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MINI-REVIEW

The climate change–noncommunicable disease nexus: Addressing the dual burden on global health

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Abstract

The convergence of climate change and noncommunicable diseases (NCDs) forms a critical global health syndemic, disproportionately impacting low- and middle-income countries (LMICs) and marginalized populations. NCDs—e.g., cardiovascular diseases, cancers, chronic respiratory conditions, and diabetes—cause over 70% of global deaths, with 78% of mortality and 85% of premature deaths in LMICs. Climate change exacerbates this burden through direct pathways, such as heatwaves, which trigger cardiovascular and renal events, and indirect pathways, including disrupted food systems that drive obesity and diabetes, and air pollution that worsens respiratory and cardiovascular health. Psychosocial stress from climate change-induced displacement and disasters further amplifies mental health disorders, interacting with NCD risk. Vulnerable groups, including migrants, indigenous communities, and the urban poor, face compounded risks due to fragile health systems and socio-economic inequities. Small Island Developing States and regions such as Sub-Saharan Africa exemplify these challenges, with rising NCD prevalence amid environmental stressors. Addressing this nexus demands integrated strategies: a strengthened health system, enhanced surveillance, equitable policies, and sustainable development.

Keywords: Climate change; Noncommunicable diseases; Syndemic; Health inequities; Integrated strategies

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1. Introduction

The 21st century is marked by the syndemic of noncommunicable diseases (NCDs) and climate change. Collectively, they create a complex syndemic that threatens global health and development (Sutanto, 2024). These challenges are not isolated. Rather, they are deeply intertwined in their mechanisms, risk factors, and effects on populations, producing overlapping vulnerabilities—especially among marginalized communities (World Health Organization [WHO], 2023). The climate change–NCD syndemic is therefore most devastating in settings of pre-existing social and structural vulnerability.

Noncommunicable diseases, including cardiovascular diseases, cancers, chronic respiratory illness, and diabetes, account for most global deaths, with low- and middle-income countries (LMICs) bearing the majority (Sesay & Osborne, 2025). Premature

deaths from these diseases emphasize urgent shortcomings in health systems. Concurrently, climate change fundamentally disrupts ecosystems, manifests in extreme weather, and fuels cascading social and health impacts (Hunter *et al*., 2024; Sutanto, 2024).

The intersection of climate change and NCDs compounds existing health inequalities and magnifies risks (Di Ciaula *et al*., 2021). Heatwaves and fluctuating temperatures directly stress cardiovascular and renal function, triggering acute events (Ndlovu & Chungag, 2024). Changes to food systems driven by climate change promote both undernutrition and a shift toward processed, nutrient-poor diets that fuel obesity and diabetes epidemics (Fanzo *et al*., 2021). Air pollution—the consequence of industrialization and deforestation—exacerbates respiratory and cardiovascular disease. Mental health burdens rise due to climate change-related disasters, uncertainty, economic insecurity, and displacement (Walinski *et al*., 2023).

Vulnerable groups—including migrants, indigenous populations, and the urban poor—experience the greatest health impacts. Migration driven by environmental stress exposes populations to hazardous working and living conditions, magnifying chronic disease risks (McMichael *et al*., 2012). Many low-resource countries face fragile health infrastructures unable to manage rising NCD burdens alongside infectious diseases and climate emergencies (Martins *et al*., 2024).

Addressing this intertwined climate change–NCD crisis requires integrated, multi-sectoral strategies encompassing health system strengthening, surveillance, equitable policy, and sustainable development. The challenge is immense, but progress is possible through collaborative scientific inquiry, targeted adaptation, and global solidarity with those most affected.

2. Methodology

This review study adopted a comprehensive, mixed-methods approach to synthesize existing evidence on the climate change–NCD nexus. The study relies entirely on secondary sources—peer-reviewed literature, institutional reports, policy briefs, and gray literature—to identify and collate pathways, impacts, and knowledge gaps in the climate change–NCD relationship.

3. Global trends and epidemiology

Noncommunicable diseases are responsible for over 70% of all global deaths annually (WHO, 2025a). The four major categories—cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes—dominate (Sutanto, 2024). LMICs shoulder 78% of this mortality, with 85% of premature deaths (age 30–70) in these settings, illustrating persistent inequities (WHO, 2025a).

For example, in India, NCDs account for 63% of all deaths (Sahu *et al*., 2024). Cardiovascular diseases are responsible for approximately 27% of all deaths, signifying their overwhelming impact (Kalra *et al*., 2023). Furthermore, approximately 1 in 9 people in India are projected to develop cancer, and chronic respiratory diseases also constitute a substantial and increasing public health burden (Salvi *et al*., 2018; Sathishkumar *et al*., 2022; WHO, 2024a). These figures underscore the urgent need for robust public health strategies focused on prevention, surveillance, and the management of NCDs, especially in rapidly urbanizing and vulnerable populations (WHO, 2023). These trends illustrate how climate change and NCDs operate as a syndemic in rapidly developing LMICs such as India.

4. Climate change: Scope and health pathways

Climate change intensifies the NCD epidemic via direct and indirect routes (Sutanto, 2024). The physical manifestations of climate change—rising ambient temperatures, increased frequency and intensity of extreme weather events, and shifting ecosystems—affect human health directly and indirectly.

In terms of direct pathways, extreme heat events lead to physiological stress, which can precipitate acute cardiovascular and renal events. Heatwaves strain the cardiovascular system, elevating risks of heart attacks, strokes, and kidney injury. Simultaneously, fluctuating temperatures can destabilize chronic conditions, pushing vulnerable individuals into healthcare crises (Hunter *et al*., 2024). However, these impacts are unevenly distributed, as various factors, such as socio-economic status, pre-existing health conditions, and governance, act as confounders that modulate outcomes (Romanello *et al*., 2023; WHO, 2021). People with pre-existing NCDs and regions with poor health infrastructure and adaptive capacity experience higher morbidity under similar climatic conditions. For example, poverty can restrict access to healthy diets, clean drinking water, and healthcare, while poor governance with a lack of disaster preparedness and equitable resource allocation further exacerbate exposure (Ebi *et al*., 2021; Intergovernmental Panel on Climate Change, 2022; United Nations Office for Disaster Risk Reduction, 2021)

In terms of indirect pathways, climate change influences the quality and availability of critical resources, such as food and water. Altered climate patterns disrupt agricultural productivity, leading to periodic food insecurity, nutrient deficiencies, and shifts toward dietary patterns associated

with increased NCD risk (Mirzabaev *et al*., 2023). Marine ecosystems also suffer, affecting fisheries and the availability of essential micronutrients (Savage *et al*., 2020). Pollution, wildfires, and allergen load are all rising, compounding disease rates, particularly in cities (Sutanto, 2024). Forced migration, job loss, and disaster exposure foster mental distress, creating a feedback loop of environmental and health risk (Hunter *et al*., 2024). Moreover, environmental degradation contributes to deteriorating air quality. Increased concentrations of pollutants, particulate matter, and allergen loads exacerbate respiratory diseases and increase cardiovascular morbidity (Breitner-Busch *et al*., 2023; Sutanto, 2024). Climate change influences the geographic range and seasonality of infectious diseases, creating additional layers of health vulnerability (Siiba *et al*., 2024; Taha, 2016). The psychosocial impact of climate change-related events—including forced displacement, loss of livelihoods, and exposure to disasters—further compounds the burden by elevating mental health disorders, which closely interplay with physical NCD risk (Hunter *et al*., 2024; Sesay & Osborne, 2025).

Collectively, these pathways illustrate how climate change operates as a "threat multiplier" and as a syndemic driver that interacts biologically and socially, deepening existing health disparities and straining health systems already challenged by the rising tide of NCDs (Sutanto, 2024; WHO, 2023).

5. Mechanisms: Detailed evidence and linkages

Understanding the mechanisms through which climate change exacerbates the burden of NCDs is critical for designing effective interventions (Table 1). Multiple overlapping pathways operate simultaneously, affecting individuals and populations across diverse environmental and social contexts (Siiba *et al*., 2024; Sutanto, 2024).

5.1. Heatwaves and extreme temperature exposure

Climate change has increased the frequency, intensity, and duration of heatwaves globally (Fritz, 2022; Sutanto, 2024). Prolonged exposure to extreme heat elevates risks for cardiovascular events, including myocardial infarction, arrhythmias, and strokes (Hunter *et al*., 2024). Heat stress impairs renal function by promoting dehydration, electrolyte imbalances, and acute kidney injury among vulnerable groups, such as outdoor laborers, the elderly, and people with pre-existing chronic illnesses (Sesay & Osborne, 2025). Additionally, high temperatures can destabilize glycemic control in people with diabetes and exacerbate respiratory conditions (Sutanto, 2024; WHO, 2025a).

5.2. Air pollution

Air pollution, a well-documented risk factor for NCDs, is influenced by and contributes to climate change (Breitner-Busch *et al*., 2023). Rising temperatures can enhance ground-level ozone formation, further degrading air quality (Hunter *et al*., 2024; Sutanto, 2024). Fine particulate matter (e.g., PM2.5) penetrates deep into the lungs and bloodstream, triggering systemic inflammation, oxidative stress, and endothelial dysfunction (Breitner-Busch *et al*., 2023). These processes accelerate atherosclerosis; increase the risk for ischemic heart disease, stroke, chronic obstructive pulmonary disease, and lung cancer; and worsen diabetic complications (Sutanto, 2024; WHO, 2023). Urban populations, especially those in LMIC megacities, experience disproportionate exposure to air pollution due to industrial emissions, traffic congestion, and biomass fuel use (WHO, 2025b).

5.3. Food security and nutrition

Climate change disrupts food systems through altered precipitation patterns and increased droughts, floods, and soil degradation (Savage *et al*., 2020; Siiba *et al*., 2024). Such changes threaten both the availability and diversity of nutritious foods, particularly fresh fruits, vegetables, and fish rich in micronutrients vital for metabolic and cardiovascular health (Savage *et al*., 2020; Sutanto, 2024). Populations facing food insecurity frequently shift toward calorie-dense, nutrient-poor processed foods, fostering obesity, metabolic syndrome, and type 2 diabetes epidemics (Siiba *et al*., 2024; WHO, 2025a). These dietary transitions represent an indirect but powerful conduit linking climate change to rising NCD incidence (Sutanto, 2024).

5.4. Water quality and availability

Water scarcity and contamination, intensified by climate extremes such as floods and droughts, elevate risks for waterborne infections and compound challenges in managing chronic illnesses, including renal diseases (Sesay & Osborne, 2025; Taha, 2016). Safe water shortages undermine hygiene and sanitation, which are essential for reducing complications and secondary infections in patients with chronic diseases (WHO, 2023).

5.5. Psychosocial stress and mental health

Climate change-induced disasters, displacement, and livelihood losses generate acute and chronic psychosocial stress (Hunter *et al*., 2024). Anxiety, depression, post-traumatic stress disorder, and other mental health conditions arise or worsen under these stressors, interacting bidirectionally with physical NCDs. Mental health disorders disrupt lifestyle behaviors, medication

Table 1. Mechanisms linking climate change to noncommunicable diseases

Pathway	Mechanism/Evidence	At-risk groups/regions	Reference
Heat events	Increased cardiovascular disease (CVD), acute kidney injury, and stroke deaths; the elderly/poor are most affected	Elderly, outdoor workers	Sutanto (2024); WHO (2023); Hunter *et al.* (2024)
Air/Water pollution	PM2.5 and ozone lead to respiratory/CVD/chronic kidney disease; especially in slums and migrants	Urban poor, migrants	Sutanto (2024); WHO (2023)
Food insecurity	Crop loss leads to a shift toward processed foods; increased obesity, diabetes, and metabolic syndrome	Small Island Developing States, Africa, South Asia	Savage *et al.* (2020)
Migration	Overcrowding leads to barriers to preventive care	Informal migrants	WHO (2025a)
Mental health	Disasters/Displacement lead to post-traumatic stress disorder, anxiety, and depression	Displaced, youth	Hunter *et al.* (2024)

adherence, and biological stress responses, increasing vulnerability to chronic disease progression (Sutanto, 2024).

5.6. Migration and urbanization

Forced migration and rural-to-urban shifts, often climate-driven, restructure population exposures (Abubakar *et al.*, 2025; Siiba *et al.*, 2024; WHO, 2025c). Migrants frequently face poor living and working conditions characterized by overcrowding, pollution, and limited healthcare access (WHO, 2024b, 2025c). These social determinants, combined with rapid dietary transitions toward ultra-processed foods, sedentary lifestyles in urban economies, and chronic psychosocial stress, elevate risks for hypertension, diabetes, respiratory diseases, and cancer, creating hotspots of heightened vulnerability frequently overlooked in public health planning (Romanello *et al.*, 2023; Sutanto, 2024; WHO, 2023).

In LMICs undergoing rapid urbanization, climate change-induced displacement compounds pre-existing inequities, pushing migrants into peri-urban slums where exposure to fine particulate matter (e.g., PM 2.5) routinely exceeds WHO guidelines by factors of 5–10, directly contributing to a rising burden of chronic obstructive pulmonary disease, asthma, and ischemic heart disease (Romanello *et al.*, 2024; Pandey *et al.*, 2020). Furthermore, loss of traditional food systems further exacerbates mental health and harmful behavior, establishing a vicious cycle that leads to intergenerational NCD risk (I. Gupta *et al.*, 2025; Sesay & Osborne, 2025).

6. Regional case studies and inequalities

6.1. Small Island Developing States

Small Island Developing States (SIDS) present a vivid example of the climate change–NCD syndemic, where environmental vulnerability and NCD burdens intersect with alarming intensity. Comprising 37 nations scattered across the Caribbean, Pacific, and Indian Ocean regions, these countries face profound geographic and climatic vulnerabilities (Guell *et al.*, 2024). Their low-lying coastal geographies heighten exposure to rising sea levels, storm surges, and intensifying cyclones, events that threaten not only livelihoods but also long-term habitability (Savage *et al.*, 2020; Sutanto, 2024). The environmental stressors have direct health impacts—including increased morbidity and mortality from extreme heat, disrupted water supply, and deteriorating food security—and indirect impacts through social and economic disruption (Sesay & Osborne, 2025).

Small Island Developing States already carry a disproportionate burden of NCDs, accounting for approximately 74% of deaths, predominantly from

cardiovascular disease, diabetes, cancer, and chronic respiratory conditions (Savage *et al*., 2020; Sutanto, 2024). The interplay of climate change and economics has accelerated dietary shifts toward imported and processed foods, undermining traditional diets rich in fresh local produce and seafood (Sutanto, 2024). Consequently, SIDS rank among the highest globally in diabetes and obesity rates, a reflection of both local determinants and globalized supply chains (Savage *et al*., 2020). Public health services in many SIDS lack sufficient resources and infrastructure to combat such intertwined crises effectively (WHO, 2023). Despite this, these nations have demonstrated resilience and commitment, advocating for integrated mitigation and adaptation strategies that include health system strengthening, food sovereignty, and sustainable urban design (Sutanto, 2024). However, funding gaps and capacity constraints remain significant hurdles to their ongoing response efforts, demanding urgent policy and financial attention.

6.2. Sub-Saharan Africa

In Sub-Saharan Africa, the impact of climate change on health systems is exacerbated by socio-economic fragility and persistent infectious disease burdens (Nilsson *et al*., 2021; Ogony *et al*., 2025). Sierra Leone exemplifies this challenge, where climate change manifests as frequent flooding events, droughts, and rising temperatures (Sesay & Osborne, 2025). These phenomena stress already overstretched healthcare services, which historically prioritize infectious disease outbreaks over chronic disease management (WHO, 2023). The health sector is ill-prepared to address the growing NCD burden, aggravated by environmental stressors (Siiba *et al*., 2024).

Recent data indicate that in Sierra Leone, approximately 81% of households faced food insecurity in 2022, with 26% of children experiencing stunting, a marker of chronic undernutrition with lifelong health implications (Sesay & Osborne, 2025). Such malnutrition increases susceptibility to NCDs and complicates disease progression among patients with existing NCDs (Grey *et al*., 2021; Melaku *et al*., 2018). At the same time, funding for health remains critically low, with government expenditures on healthcare falling well below global recommendations, compounded by severe shortages in trained healthcare workers. These systemic challenges undermine the surveillance and treatment of NCDs, rendering many patients underserved or excluded entirely from care (WHO, 2023). Urgent health system strengthening tailored to climatic and epidemiological realities is essential to reduce compounded vulnerabilities (Sesay & Osborne, 2025).

6.3. Urban migrant populations in India

India's rapid urbanization has driven mass migration from rural to urban areas, leading to burgeoning slums and informal settlements (WHO, 2025c). These populations bear significantly elevated risks of NCDs due to numerous interlocking social determinants and environmental exposures (Amrutbhai *et al*., 2025; Lumagbas *et al*., 2018). Migrants often occupy poorly serviced, overcrowded areas with limited access to clean water, sanitation, and healthcare facilities (WHO, 2025c). The stress of displacement, combined with demanding physical labor and insufficient health literacy, augments vulnerability (Kaur *et al*., 2024).

Studies have revealed a higher prevalence of hypertension, diabetes, chronic respiratory diseases, and mental health disorders among urban migrants relative to native urban residents or rural populations (Mandal & Kalandi, 2025; Poddar *et al*., 2025). Lifestyle transitions favoring tobacco use, alcohol consumption, and poor dietary habits—frequently driven by economic necessity and cultural dislocation—compound risks (WHO, 2025d). Additionally, migrants' exposure to urban air pollution and heat island effects intensifies respiratory and cardiovascular conditions (D. Gupta *et al*., 2025). Despite these risks, underdeveloped health infrastructure, inadequate insurance coverage, and fragmented data systems hinder effective monitoring and intervention for this population (De Siqueira-Filha *et al*., 2021; I. Gupta *et al*., 2025). Addressing these disparities requires multi-sectoral policies that emphasize inclusive urban planning, migrant-sensitive healthcare models, and enhanced disease surveillance integrated with environmental health metrics (WHO, 2023).

7. Specific noncommunicable diseases impacted by climate change

7.1. Cardiovascular diseases

Cardiovascular diseases remain the leading cause of death globally, and are increasingly influenced by climate change-related factors (Malhi *et al*., 2024). Both extremes of temperature—prolonged heat waves and severe cold spells—exacerbate cardiovascular stress and precipitate acute events such as myocardial infarction, stroke, and heart failure (Hunter *et al*., 2024; Sutanto, 2024). Acute heat exposure disrupts thermoregulation and triggers dehydration, electrolyte imbalances, and inflammatory responses, overwhelming the cardiovascular system, especially in vulnerable populations such as the elderly and those with pre-existing conditions (Fritz, 2022). Recent studies project a significant increase in heat-

related cardiovascular mortality worldwide over the coming decades, with urban populations in LMICs disproportionately affected due to inadequate cooling infrastructure and high ambient pollution levels (Singh *et al.*, 2024; WHO, 2023, 2025b). Pollutants such as fine particulate matter (e.g., PM2.5) and ground-level ozone, which are amplified in warmer climates, further drive systemic inflammation and atherosclerosis, accelerating cardiovascular disease progression (Breitner-Busch *et al.*, 2023; Sutanto, 2024). Occupational exposures—such as agricultural work in elevated temperatures—also contribute to heightened risks, as documented in environments such as rural India and Sub-Saharan Africa (Sesay & Osborne, 2025; WHO, 2025b).

7.2. Kidney disease

Emerging evidence links climatic stressors to the rising incidence of kidney disease (Goldfarb & Patel, 2024). Heat stress and recurrent dehydration precipitate episodes of acute kidney injury, especially among outdoor workers in agriculture and informal sectors in LMICs (Hunter *et al.*, 2024). Chronic exposure to environmental toxins, coupled with inflammation driven by particulate matter exposure, accelerates progression to chronic kidney disease (Breitner-Busch *et al.*, 2023; Sutanto, 2024). Case studies from Sierra Leone underscore how fragile health systems and the combined burden of infectious diseases and NCDs render kidney health particularly vulnerable amid climate shocks (Sesay & Osborne, 2025). Additionally, poor access to safe drinking water exacerbates disease progression and complicates management.

7.3. Diabetes and metabolic conditions

Metabolic disorders such as type 2 diabetes and obesity represent an escalating public health crisis, intricately tied to climate and socio-economic transitions (Savage *et al.*, 2020; Sutanto, 2024). Climate-driven disruptions to food systems—including decreased agricultural yields, loss of biodiversity, and reliance on imported processed foods—erode dietary quality and diversity, fuelling obesity and insulin resistance (Siiba *et al.*, 2024). Urbanization and migration further compound sedentary behaviors and unhealthy diets among vulnerable populations (WHO, 2025c). Simultaneously, chronic psychosocial stress related to climate adversity and displacement exacerbates metabolic dysregulation through neuroendocrine pathways (Hunter *et al.*, 2024). These factors interlock, accelerating the metabolic epidemic among urban poor, migrants, and communities in SIDS (Savage *et al.*, 2020).

7.4. Cancer and respiratory disease

Rising ultraviolet radiation due to stratospheric ozone depletion—exacerbated by climate change—heightens skin cancer risks globally (Sutanto, 2024). Additionally, pollutants linked to fossil fuel combustion contribute significantly to lung cancer incidence (Breitner-Busch *et al.*, 2023). Shifts in land use and industrial activities associated with climate change increase exposure to carcinogens (Siiba *et al.*, 2024). Respiratory diseases are similarly affected, with climate change amplifying airborne allergen levels and extending pollen seasons, thereby increasing asthma and chronic obstructive pulmonary disease exacerbations (Breitner-Busch *et al.*, 2023; Skevaki *et al.*, 2024). Smoke from wildfires—more frequent with climate change—introduces further respiratory toxins, disproportionately impacting urban and marginalized populations (WHO, 2023).

7.5. Mental health

The mental health impacts of climate change are complex and profound. Natural disasters, forced displacement, food insecurity, and existential anxiety about environmental futures contribute to increasing rates of depression, anxiety disorders, post-traumatic stress disorder, and other psychosocial conditions (Hunter *et al.*, 2024). These mental health challenges interact bidirectionally with NCDs, as stress, depression, and trauma can worsen physiological risk factors such as hypertension and diabetes, while chronic illness further undermines mental wellbeing (Hunter *et al.*, 2024; Sutanto, 2024). Children, youth, and socially marginalized groups experience disproportionate burdens, highlighting the need for integrated mental and physical health interventions within climate adaptation frameworks (WHO, 2025c).

Table 2 highlights integrated policy recommendations that support the climate change–NCD nexus and address the dual burden on global health.

8. Systems, policy, and adaptation gaps

8.1. Underinvestment and health system challenges

Sierra Leone illustreates these challenges, as health financing, NCD tracking, and infrastructure are grossly inadequate (Sesay & Osborne, 2025). Much of Sub-Saharan Africa and LMICs face similar gaps—78% of health budgets go to infectious diseases, leaving NCD and climate change-related risk largely unaddressed.

Additionally, out-of-pocket expenditures and poor rural/urban distribution of health workers further reduce access to NCD care for migrants, indigenous, and impoverished groups.

8.2. Surveillance and research needs

All sources stress poor integration of NCD and climate data

Table 2. Integrated policy and research recommendations

Priority area	Policy/Research recommendation	Source
Surveillance	Adopt integrated climate change–NCD monitoring; emphasize migration/SES disaggregation	WHO (2023, 2025c)
Health system	Build climate change/NCD-resilient infrastructure; develop a skilled and distributed workforce	Sesay & Osborne (2025)
Community/Migrant care	Adopt accessible, tailored services; develop social protection; invest in community-based care	WHO (2025a)
Food system	Develop nutrition-sensitive agriculture, diet support, food fortification, and climate resilience	Savage *et al.* (2020); Sutanto (2024)
Equity & donor policy	Target high-burden/vulnerable geographies in funding, align with Sustainable Development Goals	Sesay & Osborne (2025); WHO (2023)

systems—a major blind spot for effective preparedness and targeted interventions. Integrated "Health in All Policies" approaches and new partnerships are recommended, leveraging international support, domestic reforms, interdisciplinary research, and robust health information systems.

8.3. Structural inequalities and donor priorities

Global health financing continues to underfund NCD prevention, research, and surveillance. Infectious disease control receives 10–12 times as much funding as NCDs, despite NCDs constituting the largest health burden in most countries. Moreover, no major international donors currently prioritize climate change-driven NCD adaptation in their health portfolios.

9. Discussion

The climate change–NCD nexus is no longer theoretical; it is already shaping health outcomes for millions of people in SIDS, Sub-Saharan Africa, South Asia, and among migrant and urban poor. Every paper reviewed here underlines the complex pathways through which climate change accelerates NCD risk: heat, pollution, food and water insecurity, mental stress, and system-level neglect. Reality on the ground (e.g., Sierra Leone and India's urban slums) testifies to the acute vulnerability of marginalized and migrant communities—populations exposed to the harshest environments, least access to care, and structural barriers to adaptation.

Despite ample evidence, underinvestment and compartmentalized global health approaches persist. The imperative now is for fully integrated adaptation, combining climate, NCD, and equity strategies at all levels: governance, research, surveillance, health financing, service delivery, and grassroots empowerment. Future research must prioritize context-specific evaluations, longitudinal studies, and stronger evidence from underrepresented regions to inform scalable and equitable adaptation pathways.

10. Conclusion

The intersection of climate change and NCDs is real, urgent, and tractable. Solutions exist: evidence-based actions at the system, community, and global policy levels; integration of data and surveillance; health system reform; and, above all, dedicated investment in research and capacity in the world's most vulnerable regions. Only by recognizing and responding to this syndemic, rather than addressing its components in isolation, can premature mortality and health inequities be reduced.

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References

Abubakar, I. R., Onyebueke, V. U., Lawanson, T., Barau, A. S., & Bununu, Y. A. (2025). Urban planning strategies for addressing climate change in Lagos megacity, Nigeria. *Land Use Policy*, *153*, 107524.

https://doi.org/10.1016/j.landusepol.2025.107524

Amrutbhai V. K., Pratapbhai S.A., & Dhamal J. (2025). Epidemiological Assessment of Lifestyle Risk Factors Contributing to Non-Communicable Diseases in Urban Slum Populations. *Journal of Heart Valve Disease*, *30*(4), 70-77.

Breitner-Busch, S., Mucke, H., Schneider, A., & Hertig, E. (2023). Impact of climate change on non-communicable diseases due to increased ambient air pollution. *Journal of Health Monitoring, 8*(4),103-121.

https://doi.org/10.25646/11655.2

De Siqueira-Filha, N.T., Li, J., Kibuchi, E., *et al.* (2021). Economics of Healthcare Access in Low-income and Middle-income Countries: A Protocol for a Scoping Review of the Economic Impacts of Seeking Healthcare on Slum-dwellers Compared With Other City Residents. *BMJ Open*, *11*(7),e045441.

https://doi.org/10.1136/bmjopen-2020-045441

Di Ciaula, A., Krawczyk, M., Filipiak, K. J., Geier, A., Bonfrate, L., & Portincasa, P. (2021). Noncommunicable diseases, climate change and iniquities: What COVID-19 has taught us about syndemic. *European Journal of Clinical Investigation*, *51*(12).

https://doi.org/10.1111/eci.13682

Ebi, K. L., Vanos, J., Baldwin, J. W., Bell, J. E., Hondula, D. M., Errett, N. A., Hayes, K., Reid, C. E., Saha, S., Spector, J., & Berry, P. (2021). Extreme weather and climate change: Population health and health system implications. *Annual Review of Public Health*, *42*(1), 293–315.

https://doi.org/10.1146/annurev-publhealth-012420-105026

Fanzo, J., Rudie, C., Sigman, I., *et al.* (2021). Sustainable food systems and nutrition in the 21st century: a report from the 22nd annual Harvard Nutrition Obesity Symposium. *The American Journal of Clinical Nutrition*, *115*(1), 18–33.

https://doi.org/10.1093/ajcn/nqab315

Fritz, M. (2022). Temperature and non-communicable diseases: Evidence from Indonesia's primary health care system. *Health Economics*, *31*(11), 2445–2464.

https://doi.org/10.1002/hec.4590

Goldfarb, D. S., & Patel, A. A. (2024). Climate change and its implications for kidney health. *Current Opinion in Urology*, *34*(5), 377-383.

https://doi.org/10.1097/mou.0000000000001197

Grey, K., Gonzales, G. B., Abera, M., Lelijveld, N., Thompson, D., Berhane, M., Abdissa, A., Girma, T., & Kerac, M. (2021). Severe malnutrition or famine exposure in childhood and cardiometabolic non-communicable disease later in life: a systematic review. *BMJ Global Health*, *6*(3), e003161.

https://doi.org/10.1136/bmjgh-2020-003161

Guell, C., Saint Ville, A., Anderson, S. G., Murphy, M. M., Iese, V., Kiran, S., Hickey, G. M., & Unwin, N. (2024). Small Island Developing States: addressing the intersecting challenges of non-communicable diseases, food insecurity, and climate change. *The Lancet Diabetes & Endocrinology*, *12*(6), 422–432.

https://doi.org/10.1016/s2213-8587(24)00100-1

Gupta, I., & Singh, A. K. (2025). Addressing Urban Health Challenges in India: Shifting Focus to the Urban Poor. Centre for Social and Economic Progress. Available from: https://csep.org/wp-content/uploads/2025/03/Addressing-Urban-Health-Challenges-in-India-Shifting-Focus-to-the-Urban-Poor.pdf [Last accessed on 2026 Mar 20].

Gupta, D., Kumar, P., Okano, N., & Sharma, M. (2025). Climate-Induced Migration in India and Bangladesh: A Systematic Review of Drivers, Impacts, and Adaptation Mechanisms. *Climate*, *13*(4), 81.

https://doi.org/10.3390/cli13040081

Hunter, R. F., Garcia, L., Dagless, S., Haines, A., Penney, T., Clifford Astbury, C., Whiting, S., Wickramasinghe, K., Racioppi, F., Galea, G., & Kluge, H. H. P. (2024). The emerging syndemic of climate change and non-communicable diseases. *The Lancet Planetary Health*, *8*(7), e430–e431.

https://doi.org/10.1016/S2542-5196(24)00112-8

Intergovernmental Panel on Climate Change. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. IPCC Sixth Assessment Report. Available from: https://www.ipcc.ch/report/ar6/wg2/ [Last accessed on 2026 Mar 20].

Kalra, A., Jose, A. P., Prabhakaran, P., Kumar, A., Agrawal, A., Roy, A., Bhargava, B., Tandon, N., & Prabhakaran, D. (2023). The burgeoning cardiovascular disease epidemic in Indians – perspectives on contextual factors and potential solutions. *The Lancet Regional Health - Southeast Asia*, *12*, 100156.

https://doi.org/10.1016/j.lansea.2023.100156

Kaur, M., Sharma, A., Vijin, P., Kaur, R., Kaur, R., Anupama, G., Singh, P., Bansal, V. K., Sharma, N., Sahni, M., Gupta, J., Lakshmi, P., & Kumar, R. (2024). Exploring the Complexities of Slum Vulnerability in Haryana, India: A Qualitative Research Journey Into Economic, Social, Physical, and Health Dimensions. *International Journal of Qualitative Studies on Health and Well-Being*, *20*(1), 2432692.

https://doi.org/10.1080/17482631.2024.2432692

Lumagbas, L. B., Coleman, H. L. S., Bunders, J., Pariente, A., Belonje, A., & de Cock Buning, T. (2018). Non-communicable diseases in Indian slums: re-framing the Social Determinants of Health. *Global Health Action*, *11*(1), 1438840.

https://doi.org/10.1080/16549716.2018.1438840

Malhi, J. K., McEvoy, J. W., Blumenthal, R. S., & Jacobsen, A. P. (2024). Climate change and cardiovascular health: Recent updates and actions for healthcare. *American Heart Journal plus: Cardiology Research and Practice*, *45*, 100443.

https://doi.org/10.1016/j.ahjo.2024.100443

Mandal, B., & Kalandi, C.P. (2025). Association Between Rural-to-urban Migration and the Onset of Hypertension Among Middle-aged and Older Population: Evidence From India. *BMC Public Health, 25*(1).

https://doi.org/10.1186/s12889-025-22267-5

Martins, F. P., Paschoalotto, M. A. C., Closs, J., Bukowski, M., & Veras, M. M. (2024). The Double Burden: Climate Change Challenges for Health Systems. *Environmental Health Insights*, *18*.

https://doi.org/10.1177/11786302241298789

McMichael, C., Barnett, J., & McMichael, A. J. (2012). An Ill Wind? Climate Change, Migration, and Health. *Environmental Health Perspectives*, *120*(5), 646–654.

https://doi.org/10.1289/ehp.1104375

Melaku, Y. A., Gill, T. K., Taylor, A. W., Appleton, S. L., Gonzalez-Chica, D., Adams, R., Achoki, T., Shi, Z., & Renzaho, A. (2018). Trends of mortality attributable to child and maternal undernutrition, overweight/obesity and dietary risk factors of non-communicable diseases in sub-Saharan Africa, 1990–2015: findings from the Global Burden of Disease Study 2015. *Public Health Nutrition*, *22*(5), 827–840.

https://doi.org/10.1017/s1368980018002975

Mirzabaev, A., Olsson, L., Kerr, R. B., Pradhan, P., Ferre, M. G. R., & Lotze-Campen, H. (2023). Climate Change and Food Systems. In: *Science and Innovations for Food Systems Transformation*. Springer International Publishing. 511-529.

https://doi.org/10.1007/978-3-031-15703-5_27

Nilsson, M., Sie, A., Muindi, K., Bunker, A., Ingole, V., & Ebi, K. L. (2021). Weather, climate, and climate change research to protect human health in sub-Saharan Africa and South Asia. *Global Health Action*, *14*(Suppl. 1).

https://doi.org/10.1080/16549716.2021.1984014

Ndlovu, N., & Chungag, B. N. (2024). Impact of heat stress on cardiovascular health outcomes of older adults: A mini review. *Aging and Health Research*, *4*(2), 100189.

https://doi.org/10.1016/j.ahr.2024.100189

Ogony, J., Mangeni, J., Ayodo, G., *et al.* (2025). The stifling burden of climate change on African public healthcare systems. *Frontiers in Public Health*, *13*.

https://doi.org/10.3389/fpubh.2025.1559737

Pandey, A., Brauer, M., Cropper, M. L., *et al.* (2020). Health and economic impact of air pollution in the states of India: the Global Burden of Disease Study 2019. *The Lancet Planetary Health*, *5*(1), e25-e38.

https://doi.org/10.1016/S2542-5196(20)30298-9

Poddar, P., Banavaram, A. A., Ramanaik, S., Jayabalan, M., & Vismaya, S. (2025). How city living affects mental health-a qualitative exploration of urban stressors among adults in a megacity in India. *BMC Public Health*, *25*(1), 1597.

https://doi.org/10.1186/s12889-025-22817-x

Romanello, M., Napoli, C.D., Green, C., *et al.* (2023). The 2023 report of the Lancet Countdown on health and climate change: the imperative for a health-centred response in a world facing irreversible harms. *The Lancet*, *402*(10419), 2346-2394.

https://doi.org/10.1016/s0140-6736(23)01859-7

Romanello, M., Walawender, M., Hsu Shih-Che, *et al.*, (2024). The 2024 report of the Lancet Countdown on health and climate change: facing record-breaking threats from delayed action. *The Lancet*, 404(10465), 1847-1896. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(24)01822-1/abstract [Last accessed on 2026 Mar 20].

Sahu, S., Kumar, S., Nagtode, N. R., & Sahu, M. (2024). "The burden of lifestyle diseases and their impact on health service in India"—A narrative review. *Journal of Family Medicine and Primary Care*, *13*(5), 1612-1619.

https://doi.org/10.4103/jfmpc.jfmpc_693_23

Salvi, S., Kumar, G. A., Dhaliwal, R. S., *et al.* (2018). The burden of chronic respiratory diseases and their heterogeneity across the states of India: the Global Burden of Disease Study 1990–2016. *The Lancet Global Health*, *6*(12), e1363-e1374.

https://doi.org/10.1016/s2214-109x(18)30409-1

Sathishkumar, K., Chaturvedi, M., Das, P., Stephen, S., & Mathur, P. (2022). Cancer incidence estimates for 2022 & projection for 2025: Result from National Cancer Registry Programme, India. *The Indian Journal of Medical Research*, *156*(4-5), 598-607. ncbi.

https://doi.org/10.4103/ijmr.ijmr_1821_22

Savage, A., McIver, L., & Schubert, L. (2020). Review: the nexus of climate change, food and nutrition security and diet-related non-communicable diseases in Pacific Island Countries and Territories. *Climate and Development*, *12*(2), 120–133.

https://doi.org/10.1080/17565529.2019.1605284

Sesay, U., & Osborne, A. (2025). Building climate-resilient health systems in Sierra Leone: addressing the dual burden of

infectious and climate-related diseases. *Infectious Diseases of Poverty*, *14*(1).

https://doi.org/10.1186/s40249-025-01294-9

Siiba, A., Kangmennaang, J., Baatiema, L., & Luginaah, I. (2024). The relationship between climate change, globalization and non-communicable diseases in Africa: A systematic review. *PLOS One*, *19*(2), e0297393.

https://doi.org/10.1371/journal.pone.0297393

Singh, N., Areal, A. T., Breitner, S., Zhang, S., Agewall, S., Schikowski, T., & Schneider, A. (2024). Heat and Cardiovascular Mortality: An Epidemiological Perspective. *Circulation Research*, *134*(9), 1098–1112.

https://doi.org/10.1161/circresaha.123.323615

Skevaki, C., Nadeau, K. C., Rothenberg, M. E., Alahmad, B., Mmbaga, B. T., Masenga, G. G., Sampath, V., Christiani, D. C., Haahtela, T., & Renz, H. (2024). Impact of climate change on immune responses and respiratory allergies. *Journal of Allergy and Clinical Immunology*, *153*(5), 1194-1205.

https://doi.org/10.1016/j.jaci.2024.01.016

Sutanto, H. (2024). Intersecting Crises: Exploring the Impact of Climate Change on the Burgeoning Burden of Noncommunicable Diseases. *Preprints.*

https://doi.org/10.20944/preprints202402.1444.v1

Taha, T. (2016). Climate change and potential impact on disease: What are the public health agenda? *Saudi Journal of Medicine and Medical Sciences*, *4*(2), 71.

https://doi.org/10.4103/1658-631x.178285

United Nations Office for Disaster Risk Reduction. (2021, July 12). Global Assessment Report on Disaster Risk Reduction (GAR). Available from: https://www.undrr.org/gar/gar2025 [Last accessed on 2026 Mar 20].

Walinski, A., Sander, J., Gerlinger, G., Clemens, V., Meyer-Lindenberg, A., & Heinz, A. (2023). The Effects of Climate Change on Mental Health. *Deutsches Arzteblatt International*, *120*(8), 117-124.

https://doi.org/10.3238/arztebl.m2022.0403

World Health Organization. (2021). Climate change and health vulnerability and adaptation assessment. (n.d.). Available from: https://iris.who.int/server/api/core/bitstreams/6edda8d7-451e-4edc-b096-c84d76e1355b/content [Last accessed on 2026 Mar 20].

World Health Organization. (2023). Climate change and noncommunicable diseases: connections. Available from: https://www.who.int/news/item/02-11-2023-climate-change-and-noncommunicable-diseases-connections [Last accessed on 2026 Jan 30].

World Health Organization. (2024a). Fifth Global School On Refugee And Migrant Health- Advancing universal health coverage for refugees and migrants: from evidence to action. Available from: https://cdn.who.int/media/docs/default-source/documents/health-topics/refugee-and-migrant-health/5th-global-school-report.pdf?sfvrsn=67625882_14&download=true [Last accessed on 2026 Mar 20].

World Health Organization. (2024b). Global Cancer Burden growing, Amidst Mounting Need for Services. Available from: https://www.who.int/news/item/01-02-2024-global-cancer-burden-growing--amidst-mounting-need-for-services [Last accessed on 2026 Mar 20].

World Health Organization. (2025a). Noncommunicable diseases. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases [Last accessed on 2026 Mar 20].

World Health Organization. (2025b). Ending disease in Africa-Responding to communicable and noncommunicable diseases: Progress report 2020-2022. (2023). Available from: https://www.afro.who.int/sites/default/files/2023-08/Ending%20disease%20in%20Africa_Progress%20report.pdf [Last accessed on 2026 Mar 20].

World Health Organization. (2025c). No health without inclusion: Leaders call for equitable action on noncommunicable diseases for migrants and refugees at WHA78. Available from: https://www.who.int/news/item/20-05-2025-no-health-without-inclusion--leaders-call-for-equitable-action-on-noncommunicable-diseases-for-migrants-and-refugees-at-wha78 [Last accessed on 2026 Mar 20].

World Health Organization. (2025d). Thematic Dialogue Series on Non-Communicable Diseases and Mental Health: Environmental Risk Factors for NCDs and Mental Health. Available from: https://www.who.int/publications/m/item/thematic-dialogue-series-on-non-communicable-diseases-and-mental-health--environmental-risk-factors-for-ncds-and-mental-health [Last accessed on 2026 Mar 20].