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Extreme heat and informal urban workers' health – lessons for Latin America and the Caribbean from South Asia

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Background: Extreme heat events are becoming more frequent and intense, posing substantial public health risks. In Latin America and the Caribbean (LAC), 82% of the population resides in urban areas and over half of workers (51.7%) are informally employed. To address the heat-related health risk of informal urban workers, LAC can learn from other Global South regions facing similar challenges of informality, multidimensional poverty, precarious labor conditions, and rising temperatures.
Analysis: We conducted an exploratory review of academic and grey literature on urban heat responses in LAC and South Asia, the Global South region with the most documented and evaluated experience. Each response was assessed for whether it reaches informal urban workers, the structural barriers to doing so and recommendations to overcome them.
Policy Options: Responses fall into four domains, each addressing a distinct gap for informal workers in LAC: satellite-based diagnostic visualization, to map where they live and work; heat action planning and early warning, to deliver alerts through channels they use; governance innovations, to assign institutional responsibility for tackling their heat risk; and exposure reduction interventions spanning household, transit, and worksite settings.
Conclusion: South Asian experiences show that resource-constrained cities can implement effective heat responses but these will not reach informal workers unless they are designed to include them for the start. This requires political commitment, multi-level and multi-sectoral coordination, and the meaningful participation of informal workers in intervention design.

KEYWORDS
extreme heat, health, informal urban workers, Latin America, South Asia

Background

In the last decade, the world has experienced the warmest years on record, with the last 3 years being the warmest [1]. Extreme heat events have grown more frequent and intense, with the early 2025 heatwave in South America reaching record-breaking temperatures of 44 °C [1]. Latin America has already felt the toll, with heat-related mortality rising 103% in 2012–2021 compared with 1990–1999 [2]. Projections warn that heatwaves will become more prolonged too, underscoring the urgency of strengthening preparedness and cooperation in climate and health action [1, 3].

Higher exposure to extreme heat strains the human body's capacity to regulate core temperature, with negative health consequences that are unevenly distributed [4]. The elderly,



FIGURE 1
Comparison of structural vulnerabilities between Global South regions (Latin America and Caribbean, South Asia, East Asia and Pacific, Sub-Saharan Africa, Middle East and North Africa, 2026). The term "Global South" remains debated but is nonetheless increasingly understood as more than a geographic category, shaped by historical and social relations — colonial legacies, power asymmetries, and center-periphery dependencies (Sud, N., & Sánchez-Ancochea, D. (2022). Southern Discomfort: Interrogating the Category of the Global South. Development and Change, 53(6), 1123–1150. https://doi.org/10.1111/dech.12742). Therefore, East Asia & Pacific excludes high-income economies (e.g. Japan, New Zealand, Republic of Korea, Singapore). Percentages represent regional population-weighted estimates. Percentages refer to different reference populations and should not be interpreted as representing the same individuals. Data compiled from the following datasets for 2023-2024: urban population from World Bank (World Development indicators); population living in informal settlements from the United Nations Human Settlements Program (UN-Habitat) (Global Urban Indicators Database: SDG Indicator 11.1.1); population in multidimensional poverty from the United Nations Economic Commission for Latin America and the Caribbean (CEPALSTAT) and the Multidimensional Poverty Index (MPI) of the Oxford Poverty and Human Development Initiative (OPHI); labor force participation from World Bank's World Development Indicators (WDI); informal employment from the International Labour Organization World Employment and Social Outlook (ILOSTAT).

infants and children, and people with chronic health conditions that compromise their metabolism, cardiovascular, respiratory or renal systems are particularly at risk of heat stress [4]. There are also sex-specific associations with health outcomes related to physiological factors, as well as gender-related differences in heat exposure and adaptive capacities [5]. Climate change acts as a health-risk multiplier, compounding also the social and environmental determinants of health, that is, the conditions in which people are born, grow, live and work. Heat risk is therefore not only determined by biological or medical pre-conditions; it is shaped by exposure to hazards, as in the case of outdoor workers, and by structural vulnerabilities such as informality, marginalization, access to healthcare, multidimensional poverty and unequal opportunities for development [6].

In Latin America and the Caribbean (LAC), 82% of the population lives in urban areas and 51.7% of the working population is in informal employment, rising to 60% among youth. Examples of informal urban workers include street vendors, caregivers, construction laborers, waste pickers and transport workers. Far from an inevitable fact, informality "results from the combination of poor public services, a burdensome regulatory regime, and weak monitoring and enforcement capacity by the state" [7]. These are people working without registration, legal protection or regulatory coverage, who typically combine high vulnerability to heat with limited capacity to adapt, some dealing simultaneously with multidimensional poverty, informal housing and informal working conditions across the Global South (see Figure 1). Governments are urged to design responses that can protect them from extreme heat. Not only considering the hazard or biological conditions, but also structural vulnerabilities and exposure. Here lies an opportunity for South-South learning, exchanging knowledge between regions facing the same structural challenges of urban informality, multidimensional poverty, precarious working conditions, and rising temperatures, although at different magnitudes.

Over the past decade, South Asian cities have developed the most extensive body of documented experience in urban heat responses in the Global South [8]. Building on early state-level responses following the deadly Odisha (India) heatwave of 1998 and catalyzed by the 2010 Ahmedabad (India) heatwave — which caused over 1,300 excess deaths in a single month [9] — the region has since produced a comprehensive portfolio of urban Heat Action Plans, spanning more than a dozen cities across India, Bangladesh and Pakistan [10, 11].

This accumulated experience from the region with the highest rate of informal employment offers an evidence base that LAC has not yet drawn upon systematically. Given the demographic relevance of informal urban workers in LAC, this policy brief analyses available evidence from South Asian cities in urban heat responses, focusing on the implications for this group as well as potential adaptations to the intervention to include them.

Analysis

Evidence

In LAC, assessments of heat distribution through satellite images show heat concentration in densely built urban areas, leading to warmer microclimates in zones with little vegetation, predominantly artificial surfaces and compact high-rise construction compared to zones with more vegetation cover, shade and scattered trees [12]. Increasing exposure to heatwaves in city-level studies show, for example, increases of up to 50% in heat-related mortality in Buenos Aires (Argentina) during the 2013 heatwave [13].

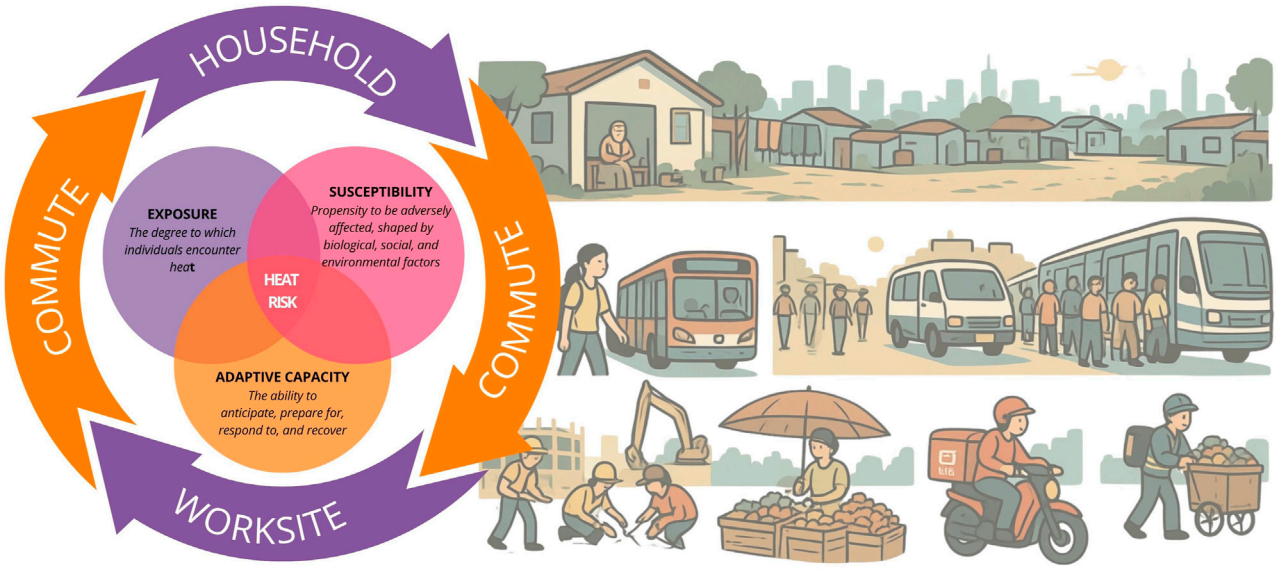

FIGURE 2
Heat exposure continuum. From household through transit to worksite back to household (Extreme heat and informal urban workers' health - lessons for Latin America and the Caribbean from South Asia, 2026). The risk framework and definitions for hazard, exposure, susceptibility and adaptive capacity are based on IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. doi: 10.1017/9781009325844.001. The image is partially based on Chilling Prospects.

Internationally accepted indicators for monitoring heat stress–like the Wet-Bulb Globe Temperature (WBGT) or the Universal Thermal Climate Index (UTCI) – only capture physiological and environmental factors [14]. Some countries are implementing thresholds using these indicators, but the equipment to measure them is expensive, they assume healthy well-hydrated individuals, do not account for cumulative heat exposure, and are often associated with recommendations considering formal worksites, with potential for standards and regulation [15]. Informal urban workers have rarely been at the center of any of these investigations, making transferability to countries of the Global South difficult. Prolonged exposure and vulnerability associated with informality are seldom considered, thus heat risk is often underestimated, including in LAC where informality is a feature of the urban fabric [16–18].

Interventions

Research on the health impacts of extreme heat is growing, yet monitoring and evaluation of responses varies considerably. Though no documented response explicitly targets informal urban workers nor integrates protections across their full exposure continuum from household through transit to worksite (Figure 2), these experiences represent a foundational basis [10, 16]. In LAC, responses remain nascent and geographically concentrated in a few flagship initiatives. Rio de Janeiro's tiered heat alert protocol (Brazil), operational since 2024 through the city's Centro de Operações, represents the region's most institutionally developed early warning system. Medellín's Green Corridors program (Colombia, 2016) has become one of the most referenced nature-based solutions cooling cases.

South Asia offers a more developed evidence base. India's portfolio of city-level Heat Action Plans—evaluated across eight cities Dasgupta et al. (2025)and with demonstrated mortality reduction in Ahmedabad [9] — constitutes the most rigorously evaluated Heat Action Plan model in the Global South [10, 16]. Being the most developed, documented and assessed, the experience of South Asia represents a unique learning opportunity for LAC, with the possibility of context-sensitive adaptation and the inclusion of informal urban workers from an early stage.

Policy options

We conducted an exploratory review of peer-reviewed and grey literature on urban heat responses in South Asia and LAC. We searched databases (Google Scholar, Scopus, and The Journal of Climate Change and Health) and grey literature sources (Global Heat Health Information Network, Prevention Web–site operated by the United Nations Office for Disaster Risk Reduction-, city government websites, the Climate and Development Knowledge Network, and IDB repository) for documents published in English and Spanish, using terms combining extreme heat, heat action plans, heat governance and informal work. We included documents describing a city- or national-level heat response with implementation or evaluation data. Responses were grouped by how they act on heat-related health risk: identifying where risk concentrates (heat-risk mapping), preparing for and

responding to heat events (heat action planning and early warning), assigning institutional responsibility (heat governance), and lowering day-to-day exposure (exposure reduction). For each domain, we assessed whether and how responses reach informal workers across the household, commute and worksite. The resulting four domains are presented in this policy brief, offering evidence and potential entry points for including informal urban workers' health by LAC countries (see Table 1).

Satellite-based diagnostic infrastructure

Informal workers are, by definition, out of the legal and statistical systems, which makes them hard to find, measure, and address systematically. To solve this identification problem, we propose an urban-territorial approach leveraging earth observation methodologies. Areas with high levels of informal housing tend to be surrounded by areas with high rates of labor informality [22]. Heat-related health risk for informal urban workers results from a cumulative function of exposure, susceptibility, and adaptive capacity that is not confined to the worksite but accumulates across three interconnected spatial domains: household, commute, and worksite (see Figure 2). Satellite-based heat-vulnerability prioritization can assist in operationalizing the household-level dimension. Open-source algorithms now enable municipalities to produce granular heat island maps from freely available datasets, like Landsat, with minimal infrastructure, financial or technical requirement [23].

Local governments like Rajshahi (Bangladesh) and Nepalgunj (Nepal) have already used these tools to identify heat thresholds and hotspots, combining them with existing data systems to identify where heat concentration is highest, and which social factors shape vulnerable groups, among which they consider informal workers, like rickshaw pullers [24, 25].

For LAC, the diagnostic pipeline developed by the Inter-American Development Bank's Cities LAB combines URSA (Urban Reporting Based on Satellite Analysis), which produces granular urban heat island maps for any LAC city above 100,000 inhabitants, with MAIIA (Mapping with AI for Informal Areas), an AI-based algorithm for automated informal settlement mapping from satellite imagery [25]. Overlaying both outputs generates a heat-vulnerability prioritization layer, identifying where highest heat risk and informal settlement location coincide. The World Resources Institute's Cool Cities Lab, launched in 2026 and operational across more than 20 cities globally, provides complementary block-level heat risk mapping and a cooling scenario modelling platform built on open data [21].

Connecting heat-vulnerability maps from satellite-based diagnostic tools with demographic and epidemiological information and informal economy activity data can yield a robust baseline assessment of heat-related health risks among informal workers.

Heat action plans

Heat Action Plans (HAP) are coordinated pre-season and in-season protocols linking tiered meteorological alerts to specific actions across health, emergency management, and public services, designed to reduce heat-related morbidity and mortality [11].

The Indian city Ahmedabad´s HAP demonstrated mortality reduction at scale: implementation was associated with approximately 1,190 annualized deaths avoided [9]. Systematic assessment of eight Indian city HAPs confirms their effectiveness in coordinating health system preparedness and alert dissemination, while identifying consistent underperformance in care for vulnerable populations, real-time surveillance, and long-term urban planning [10]. No evaluated HAP documents measurable impacts on informal urban workers as a primary population [16]. HAP alert systems have been designed for populations with fixed addresses, registered with health services, and reachable through formal employment channels. Informal workers have none of these. In Dhaka (Bangladesh), over 83% of surveyed informal workers reported no access to public shade or green space, and only 15% indicated willingness to use public cooling centers, reflecting gaps in physical accessibility and institutional trust that HAPs as currently designed do not address [21].

In LAC, HAP are in place in Rio de Janeiro (Brazil), Cordoba (Argentina) and Saint Lucia, without specific actions designed for informal workers [20, 26, 27]. To adapt the HAP model and include them we recommend four structural modifications: (i) shifting alert delivery from fixed-address to mobile-first, using location-based SMS or cell broadcast alerts and voice messages (Interactive Voice Response) that reach basic phones and workers with low literacy, complemented with community-mediated channels capable of reaching workers at dispersed worksites; (ii) incorporating occupational exposure as a primary vulnerability criterion alongside age and comorbidity; (iii) extending preparedness protocols into the pre-season period, when behavioral adaptation — modified work schedules, increased hydration — meaningfully reduces cumulative exposure and heat-related health risk; (iv) co-designing plans and interventions with informal urban workers [21].

Governance innovations

Governance innovation refers to institutional arrangements that assign explicit cross-departmental responsibility for heat risk management, from Chief Heat Officers to inter-agency coordination bodies [28].

A global assessment of Heat Action Plans carried out by the Global Heat Health Information Network (GHHIN), the United Nations Office for Disaster Risk Reduction (UNDRR), and the World Meteorological Organization (WMO) identifies weak institutionalization as the most common shortcoming: plans exist but dedicated resources, inter-agency coordination, and metrics-based evaluation are systematically absent [10, 11]. Where governance innovations have been piloted, institutional sustainability questions have emerged. The Chief Heat Officer model, piloted in cities including Dhaka North (Bangladesh) and Freetown (Sierra Leone), has relied on external funding rather than municipal budgets in most deployments [29]. Integration with existing climate adaptation and disaster risk

TABLE 1 Summary of policy options structural barriers to reaching informal workers, and recommended approaches to overcome them (Extreme heat and informal urban workers' health - lessons for Latin America and the Caribbean from South Asia, 2026).

Policy option	Structural barriers to reaching informal workers	Recommended approaches
Satellite-based diagnostic infrastructure	Current frameworks insufficiently account for physiological factors and pre-existing health conditions that may amplify adverse health outcomes among this population. The informality of working conditions does not necessarily correspond to residence in informal settlements; patterns of mobility and living arrangements remain largely undocumented. Exposure assessments must integrate both household and worksite dimensions, as informal workers may experience heat exposure levels at their place of work that equal or exceed those at their place of residence.	Existing data systems should be integrated to enable a holistic analysis of risk, replacing siloed approaches in which epidemiological data and urban environmental data are managed independently. Individuals with limited adaptive capacity are likely to belong to multiple, overlapping risk groups simultaneously. Comprehensive vulnerability assessments should therefore be locally grounded and designed to capture the intersection of distinct risk factors and vulnerabilities. An intersectional analytical lens is essential to move beyond broad, undifferentiated vulnerability categories. National climate and health authorities could lead systemic reach: establishing standardized heat-health surveillance protocols. Local governments could be at the frontline of diagnostic mapping, which open-source tools now placed within municipal reach, heat planning and implementation.
Heat Action plans	A limited number of HAPs identify informal workers as a vulnerable group and often they remain unreached by awareness campaigns, unaware of risks and preventive measures [19]. Interventions are not designed to address their needs. In addition, economic necessity often overrides safety: Recommendations to remain at home may not constitute a viable option. Informal unpaid work remains excluded from compensation frameworks.	Informal workers should be part of the design of interventions from the first stage to understand what works and incorporate targeted measures with allocated budget. Early warning systems should be evaluated not only in terms of how effectively information reaches informal workers, but also in terms of whether the recommended actions are feasible and applicable for them. State or provincial administrations could merge different HAP targeting the same informal workers throughout the heat exposure continuum, bridging peri-urban residence and urban worksite into a single heat-vulnerability layer. They are best positioned to lead cross-local data integration through coordination with labor and social protection agencies, and the management of early warning systems exceeding administrative boundaries.
Governance innovations	Weak institutionalization is not unique to informal worker protection: it is the systemic failure mode of heat governance generally, from underfunded innovations dependent on external financing to the absence of sustained inter-agency mandates [9, 20]. This generality is precisely problem. A governance layer too fragile to sustain accountability for the population it was built to serve is even less likely to extend deliberately toward workers who never had institutional representation to begin with.	Extend existing structures rather than building new ones. Embedding heat governance within disaster risk reduction and climate adaptation frameworks — where LAC institutional capacity already exists — is more viable than standalone heat offices dependent on external funding [11]. Because informal workers fall outside occupational health systems by definition, effective design must also incorporate social protection and labor agencies, aligning reactive response with proactive risk reduction [21]. Explicit representation of informal worker organizations within governance bodies converts this alignment from aspiration into mandate. Coordination across government levels must be explicit and assigned, embedding occupational heat exposure into national climate adaptation frameworks and occupational health legislation, and providing the financing mechanisms and technical standards that lower levels of government cannot generate independently. Without national mandate, governance innovation at city level remains siloed, fragile, and reversible.
Exposure reduction	Urban informal workers require accessible cooling infrastructures. For example, climate shelters should provide space to safely store bikes, merchandise or carts of street vendors, transport and delivery workers, and urban recyclers or waste pickers. Adapting just one of the spaces without considering all the exposure continuum fails to effectively reduce exposure of informal workers facing long commuting, need to transport merchandise, and inadequate housing or indoor working conditions.	Intervention design should take into account commuting and household heat exposure. For action protocols during heatwaves, thresholds should consider accumulated exposure when considering health effects (the physiological burden on the third or fourth consecutive day of a heatwave is substantially greater than that of the first). The potential disruption of essential services in areas where informal workers live and work must also be factored into intervention planning. For this, local governments must be resourced and mandated to act, opening formal channels for co-design with worker organizations, trade unions, and informal sector associations operating in their jurisdictions.

management frameworks and mandates offers a more institutionally viable and cost-effective pathway than creating standalone heat agencies, as it builds on established inter-agency coordination structures without requiring new institutional architectures [11].

For LAC, this integration could also help overcome the complexity of its fragmented metropolitan governance structures between peri-urban administrations, where informal settlements are most concentrated, and urban governments, where informal urban workers commute to. Explicitly extending these frameworks' mandate to cover informal workers' heat-related health risk would make a specific institution accountable for it [10]. Ensuring representation of informal worker communities is essential; the evidence base for determining their heat-related health risk has been produced without their participation, and the interventions designed in response have consistently failed to reach them [16, 30].

Exposure reduction in continuum from household through transit to worksite

This option comprises nature-based solutions and physical interventions in public space and building-level adaptations (i.e., cool roofs, climate shelters) designed to reduce heat exposure across the full daily cycle from household through transit and public space to worksite.

Evidence from urban South Asia documents that structural factors, including inadequate cooling infrastructure and limited access to cooling resources, systematically constrain informal workers' adaptive capacity [16, 21]. Individual components have documented cooling effects. Cool roofs in Dhaka produce mean daytime temperature reductions, but negligible nocturnal benefit [31]. Nature-based solutions in subtropical cities of comparable density produce mean air temperature reductions of up to 1.2 °C and localized effects of up to 3.9 °C under combined greening scenarios [32].

Comparable LAC-specific data are limited, but spatial analyses of nature-based solutions distribution consistently show a concentration of green cooling infrastructure in wealthier, better-served neighborhoods — a pattern the equity literature describes as the "luxury effect" [30]. Addressing cumulative heat exposure for the prevention of mild, moderate and severe heat-related illness requires interventions at each point across the continuum rather than at a single scale. Community co-design is key; without participation from informal workers, investments risk geographic mismatch and underutilization. Furthermore, anti-displacement safeguards, including security of tenure provisions, must accompany any investment in nature-based solutions in informal settlements.

Conclusion

Informal workers play a major role in sustaining urban economies across the Global South, nearly one in two workers in Latin America and the Caribbean, but remain structurally absent from heat protection frameworks. Closing this gap is a policy choice that calls for every level of government to act on it, whether by revising existing plans or addressing it from an early stage of design.

Heatwave frequency and intensity are accelerating, and heat-related mortality and morbidity among informal workers is already occurring — underreported, undercounted, and uncompensated. Further delay in action exacerbates both the health damage and the remediation cost.

South Asian experience shows that resource-constrained cities, even when managing multiple crises, can implement heat responses that reduce mortality [9]. Diagnostic infrastructure enables the geographic targeting that makes subsequent interventions evidence-based rather than generic. Governance innovation provides institutional accountability without which plans exist, but management does not. Redesigned Heat Action Plans extend alert systems toward workers currently absent from formal delivery channels. Physical interventions address the exposure conditions that no warning system alone can resolve. Together, they represent the structural reorientation required to reach a population these frameworks were not built to serve. It requires political will, cross-level coordination, and the inclusion of informal workers. They have been systematically absent as a target population and key stakeholder, whether this reflects design choices or implementation gaps, the practical result is the same: the population bearing the highest occupational heat stress due to their work conditions remains outside the reach of existing frameworks.

Precedents established across South Asia confirm the feasibility of meaningful and successful interventions. Continued inaction — failing to build the diagnostic base, strengthen accountability mechanisms, reaching informal workers through redesigned alert systems, and addressing physical exposure — will contribute to the escalation of what is currently a growing concern into a systemic crisis requiring far greater resources and remediation.

Author contributions

Conceptualization, SS; methodology, SS and JM; writing – original draft preparation, SS and JM; writing – review and editing, FG, SS, and AR. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that they do not have any conflicts of interest.

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