DOI: https://doi.org/10.36094/sc.v92.2026.Air_Pollution_in_the_Era_of_Climate_Change.Adhikari_Samajder.344

ARTICLE

Sci. and Cult. 92 (5–6) : 344-346 (2026)

AIR POLLUTION IN THE ERA OF CLIMATE CHANGE: CHALLENGES AND STRATEGIC DIRECTIONS FOR URBAN HEALTHCARE PLANNING IN INDIA

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Air pollution is a major climate-linked health risk in rapidly urbanizing India. Climate change intensifies pollution through rising temperatures, altered atmospheric chemistry, and extreme events, increasing exposure to particulate matter and ozone. Urban populations face higher risks of respiratory and cardiovascular diseases, adverse pregnancy outcomes, and greater healthcare demand. This review examines links between climate change, air pollution, and urban health, highlighting gaps in integrated, climate-responsive healthcare planning and equity-focused adaptation.

Introduction

Climate change and air pollution are deeply interconnected environmental challenges with profound implications for public health. Rising global temperatures influence atmospheric conditions that exacerbate the formation and dispersion of pollutants such as particulate matter (PM2.5), nitrogen oxides, and ground-level ozone[5]. In India, rapid urbanization, vehicular emissions, industrial growth, construction activities, and fossil fuel dependence have significantly deteriorated urban air quality. Several Indian cities consistently rank among the most polluted globally[4].

Exposure to air pollution is associated with respiratory illnesses, chronic obstructive pulmonary disease (COPD), asthma, cardiovascular diseases, stroke, and premature mortality. Climate change intensifies these health risks through heatwaves, stagnant air masses, and increased frequency of wildfires. Despite environmental policies and pollution control measures, urban healthcare systems are underprepared to manage the escalating health burden linked to climate-driven air quality deterioration. There is a pressing need to integrate environmental health considerations into urban healthcare planning.

Review of Literature

Climate Change and Air Pollution Interlinkages: Climate change modifies atmospheric chemistry, influencing pollutant concentration and distribution. Higher temperatures accelerate ozone formation and prolong pollution episodes[3]. Heatwaves exacerbate particulate pollution by reducing dispersion, while climate variability influences dust storms and biomass burning. These interactions create compounded environmental risks, particularly in densely populated urban settings.

Health Impacts of Urban Air Pollution: Air pollution is a leading environmental risk factor contributing to millions of premature deaths globally[6]. In India, long-term exposure to PM 2.5 has been linked to increased hospital admissions for respiratory and cardiovascular diseases[2]. Vulnerable groups—including children, the elderly, pregnant

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women, and individuals with pre-existing conditions—face disproportionate risks. Studies also associate pollution exposure with adverse birth outcomes and reduced lung development in children.

Urbanization and Healthcare Burden: Rapid urban growth in India has strained public health infrastructure. Increased patient loads during severe pollution episodes lead to overcrowded outpatient departments and emergency services. Seasonal pollution spikes in cities like Delhi, Kolkata, and Mumbai correlate with higher respiratory admissions[1]. However, healthcare planning rarely incorporates environmental forecasting into resource allocation and capacity building.

Equity and Environmental Justice: Air pollution disproportionately affects low-income communities residing near industrial zones, highways, and congested urban settlements. Limited access to quality healthcare further exacerbates vulnerability. Climate-linked pollution therefore reinforces existing social and health inequities. Integrating environmental justice principles into urban healthcare planning is essential to reduce disparities.

Policy and System-Level Responses: India has introduced initiatives such as the National Clean Air Programme (NCAP) and climate action policies aimed at emission reduction. However, coordination between environmental regulation and healthcare system preparedness remains limited. There is inadequate integration of air quality surveillance data into hospital planning, early warning systems, and preventive health strategies.

Gaps in Existing Literature

Existing research extensively documents the health effects of air pollution and climate change independently. However, there is limited evidence linking climate-driven pollution trends with healthcare infrastructure preparedness in Indian urban settings. Few studies examine how hospitals adapt operational strategies during pollution peaks. Additionally, economic evaluations assessing the long-term cost implications for healthcare systems remain scarce.

Methodology of Study

This study adopts a narrative review approach, analyzing secondary literature from peer-reviewed journals, policy documents, global health reports, and national environmental databases. The review focuses on the intersection of climate change, air pollution, and urban healthcare planning in India. Literature was selected based on relevance to environmental health, urban systems, and policy adaptation frameworks.

Recommendations

To strengthen urban healthcare systems against climate-linked air pollution risks, the following strategic directions are proposed:

- ***Integrate Air Quality Surveillance with Health Planning:*** Establish real-time data-sharing mechanisms between pollution control boards and hospitals.
- ***Develop Climate-Responsive Health Infrastructure:*** Design hospitals with improved ventilation systems, air filtration units, and energy-efficient cooling mechanisms.
- ***Strengthen Preventive and Community Health Programs:*** Promote awareness campaigns on pollution-related health risks and preventive behaviors.
- ***Enhance Emergency Preparedness:*** Develop surge capacity plans for pollution-related health spikes.
- ***Prioritize Vulnerable Populations:*** Implement targeted interventions in high-risk urban communities.
- ***Promote Intersectoral Collaboration:*** Encourage coordination between urban planning authorities, environmental agencies, and health departments.
- ***Invest in Research and Economic Evaluation:*** Conduct longitudinal studies to assess healthcare costs attributable to climate-linked air pollution.

Conclusion

Air pollution in the era of climate change represents a complex and escalating challenge for urban India. The compounded environmental and health risks demand a shift from reactive healthcare delivery to proactive, climate-responsive planning. Integrating environmental surveillance, strengthening infrastructure resilience, and embedding

equity principles within urban healthcare systems are critical to ensuring sustainable and inclusive public health outcomes. Addressing air pollution as a climate-linked health risk requires coordinated policy action, system-level adaptation, and sustained research engagement. ❐

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