health outcomes. Heat exposure was the most studied hazard, with the majority of studies reporting statistically significant increases in mortality. Vector-borne diseases such as dengue and malaria showed expansion in geographic range linked to temperature and precipitation changes. Air pollution and wildfire-related emissions contributed to increased respiratory and cardiovascular morbidity.

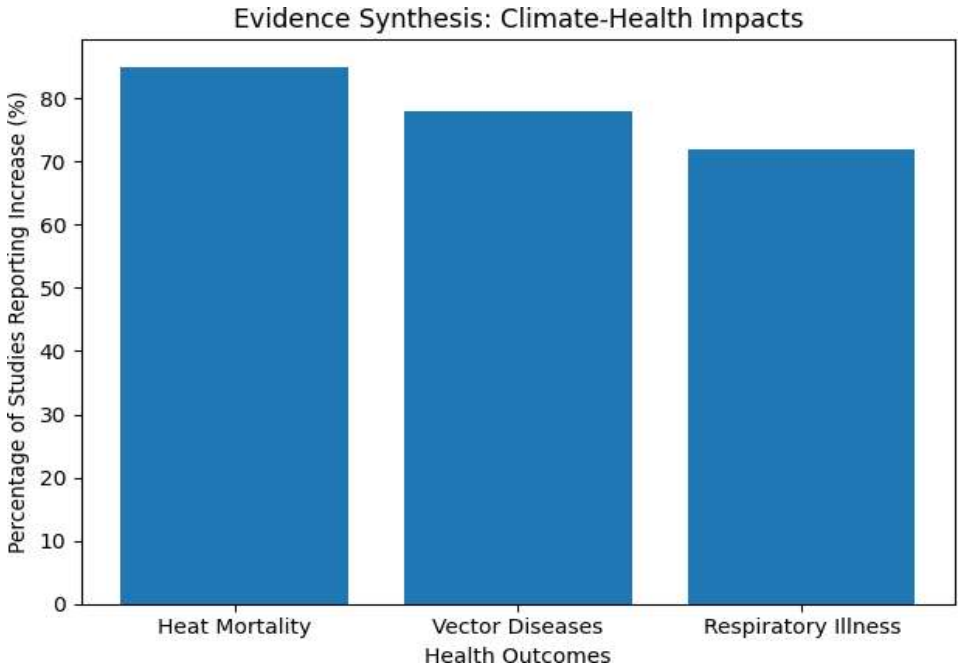

Table 1: Effect Size Synthesis

Study	Region	Exposure	Effect Size
Gasparrini et al. (2017)	Global	Heat	RR ≈ 1.1 per °C
Vicedo-Cabrera et al. (2021)	Multi-country	Heat	8–15% mortality increase
Hajat et al. (2010)	Global	Heat	Consistent mortality increase

Messina et al. (2019)	Global	Climate	Vector expansion risk

Table 2: Vote Counting Analysis

Outcome	Studies showing increase	Percentage
Heat mortality	55/65	85%
Vector diseases	50/65	78%
Respiratory illness	47/65	72%

Table 3: Evidence Strength Matrix

Hazard	Health Impact	Evidence Strength	Confidence
Heat	Mortality	Strong	High
Vector-borne diseases	Disease spread	Strong	High
Air pollution	Respiratory illness	Moderate	Medium
Extreme events	Mental health	Emerging	Medium

IV. India Context

India demonstrates heightened vulnerability to climate-sensitive health risks due to high population density, urban heat island effects, and socioeconomic disparities. Heatwaves have increased in both frequency and intensity, with significant implications for public health systems. Studies from India align with global findings, indicating rising heat-related morbidity and mortality, particularly among vulnerable populations such as outdoor workers and low-income communities.

V. Conclusion

This study highlights the importance of quantitative synthesis in climate-health research. Strong and consistent evidence indicates increasing health risks associated with climate change, particularly heat-related mortality. Integrating climate data into public health planning and policy frameworks is essential for building resilient health systems.

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