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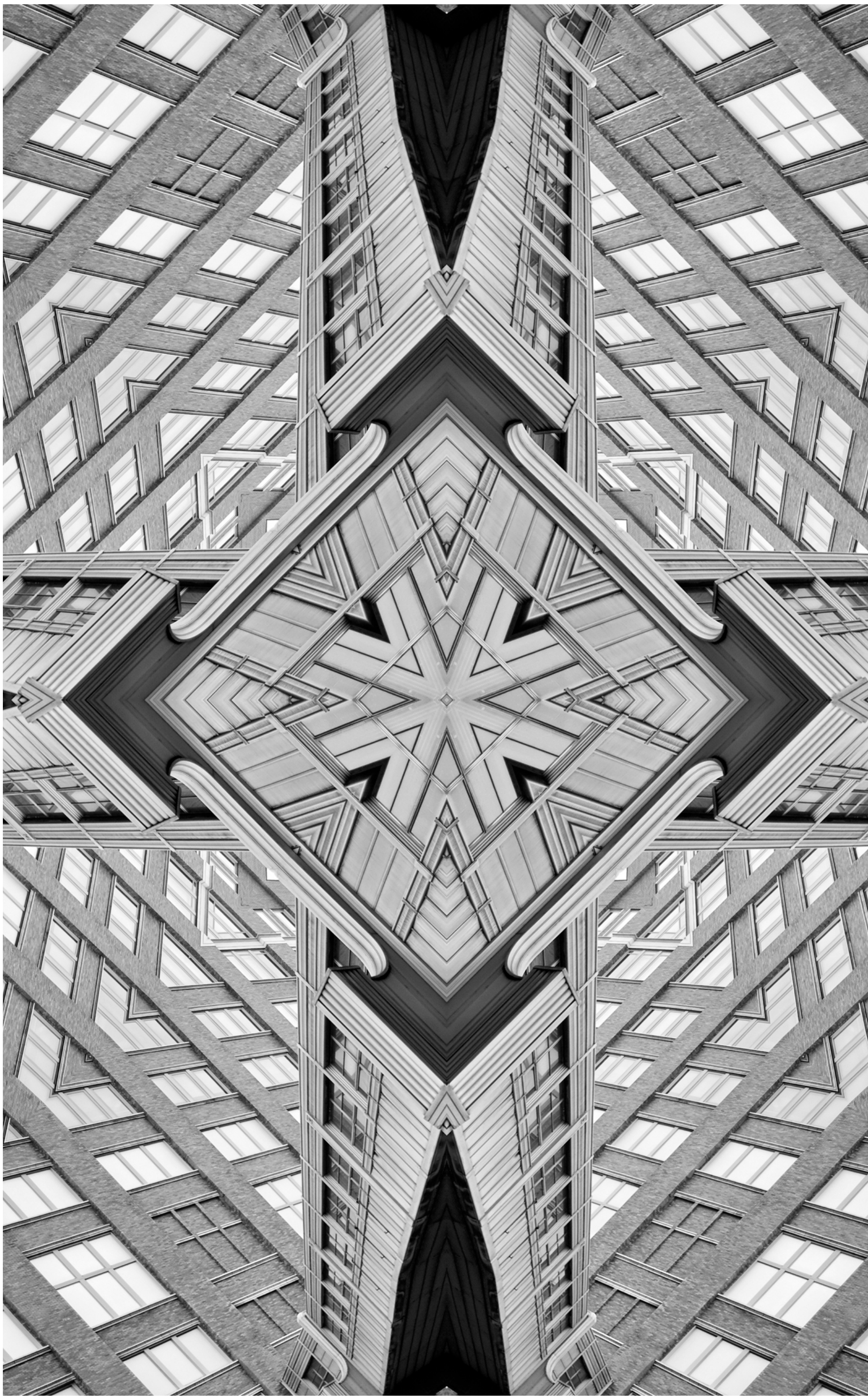

From Heat Vulnerability to Heat Equity: Pathways for Inclusive Urban Climate Resilience

Nitya Mohan Khemka

Cities across the globe are increasingly using materials such as concrete, which store more thermal energy than natural materials and absorb sunlight rather than reflecting it, warming their surroundings. This 'urban heat island' (UHI) effect has consequences on health, ranging from heat exhaustion to cerebrovascular events and circulatory failures resulting in death. Compounding the challenge is that the impact of extreme heat on health is uneven; it is shaped by both biological and social determinants of health. This brief argues that the path to heat equity requires bold policy action: Cities must revolutionise their approach to emissions control and environmental preservation to prevent catastrophic heat impacts on vulnerable populations.

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Introduction

In 2008, for the first time in human history, more people globally lived in cities than in rural areas.[1] This global shift toward urbanisation, which began during the Industrial Revolution, has not only transformed how we live, build, and connect with each other, but has also fundamentally altered the earth's climate.

Cities are increasingly using materials such as concrete, which store more thermal energy than natural materials and absorb sunlight rather than reflecting it, warming their surroundings. This effect, amplified by heat from vehicles and industry, creates urban heat islands (UHIs)—city zones that are significantly warmer than neighbouring rural areas.[2] While the UHI effect currently averages between 2 and 4°C worldwide,[3] this phenomenon is expected to intensify with worsening climate change. According to the IPCC's Sixth Assessment Report, global surface temperatures are projected to rise by anywhere from 1.4°C to 4.4°C by 2100 under various scenarios.[4] In urban areas, this warming will be amplified by the UHI effect, potentially leading to temperature differences of up to 8-10°C between cities and their surrounding areas by mid-century.[5]

Heat and Health

The direct heat effects on health range from heat exhaustion, as the earliest symptom, to cerebrovascular events and circulatory failures resulting in death. When exposed to extreme heat, living organisms are under constant stress to maintain their optimal temperature. This thermal balancing act—producing sweat and redirecting blood to the skin—forces the heart to work harder, potentially leading to cardiovascular failure. The strain extends to the respiratory and circulatory systems, raising the risk of both lung failure and stroke.[6] Without adequate access to water, the body quickly succumbs to dehydration.[7]

Most heat-related deaths are not caused by heat alone. Intense heat exacerbates numerous health conditions and impedes the effectiveness of medication, making its true threat to human life difficult to quantify.[8] However, heatwaves are consistently linked to peak mortality events.[9] Studies have estimated that UHIs may specifically contribute as much as 40 percent to heat mortality in European cities.[10]

Heat also has countless indirect effects on human health. Rising temperatures amplify air pollution, worsening its documented health consequences—particularly respiratory diseases.[11] Even young, healthy individuals struggle to regulate body temperature when exposed to high heat and humidity—a phenomenon known as the '*wet-bulb effect*'.[12] Cities like Jacobabad in Pakistan and La Paz, Mexico have already experienced dangerous wet-bulb temperatures, highlighting the urgent need for adaptation strategies that account for both extreme heat and high humidity.[13]

UHIs also disrupt local weather patterns, destabilising air flows and heightening flood risks.[14] UHIs are only expected to worsen as the global climate continues to change. In New York in the United States alone, the heat levels are projected to be two to six times higher in 2080-99 than in 1991-2004, resulting in 616 additional days of hospitalisation and US$644,069 of healthcare costs every year.[15]

Compounding the challenge is that the impact of extreme heat on health is not uniform; it is shaped by both biological and social determinants of health. While older people and those with chronic conditions face elevated risks everywhere, the socio-spatial distribution of heat vulnerability varies significantly between Global North and Global South contexts. A 2020 study in Delhi's informal settlements found indoor temperatures regularly exceeding outdoor temperatures by 3-5°C due to poor ventilation and construction materials.[16]

In rapidly urbanising cities of South Asia and Africa, informal settlements face particularly acute challenges. Heat exposure in informal settlements presents unique problems, particularly in Low- and Middle-Income Countries (LMICs), where large populations reside in dense, low-income housing with limited green spaces and poor ventilation.[17] For example, Mumbai in India experiences extreme UHI effects in its overcrowded neighbourhoods, with temperatures exacerbated by a lack of green infrastructure and high population density.[18] In Mumbai's slums, home to 40 percent of the city's population, extreme heat compounds existing health challenges from poor sanitation and limited access to water.[19] Similarly, in Lagos, Nigeria, heat exposure is severe in unplanned settlements, where residents often lack reliable access to cooling solutions such as electricity or water for hydration.[20] These environments heighten health risks for vulnerable groups, including outdoor workers in informal sectors, such as street vendors and labourers, who face heat stress daily due to limited shade and hydration options.[21]

The occupational dimension of heat exposure is particularly significant in developing countries. In Ahmedabad, India, a study of outdoor workers found that 90 percent reported heat-related symptoms during peak summer months, with informal workers lacking basic protections such as shade or regular water access.[22] Similar patterns are seen among Bangkok's street vendors and Jakarta's construction workers, where economic necessity forces continued work during dangerous heat conditions.[23]

Understanding these inequalities is essential if interventions are to serve the people who need them the most. Yet, cities have historically relied on a flawed solution: designing urban spaces around universal air conditioning.[24] This approach is deeply problematic; air conditioning intensifies UHIs while increasing the energy consumption that drives climate change.[25] Worse still, the majority of those who most need cooling, particularly in cities in the Global South, do not have access to the electricity required to power cooling solutions.

Reducing UHIs

Pavements and Roofs that Cool

Two types of measures can reduce UHIs: interventions in the built environment that reduce heat absorption and interventions that increase vegetation and thus evapotranspiration.

Cool pavements fall within the first category. These are paving materials that are more reflective than dark asphalt and enhance evaporation. Cool pavements have been trialled in various contexts. In Doha, Qatar, cooling material applied to the asphalt of a road stretch in 2019 reduced the temperature of the asphalt by 7°C.[26] Cool pavements were trialled in Phoenix, United States, where an evaluation study showed that US$10-20 million in air conditioning costs could be saved every year if the whole city used the same construction materials for roads.[27] Cooler pavements also required less maintenance, reducing public costs and resource usage in the long term.[28]

The implementation of cool pavements extends beyond high-income contexts. In Hyderabad, India, the Cool Roofs initiative has adapted traditional white limewash techniques for modern urban conditions, reducing indoor temperatures by 2-5°C in informal settlements. Similar programmes in Bangkok have demonstrated that locally sourced reflective materials can achieve comparable cooling effects at lower costs than imported solutions.[29]

Conker Trees Instead of Concrete

Increasing urban vegetation offers a more holistic solution to combat UHIs. Unlike artificial cooling methods, plants deliver multiple benefits: they moderate temperatures while absorbing rainwater and carbon dioxide, reducing flood risks and air pollution. Trees, in particular, transform city life, boosting mental health, encouraging outdoor activity, and fostering community connections. Yet, access to these green spaces remains unequal, with disadvantaged communities typically having access to fewer parks and trees.[30] By greening our cities strategically, we can simultaneously tackle climate change, improve public health, and address environmental inequality.

One approach to urban greening involves creating extensive plant-covered spaces such as parks and cemeteries. In Medellín in Colombia, US$16.3 million was invested in developing 30 green corridors that link existing natural areas into a connected network. This initiative is projected to lower city temperatures by several degrees by 2030, potentially saving tens of thousands of lives from heat-related illness.[31]

Vertical forests, i.e., skyscrapers covered in greenery, can provide a more space-efficient alternative for densely populated areas. This concept, first tested in Milan in Italy, has now reached cities like Huanggang in China, where a single building absorbs 20 tonnes of CO_2 and produces 10 tonnes of oxygen annually.[32] While these vertical forests remain luxury projects today, their growing popularity could make them more accessible to less wealthy residents in the future.

The spread of vegetation throughout a city can be assessed by its tree canopy—the percentage of urban areas shaded by trees. While large-scale tree planting faces obstacles—notably the cost and carbon footprint of removing concrete—successful programmes can mobilise volunteer labour and empower community members to shape their local area. Chicago's Our Roots initiative adopted this approach to increase the tree canopy in underserved communities. Targeting neighbourhoods with tree coverage of 7 percent below the city average, the programme empowers residents to choose tree locations and participate in their care.[33]

In Chennai, India, the Green Ways project has transformed narrow urban lanes into green corridors, reducing local temperatures by 3-4°C while improving drainage during monsoons.[34] Jakarta's Urban Forest initiative has converted abandoned lots into community-managed green spaces, particularly targeting flood-prone areas where vegetation can serve multiple resilience functions.[35]

Policies, Finance, and COP29

Cities have adopted several tools to combat rising temperatures, from cool pavements to urban forests, but these solutions demand a comprehensive approach. To be truly effective and economically sustainable, heat-adaptation strategies must be woven into city-wide policies that connect multiple systems: healthcare ready to respond to heat emergencies, early warning networks to alert residents, transportation designs that reduce car dependency, and architecture engineered for cooling. Yet, despite these possibilities, only one in three cities has integrated health into their climate-resilience plans.[36]

To effectively address the health impacts of urban climate initiatives, cities must gain recognition within international policy agendas and receive corresponding financial support. At COP27 in 2022, the Sustainable Urban Resilience for the Next Generation (SURGe) initiative brought together 180 cities.[37] Building on this, COP28 hosted an even larger Local Climate Action Summit, leading to the creation of the landmark *Guiding Principles for Financing Climate and Health Solutions*.[38] In anticipation of COP29, a Multisectoral Action Pathways (MAP) Declaration for Resilient and Healthy Cities has already been drafted, signalling an increasingly holistic, cross-sectoral approach to the health-climate nexus in urban contexts.[39]

However, while these developments are promising, uncertainty persists around funding. The International Finance Corporation (IFC) projects that cities could unlock up to US$30 trillion in climate-related investments by 2030.[40] Although national governments appear the most likely sources to address the shortfall,[41] their fiscal capacities vary widely. To date, COP summits have struggled to mobilise significant solidarity funds for LMICs—those least responsible for, but most vulnerable to climate change.[42]

Cities currently receive very little climate finance from multilateral development banks (MDBs). The creditworthiness of cities is relatively low, and they face fiscal constraints from national governments. COP28 saw MDBs committing to increased climate finance, but their tendency to fund big infrastructure projects means that smaller city investments often do not reach their funding thresholds. Programmes such as the Green Cities initiative by the European Bank for Reconstruction and Development show that it is possible to finance comprehensive climate action plans at the sub-national level. A positive outcome of COP29 could thus be a commitment from more MDBs to adapt their operational systems to make their funds more accessible to cities.[43]

Conclusion

The intersection of climate change, health, and cities demands urgent attention, particularly in rapidly urbanising regions of the Global South. The use of innovative methods to improve urban design, safety, and well-being within cities has high potential.

However, these promising opportunities must not disguise the existential threat that climate change poses to cities worldwide. While the understanding of UHIs has improved considerably in the last decade, research is only now beginning to understand the interaction of heat and humidity levels and their repercussions for human health.

As we approach the next COP, strengthening urban preparedness for extreme heat is both urgent and essential. However, it is also critical to recognise that adaptation alone cannot fully shield cities from the impacts of climate change. The path to heat equity requires bold policy action: cities must revolutionise their approach to emissions control and environmental preservation to prevent catastrophic heat impacts on vulnerable populations.

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