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Urban Heat Inequality: Social Stratification, Policy, and Health Outcomes

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ABSTRACT

Urban heat islands (UHIs) amplify the effects of climate change in cities, disproportionately affecting vulnerable populations. Social stratification, including income, race/ethnicity, housing tenure, and occupation, shapes differential exposure to extreme heat, mediates adaptive capacity, and contributes to inequities in health outcomes. Vulnerable populations residing in low-quality housing or neighborhoods with limited greenness face higher indoor and outdoor heat exposure, leading to increased cardiovascular, metabolic, respiratory, and mental health risks. This review examines the mechanisms linking urban heat, social stratification, and health, highlighting measurement strategies, data gaps, and methodological challenges. It further explores policy and intervention strategies, including equity-oriented urban planning, access to cooling, and community engagement, to mitigate heat-related health disparities. Addressing urban heat inequality requires interdisciplinary approaches that integrate social, environmental, and policy dimensions to promote climate justice and protect public health.

Keywords: Urban Heat Islands (UHI), Social Stratification, Climate Justice, Health Inequities, and Adaptive Capacity.

INTRODUCTION

The changing climate has led to increased urbanization, with over 55% of the world's population currently living in urban areas [1]. This percentage is expected to rise alongside rising temperatures, leading to higher demand for housing with less access to cooling. Urban heat islands (UHI) have emerged as a major public health concern, with heat waves projected to become a common phenomenon in many areas surrounding urban cities. Heat waves have been associated with many negative health outcomes, including heat-related morbidities and all-cause mortality [2]. Elderly persons, children, and individuals suffering from pre-existing chronic health conditions are found to be at higher risk. Additional social stratification factors are identified that put persons living in socioeconomic disadvantage at an even higher risk. Even in the absence of a heat wave, day-to-day heat exposure can result in cardiovascular, respiratory, and metabolic harmful health outcomes [3].

Conceptual Framework

Urban heat inequality comprises spatially and temporally heterogeneous heat stress influenced by urban–rural, intra-metropolitan, and intra-urban differences [1]. Low-income communities, racialized groups, and those living in structurally vulnerable housing endure higher heat stress due to the interaction of exposure with microclimate variability and structural factors. Environmental and social factors combine to determine risk under extreme heat. An equity lens focused on these structural underpinnings highlights additional pathways from climate risk to health inequities [3]. Formalized in the conceptual framework presented, these pathways detail how urban development affects microclimate, housing, and land use to amplify low-income, racialized, and similarly situated groups' exposure to extreme localized heat, even in cooler municipalities[4].

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Definitions of Urban Heat Islands and Heat Inequality

Urban areas can experience elevated temperatures relative to their surroundings. This phenomenon is known as the urban heat island (UHI) effect, and it results from both the modification of land surfaces and the waste heat generated from energy use. Cities, compared to rural areas, typically have much higher ambient temperatures during and after the hottest days [5]. The difference is often as much as 5°–10°C, lasting between several hours and several weeks. Urban heat islands are therefore an important dimension of urban climate and play a significant role in the evolution of cities [1]. Exposure to excessive heat has detrimental effects on human health, leading to direct effects such as dehydration or heat stroke and exacerbating chronic diseases both physically and mentally. The increase in daily mean temperatures worldwide limits the capacity of individuals to fully adapt to extreme heat. Heat exposure is defined as the difference between the ambient temperature and a base temperature at which exposure starts to have adverse effects [6]. Vulnerability to heat is determined by several sociodemographic characteristics. Areas that experience high urban heat islands are typically low-income neighborhoods with fewer resources to cope with heat [7].

Social Stratification and Exposure

Social stratification shapes differential exposure to the urban heat island effect and influences temperature-related heat exposure, vulnerability to extreme heat events, and associated health effects [7]. The term urban heat island denotes the phenomenon whereby urban areas experience higher near-surface air temperatures than their surrounding rural environments. Various housing and neighborhood characteristics impose disparate exposure to the urban heat island effect and influence indoor temperatures. Consequently, urban heat islands shape temperature exposure alongside sociodemographic factors such as income, race/ethnicity, housing tenure, and occupation. Housing tenure interacts with neighborhood greenness and land surface temperature to shape temperature exposure. Urban land cover, housing type, and neighborhood greenness relate to differences in cooling accessibility, augment adaptive capacity, and help define the frontier of resilience under heat stress [8]. Social stratification affects the unequal distribution of power, access to resources, and exposure to risk. For example, conditioning on sociodemographic factors, stressors associated with long-term poverty amplify the physiological impacts of particulate matter and heat exposure on cardiovascular and respiratory health. Households living below the poverty line exhibit a more than 25% higher sensitivity to these pollutants, regardless of location [9]. The psychosocial stress model posits that chronic stress associated with discrimination, material deprivation, and insecurity can enhance vulnerability to environmental hazards and related health effects. Housing, urban form, and neighborhood greenness represent fundamental determinants of urban heat exposure that shape inequities in broader socioeconomic and social contexts [8]. The term frequency of heat exposure denotes the number of days per year over which minimum, maximum, or average temperatures exceed specified, domain-appropriate statistical thresholds [1]. Hot days and nights are defined as those exceeding the 90th percentile of the respective temperature distributions, while very hot days and nights refer to those exceeding the 95th percentile. The relevant statistical distribution is computed from the available Long-Term Average data for the domain. Alongside frequency of heat exposure, daily temperature ranges, maximum temperatures, and humidex levels are utilized to gauge urban heat exposure [2]. Housing, neighborhood greenness, and urban land-cover characteristics can determine the extent of urban heat islands and associated exposure. High neighborhood greenness can cushion the urban heat-island effect by lowering land-surface temperature [2]. Well-insulated, single-family homes with air-conditioning have the potential to keep indoor temperatures stable during heat periods, while nontraditional housing types are significantly more prone to indoor heat (ina) amplification [3].

Pathways to Health Impacts

Social stratification shapes both the distribution of urban heat islands across residential neighborhoods and the exposure of different groups to the adverse effects of heat [2]. Some neighborhoods exhibit higher heat concentrations, often termed urban heat islands because of characteristics such as land cover, form, configuration, and location [1]. Groups subjected to stratification according to income, race, housing tenure, and occupation disproportionately inhabit these hotter neighborhoods and/or reside in structures poorly equipped to ameliorate indoor heat [3]. Social stratification governs differential exposure to extreme heat and vulnerability to its effects. This additional heating results in important health consequences: elevated mortality, exacerbation of pre-existing cardiovascular, metabolic, and pulmonary conditions, increased admissions to mental health facilities, and degraded general well-being [2]. The elevated health risks experienced by some groups compared to others differ markedly from the areas of exposure, providing a more nuanced understanding of urban heat inequality, yet these areas constitute the only dimension considered in previous analyses [1]. The framework not only describes urban heat inequality and sets an agenda for research on its drivers and implications, but also clarifies the mechanisms through which urban heat promotes illness. Four health endpoints are directly linked to increased exposure to ambient or indoor heat: cardiovascular and metabolic disorders, respiratory diseases, and mental health issues [2].

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Measurement and Data

High-quality land-surface temperature data are critical to estimate exposure to urban heat islands and inform climate-sensitive city policies [2]. While multiscale remote-sensing satellite land-surface temperature products, with resolutions ranging from a fraction of a kilometer to hundreds of kilometers, are widely available, additional pre-processing is required before assessing the thermal environments of urban Brazilian cities [3]. These pre-processing activities include the aggregation of data products over suitable periods, re-projection of the satellite data, and quality control of the database [4]. Depending on the modelling application, multitemporal temperature data from remote sensing are aggregated over selected time periods to produce single-value temperature data sets, facilitating the construction of the necessary socio-spatial heat-exposure variables. Econometric estimations show that the choice of aggregation period affects the nature and significance of socio-spatial inequalities in temperature exposure [1].

Temperature Monitoring and Spatial Resolution

A clear understanding of temperature metrics, spatial resolution, and temporal scales is vital to assess urban heat exposure and health implications [1]. Averaged temperatures, the de facto metric for extreme heat, miss critical details on patient vulnerability during emergency heat events. In particular, heat during the warmest nights aggravates health conditions and amplifies mortality risk [1]. Temperature extremes exert the strongest influence on cardiovascular diseases, causing stress during warm nights, aggravating mental illness, catalyzing respiratory illness, and contributing to infectious disease evolution [2]. Temperature thresholds must be adjusted for specific groups, and temperature profiles vary by income and race. Section 3 specifies temperature metrics, spatial resolution, and temporal scales for the analysis.

Socioeconomic and Demographic Indicators

Urban heat stress drives significant public health impacts and is a growing area of scholarly inquiry, yet precisely how human activity influences the intensity and duration of urban heat exposure remains opaque [1]. Exposure to the urban heat island (UHI) effect varies across cities and neighborhoods, which are themselves shaped by the historical urbanization process, but the dominant approach has focused on whether income or race accounts for a greater share of the observed inequality [2]. This line of reasoning goes only part of the distance in understanding heat inequality, as variables such as housing quality and greenness covary with social stratification and influence exposure [3]. Perhaps more crucially, stratification operating through heat exposure maps into health endpoints that drive social inequities in heat stress. Advances in remote sensing and building energy modeling facilitate a more complete picture of the role of stratification in shaping urban heat exposure [4]. A mapping of health impacts from urban intensity to health outcomes reinforces the importance of heat exposure as a potential mechanism through which urban form, built environment, climate change, and socioeconomic status link together to create health inequity under heat stress [2]. The social science literature distinguishes heat exposure from heat vulnerability, and a conceptual framework linking these two factors is advisable. Variables constituting exposure, ambient temperature, surface temperatures, and land use/land cover (LULC) type are defined, as are the associated indicators (i.e., temperature, percent impervious surface, and vegetation) at local, neighborhood, and citywide scales [3]. A second chain of influences shows how stratification shapes exposure through the built environment. These channels operate where similar land cover exists, and detailed datasets on housing quality and built environment variables allow an exploration of inner, outer, and wide rings around city centers [2]. A practical engagement with urban heat inequality requires measurement of both temperature and socioeconomic variables. Various approaches to quantifying urban heat from a broad range of data sources exist, such as using land surface temperature (LST) data from either satellite observations (MODIS, Landsat) or citywide monitoring stations (NCDC), or model-based estimates derived from archetypal building-energy simulations for hot and humid climates, and the metric selected exerts a substantial influence on the results. Temperature records are available at varying spatial and temporal resolutions, from hourly to monthly observations and from point-wise to city-wide estimates [2]. Indicators of heat exposure, the first component of the socio-physical system framework and process through which climatic warming translates into health impacts, are therefore collected from publicly available resources [1].

Health Outcome Metrics

Globally, heat stress has been associated with multiple health outcomes, including cardiovascular, respiratory, and mental health effects [1]. Among continuously measured temperature variables, daily minimum temperature has often been found to show a stronger correlation with these health endpoints than maximum temperature [3]. In certain regions, extreme heat exposure may further exacerbate urban heat stress. Regulations that directly affect neighbourhood characteristics may also play an important role in determining urban thermal inequities [4]. For example, land-use planning regulations can dictate local zoning, floor-area ratios, and built-form characteristics that directly influence urban heat formation. Through such regulations, equity-oriented reforms that specifically target historically underserved communities could help to alleviate inequitable access to neighbourhood-level cooling resources and other factors that moderate ambient and indoor heat-equity formation [6]. Consequently, mapping the urban heat-island effect and the vulnerability of neighbourhoods to both extreme and average heat conditions is essential for identifying neighbourhoods disproportionately affected by heat. Temperature changes within urban areas are fundamentally driven by urban form, land use, and the materials that comprise the urban fabric [9]. Studies have found that materials such as green roofs and permeable pavement strongly influence urban-heat-island magnitude in laboratory settings and under specific climate regimes. Additional factors that condition neighbourhood cooling resources include population and housing characteristics such as occupancy, building ages, housing value, income, and whether units are rented or owned, along with broader socio-environmental factors like land-cover change and investment patterns[8]. An essential step involves clarifying data resolution for health metrics and conditions requiring large spatial or temporal windows [6]. Deploying an exposure–health-metric cycle that illustrates population health impacts from climate events, heat exposure remains a global concern. Large heating and cooling degree days correlate with the Under Five Mortality Rate in Papua New Guinea. Globally, direct health outcomes connecting heat, hazard, and socio-economic status ranking prove challenging to document; developing high-resolution frames on a case-study basis remains a priority in such scenarios [6].

Mechanisms Linking Heat, Social Stratification, and Health

Urban heat islands disproportionately affect the urban poor because, in many cities, low-income households experience much higher levels of heat exposure [1]. The vulnerable tend to live in more severe microclimates, characterized by inadequate vegetation, water features, and permeable surfaces. Increased exposure is amplified by the inability of low-income tenants to adapt their accommodations to rising temperatures [3]. Tenure and aging buildings amplify protection deprivation through activities such as cooling distribution and shading configuration. Urbanism, as expressed spatially in land use, topology, configuration, street patterns, and green-space distribution, also contributes to heat-mitigation discrepancies [5]. With inequitable greening opportunities (such as community gardens) and lack of access to survival-space communities to cool off or shelter from heat, low-income groups' disparity expands.

Housing Quality and Neighborhood Greenness

Housing quality significantly mediates exposure to urban heat. Geographical context shapes the importance of materiality, form, and function in the thermal regime of the dwelling and surrounding spaces. High-quality, well-insulated housing lessens the need for cooling and mitigates amplification of outdoor temperatures [3]. Access to supplemental cooling and evaporative cooling systems enhances indoor resilience. Conversely, unhoused individuals experience acute marginalization under heat stress, and inadequately maintained indoor spaces intensify heat exposure [1]. The urban heat island (UHI) effect is most pronounced in dense urban forms characterized by extensive heat-retaining materials and limited vegetation. Neighborhood urban form, land use, and social conditions determine access to green infrastructure, which provides cooling and similar benefits. Robust street and building typologies reduce solar loads, restrict infiltration, and extend residence times, resulting in high temperature amplification and longer exposure durations [5]. Proactive adaptation involves efficient resource use, awareness of system behavior, and coproduction of knowledge among individuals and organizations. Limited adaptation, profoundly influenced by various phenomena, compromises adaptive capacity [3]. Long-term exposure to social stressors is positively correlated with heat-related morbidity and mortality. Chronic stress potentiates physiological and psychosocial vulnerability, widespread susceptibility to acute heat, and accumulation of environmental insults [5]. Design and policy influence housing quality, neighborhood greenness, and the factors determining day-to-day risk. Addressing exposure, sensitivity, and vulnerability through strategic interventions and resources promotes equity and enhances overall resilience [7].

Urban Form and Infrastructure

According to recent research, housing quality, including the ability for residents to keep their homes cool and the insulation found within them, plays a role in determining indoor heat levels [5]. Some neighborhoods have ample nearby vegetation and other features that support lower cooling costs; residents in those neighborhoods may also be more likely to have built-in cooling systems that encourage keeping windows closed during hot, humid days, and mitigating energy demand. Access to those features raises the so-called adaptive capacity of city residents and influences where the frontier of resilience lies [4].

Access to Cooling and Adaptive Capacity

Access to air conditioning (AC), the most common cooling mechanism globally, is highly unequal and largely determined by social stratification [4]. The capacity to obtain and operate AC systems or, conversely, to rely on building design features permitting passive cooling is crucial to managing heat loads effectively. Spatial variation in cooling availability and type shapes not only indoor conditions but also energy use and bills, and often both

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variables are correlated, but also preparatory adaptation measures and actions taken during a heat event. Accordingly, AC access and adaptive capacity generally constitute the frontier of resilience for urban-dwelling populations [5]. AC is available to roughly 90% of households in the United States, but such coverage is by no means universal even in high-income countries. In survey research conducted in two low-income neighborhoods in Los Angeles, indoor cooling was the most frequently reported adaptation measure taken before, during, and after heat events [5]. Residents identified AC purchasing and installation as the most difficult mitigation action [5]. The qualitative study nevertheless notes that 40% of participants lived in homes without AC; of those with systems, not all operated them to mitigate exposure during heat spells. Such findings are consistent with a broader U.S.-based survey indicating that residents of neighborhoods with high poverty or structural disadvantage report far less frequent preemptive indoor cooling actions [1]. Lacking AC, households are likely to adopt alternative cooling techniques such as window opening, electric fans, or natural ventilation during cooler hours. When buildings are not equipped with proper cooling systems, indoor heat loads can accumulate through normal activities, objects, or direct solar incidence and remain elevated overnight [4]. During this period, multi-day heat waves can lead to chronic sustained exposure and considerable allostatic load. Consequently, indoor cooling capability is less a root mitigation measure than one intimately connected with indoor heat amplification/vector pathways and the overall exposure-reducing effect of dwelling quality [3].

Chronic Stress and Vulnerability

Prolonged exposure to extreme temperatures can lead to chronic stress, heightened vulnerability, and increased risk of heat-related illness or death. Allostasis maintains equilibrium by adjusting physiological variability within fixed limits [5]. Outside these limits, health complications arise; progressive system failure occurs if the imbalance continues. Heat exacerbates the wear-and-tear equivalent of a resource-depleting stimulus. Under conditions such as poverty, where resources are chronically limited or already depleted, less capacity remains to cope with extreme heat [6]. Chronic stress increases exposure to urban heat islands and compounds the physiological burden of temperature extremes [2]. Stressful living conditions create and reinforce heat-stress clusters, leaving individuals intensely vulnerable to further strains. Unstable employment, income, and housing hinder cooling consumption and increase indoor amplification of outdoor heat [4]. Reckoning with routinely unmet basic needs energy, privacy, hygiene, safety directs coping responses toward other priorities [1].

Policy Landscape and Intervention Strategies

Low-income communities and communities of color face greater heat exposure and vulnerability, contributing to increased health risks during extreme heat events [1]. The term urban heat island describes a built environment that absorbs, retains, and re-radiates heat, elevating temperatures (Oke, 1982). Exposure to extreme heat disproportionately affects low-income neighborhoods and neighborhoods with higher proportions of people of color [6]. Urban areas have higher temperatures than surrounding rural areas. Extreme heat is associated with a number of health issues, including worse health outcomes across the cardiovascular, metabolic, and respiratory systems [3]. Differential exposure to and vulnerability from urban heat islands are shaped by social stratification, generally defined as observable attributes that cluster geographically and that determine the access to resources, decision-making power, and social capital available to people[6]. At the local scale, social stratification can include income, race and ethnicity, housing tenure, and occupation. Heat-exposure vulnerability and the urban heat island effect heighten the risk of poor circulation, heart disease, diabetes, and heat-related mortality, as well as aggravating pre-existing respiratory conditions and increasing the risk of heat-related illness [5].

Equity-Oriented Urban Planning

Inequalities in urban heat exposure reflect inequities in power, resources, and decision-making across social groups[3]. Social stratification operates through interconnected economic and political mechanisms, influencing processes of governance and resource allocation [1]. Housing quality and type, neighborhood greenness, and public and private cooling resources are crucial exposure determinants [2]. Under extreme heat events, cardiovascular, respiratory, metabolic, and mental health outcomes are adversely affected, with differential impacts across socioeconomic groups and areas [4]. Considerations of climate justice and urban environmental justice require explicit attention to distributional equity in the identification of heat exposure determinants and health impacts. Heat islands are urbanized areas with elevated temperatures corresponding to built-up land cover, insufficient vegetation, and additional anthropogenic thermal energy inputs [5]. Higher ambient air temperatures correspond to higher heat-exposure levels, and cumulative and prolonged exposure influences health. The adverse health outcomes associated with heat exposure are determined by both the intensity (e.g., maximum temperatures, average temperatures) and duration (e.g., number of consecutive hot days) of the exposure. The increasing frequency, intensity, and duration of heat waves limit options for behavioral adaptation and are expected to increase temperature mortality rates [4].

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Mitigation and Adaptation Measures

Urban heat islands lead to elevated temperatures and increased health risks in cities, disproportionately affecting vulnerable populations. Cities can heat significantly more than surrounding areas due to human activities and built environments [4]. For example, urban areas are hotter than rural ones, and surface temperatures differ widely between hot and cool neighborhoods, depending on land cover and materials 5. Low-income groups working outside or without air conditioning are more severely affected [3]. Hybrid policy responses mitigate the burden of urban heat stress while facilitating adaptation and resilience across social strata [1]. Mitigation techniques cushion the effects of climate change by reducing greenhouse gases and heat exposure from buildings, so measures such as urban greening, cool roofs, and reflective pavements are relevant for equity-oriented planning. Attempts to lessen heat islands have tended to leave disadvantaged groups behind and sometimes worsen social disparities [3]. Many urban plans, the spatial organization of urban amenities and services, also fail to address heat exposure across various urban contexts, and it is considered an afterthought or not a priority [3].

Financing, Governance, and Stakeholder Engagement

Urban heat islands (UHI), metropolitan areas exhibiting significantly elevated temperatures relative to surrounding regions, are a pervasive phenomenon in modern cities. Urbanization alters the natural landscape and replaces vegetation with impervious surfaces, increasing heat retention and reducing evaporative cooling, which increases local air temperatures [5]. The interaction of climate change and urbanization intensifies UHI development. The direct health effects of prolonged elevated temperatures are compounded by the indirect effects of extreme heat on socioeconomic and structural conditions, leading to adverse health effects for vulnerable populations. Stratification groups differ in exposure severity, health status, housing conversion capacity, and access to basic cooling infrastructure [3]. Geographic, economic, and social factors contribute to these inequities at multiple territorial levels and points in the cause chain [1]. Policy measures deployed to mitigate the UHI phenomenon must incorporate an equity dimension in relief and adaptation strategies to avoid accentuating existing health disparities. Urban heat profiles reveal that certain demographic groups are substantially more exposed to extreme heat than others due to geographic location and structural factors, and exposure that exceeds a critical threshold generates various adverse health effects, including excess morbidity and mortality. The social factors of stratification shape both exposure to heating and adverse effects on health [9]. Public policies addressing urban heat mitigation must, therefore, consider stratification stipulations to avoid inducing further inequalities in health care access, social protection securities, and other assets shaping individual and collective well-being [8]. Strategies for stakeholder engagement, financing, and governance with an equity lens are critical for ensuring fair implementation of urban heat policies [8]. Heat intervention measures, land use planning, and green–grey infrastructure zoning policies can improve thermal comfort and public health, especially for lower-income and vulnerable populations[7]. Effective stakeholder engagement ensures that policies are appropriately aligned with user needs, contextual factors, and existing infrastructure. Such stratification, however, also generates contested priorities among social groups regarding types of intervention and the authority of institutions to promote policies, which can escalate the complexity of the stakeholder engagement task [5].

Health Outcomes and Public Health Implications

Urban greening has the potential to counteract increased heat exposure among vulnerable communities, as illustrated by ongoing planning and design efforts in U.S. cities. Adapting urban environments is crucial to meeting climate resilience and sustainability targets [8]. However, differences in social and environmental indicators during extreme heat days reveal unaddressed equity issues in public health and climate adaptation strategies [1]. Urban residents are increasingly vulnerable to extreme heat, and historical zoning practices have marginalized communities of color in parts of cities subject to intense solar radiation and exposure to heat-retaining materials. Transport and job accessibility further limit adaptive capacity to reduce indoor heat, thereby amplifying heat's effects on cardiovascular, respiratory, and metabolic systems [3]. Resistance to urban injustice and the potential of cooling centers as public health-leveraging strategies under pandemic-distance constraints warrant exploration. Current heat stress on marginalized groups, their qualifications for recovery, and the temporal range of lasting effects on public health remain unrecorded and require attention [6].

Cardiovascular and Metabolic Effects

Heat exposure is linked to a variety of health outcomes, with cardiovascular and metabolic effects receiving considerable attention. Numerous studies indicate that increases in extreme heat threat are correlated with increased mortality and morbidity attributable to cardiovascular and cerebrovascular disease [3]. Heat exposure has also been associated with a range of metabolic disorders, including obesity, diabetes, and metabolic syndrome. Four primary public health pathways convey these risks: [1] direct exposure to heat, [2] indirect exposure to heat and ambient pollution, [3] chronic work-related stress and heat exposure for outdoor workers, and [4]stress from urban heat associated with neighborhood-level socioeconomic conditions, housing quality, and regional climate

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adaptations. It is evident that heat stress exacerbates preexisting cardiovascular and metabolic conditions, thereby leading to associated mortality and morbidity. Urbanization leads to high-energy urban heat island (UHI) effects, affecting large urban agglomerations and producing differential urban heat island effects. Studies reveal that during heat waves, neighborhoods with high temperatures show high incidences of cardiovascular morbidity and mortality [9]. Heat-related mortality is significantly correlated with neighborhood proportions of income, race/ethnicity, housing tenure, and occupation. People with lower incomes can afford only low-quality housing and move into areas with hotter urban environments [8]. Health consequences of neighborhood temperatures and the equity of heat-related health risks are emerging issues for North America as the climate warms and heat waves increase.

Respiratory and Mental Health Consequences

Urbanization amplifies the frequency and intensity of heat waves, global warming, and widespread forest fires, intensifying heat and humidity-stimulating ailments such as heat exhaustion and heat stress as well as respiratory diseases [9]. Problems of respiratory and mental health emerge due to increases in ambient temperature and the urban heat-island effect that raises risk [3]. Policies that can reduce this effect and minimize exposure levels at residential locations, because vulnerable groups depend on the combination of wheelchairs and other mobility aids when traveling about, and those who are subject to imprisonment, mental health issues show limited improvements, and challenges to specific forms of assistance remain[6]. Nationally, public funds in the Netherlands provide support for residents faced with heating issues stemming from specific disabilities under a particular scheme known as the "Wmo" (Wet Maatschappelijke Ondersteuning). Creative, appealing, and attention-grabbing use of communication media and social platforms could help prevent neighbourhood deterioration by providing information on travails faced by disabled and vulnerable groups. Producing sustainable mobility could also lessen heat exposure [7], and concentrations of harmful pollutants also affect respiratory and mental conditions.

Inequities in Health Burden and Access to Care

Heat stress increases the risk of several health conditions, including cardiovascular disease, metabolic disorders, respiratory ailments, and mental health challenges [1]. Urban heat is insufficiently accounted for in health studies with a social equity lens; urban heat exposure, stratification, and health outcomes are notably unexplored [9]. Urban heat inequality poses significant health burdens on already disadvantaged populations in cities; disproportionate health impacts arise from systemic policy inequities and differentiated exposure and vulnerability. Health inequalities linked to differential heat exposure are observed across diverse contexts, affirming the need for evaluation and intervention [2].

Case Studies across Urban Contexts

Cities are at the forefront of climate change, experiencing more frequent extreme heat events than surrounding rural areas. Social stratification affects differential exposure, vulnerability, and health impacts from heat stress; these inequities are further shaped by urban policy [7]. Case studies from Mexico City, Colombia, Toronto, the United States, England, Paris, and Tunisia illustrate geographical variance in urban heat inequality. In many Global North cities, social stratification shapes urban heat exposure, yet other health effects, including respiratory problems linked to the urban heat island effect, are disproportionately felt in low-income areas [1]. In Global South cities, air conditioning penetration remains limited, with fixed–mobile phone ratios used as a proxy for stratification and adaptive capacity in analytical frameworks [8]. Emerging evidence highlights inequitable heat exposure in extreme urban heat conditions, exacerbated in hotter areas through land-cover- or housing-type-channelled mechanisms. Differentiated exposure and policy responses further configure heat inequity along stratification lines [5].

North American Cities

Differential exposure to heat varies widely across North America, conditioned by metropolitan context, urban morphology, land surface materials, and greening [8]. These factors reflect broad metropolitan patterns, with large conurbations characterized by extensive impermeable surfaces, few trees, and strong heat-island effects experiencing the greatest exposure; cities with extensive parks, gardens, and green roofs outside the densest built-up areas exhibit lower exposure [6]. Differential exposure results from the interaction of social stratification with environmental, urbanization, and developmental histories, alongside historical urban planning and zoning decisions [1]. Detailed analyses undertaken in several U.S. metropolitan areas establish a clear pattern: vulnerable populations face elevated exposure, large metropolitan areas experience greater disparities than smaller regions, and across the conterminous United States, poverty is a more influential factor than race in determining heat exposure [2]. Major southern and southwestern cities such as Houston, Phoenix, and San Antonio demonstrate significantly unequal exposure, measuring 1 °C to 2 °C hotter in the most disadvantaged communities. Such

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disparities in the most affected urban settings expose residents to average daily maximums over 38 °C. In the southwestern United States, maximum temperatures rise above the human survivability threshold of 54 °C [9].

European Cities

Across European cities, urban heat stress is anticipated to impact public health, although expected temperature increases appear modest compared with the North American context [8]. During heat wave events, detrimental health endpoints are expected to occur in southern European cities such as Madrid and Athens, where average temperatures are already elevated, and exposure to high urban temperatures is significant, particularly in downtown areas [5]. The European Centre for Disease Prevention and Control has developed a Heat Health Action Plan to assist member states, yet knowledge of the health effects of urban heat islands remains weak due to data and methodological challenges [1].

Global South Contexts

Heat exposure, vulnerability, and adaptation are closely interrelated in Global South contexts, where metropolitan expansion coupled with socio-political inequities has strengthened both heat islands and sensitivity to warmth [1]. Built environments, notably informal settlements lacking infrastructure and services, amplify heat exposure through dense urban forms, non-vegetated surfaces, and inferior housing quality [8]. Vulnerability arises from inadequate provision of air conditioning and public cooling facilities, low adaptive capacity, and marginalization in climate governance. An additional compound stressor is exposure to non-thermal hazards such as flooding, air pollution, and urban violence that, together with urban heat, elevate chronic stress and allostatic load. Despite the higher probabilities of direct health effects from climate change that urban heat engenders in the Global South, attention to urban heat and corresponding health risks has thus far been limited[7]. Many cities in these regions have taken a few high-impact measures with significant heat-mitigating potential. Consequently, efforts to confront inequities in exposure and vulnerability among the continent's social groups remain essential [5].

Methodological Considerations and Gaps

All studies cited herein lack time-variant individual data on health conditions, making it impossible to isolate the effects of changes in heat exposure on health outcomes from the influences of policies and other relevant factors[8]. Furthermore, most studies investigate the impact of heat on overall health but fail to specify the underlying health conditions or pathophysiological mechanisms [1]. Finally, while some research identifies a high association between stratification factors and disadvantaged neighborhoods, it does not establish a clear statistical connection between health vulnerability and specific stratification factors at the individual level [9].

Causal Inference in Heat Inequality Research

Urban heat inequality requires rigorous, evidence-based analysis; thus, approaches must combine the technical competence of physical science with the contextual understanding of social science, while fostering interactions among the relevant academic disciplines [7]. Exposure to urban heat islands and heat inequality is shaped by social stratification, which emerges from past and present racial and ethnic discrimination, class exploitation, and their interplay. The challenge lies in disentangling correlation from causation, rigorously combining a broad array of quantitative and qualitative data from various sources across disciplines, and translating the findings into policies addressing the drivers of urban heat inequality [6]. The key elements of research on housing, neighborhoods, and health are exposure, susceptibility or vulnerability, and health outcomes [1]. Exposure refers to where and when individuals are affected by external factors; it is defined by environmental conditions outside the body, such as temperature, relative humidity, and air quality; the levels of those factors vary across space and time. Empirical evidence shows that low-income and communities of color experience disproportionately higher exposure to pollutants and hazardous facilities, intermixed with fewer amenities such as parks [3]. Susceptibility or vulnerability is the tendency of an afflicted person or group to experience adverse health effects from those environmental factors. Urban heat islands, which cause heightened temperatures, exacerbate pre-existing health inequities and amplify the effects of climate change. Attention to susceptibility or vulnerability is vital because exposure is rarely uniformly distributed among urban populations [9].

Interdisciplinary Approaches

Urban Heat Inequality: Social Stratification, Policy, and Health Outcomes

Despite increased interest in heat-related vulnerability, few studies have examined how social stratification intersects with policy and health outcomes [9]. Culturally and geographically relevant interdisciplinary approaches can elucidate these intersections, advancing scholarship and creating information networks for equity-oriented governance. Research in climate change, meteorology, urban planning, public policy, sociology, epidemiology, public health, and community activism show how [1] and (1970) social stratification determines differential exposure to urban heat islands; [2] exposure under climate change affects mortality, morbidity, and hospital admissions for cardiovascular, metabolic, and respiratory diseases, as well as mental health; and (3) exposure and associated health risks appear inequitably distributed [8]. Causal chains connect social stratification to urban heat exposure through diverse scalar pathways. Social strata, including income, race/ethnicity, housing tenure, and occupation, influence micro-level factors such as land use, building materials, housing quality, and access to vegetation. Chronic stressors at broader spatial scales filter the impacts of social stratification across urban systems [5]. For example, economic disadvantage drives housing choices in heat-retaining materials, while many vulnerable areas lack tree canopy, parks, and cooling centers. Unequal access to timely, high-quality information compounds exposure and guides adaptive responses. Stressors such as resettlement and segregation amplify vulnerability, as do limited cooling access and extreme indoor amplification [8].

Data Gaps and Standardization

Differential exposure to urban heat islands and consequent heat-related health risks depend not only on meteorology, geography, and urban form but also on social stratification [1]. Social groups defined by income, race/ethnicity, housing tenure, and occupation experience greater vulnerability to heat stress due to the interaction of local climate with their broader social, economic, and political contexts [2]. Whereas Urban Heat Island (UHI) research has overwhelmingly focused on the role of land cover and composition in exposure to environmental hazards, the integration of exposure models and analyses of social stratification reveals extensive inequalities in urban heat exposure and heat stress [9]. The presence of societal conditions such as concentrated poverty, residential segregation, and the prevalence of nontraditional housing that amplify health risks can inhibit or delay adaptive responses and play a crucial role in shaping exposure and, ultimately, the social gradient of heat stress[4]. Social stratification determines exposure to Urban Heat Islands and heat inequality. Stratification influences, and is in turn influenced by, policy decisions that mediate the relationship between urban heat and public health. This chain of causation begins with the urbanization process itself, which is governed by formal and informal systems of racial and economic segregation [5]. Public policies and decision-making processes have tended to deliver inferior housing quality, less vegetation, and a larger share of impervious surfaces to historically disadvantaged groups and, in some cases, still actively segregate these groups through processes such as redlining and denial of federal mortgage insurance [1]. Urban form influences heat, so race and income contribute to the first link of the causal chain, influencing differential health risks during heat stress [8].

Policy Recommendations and Practical Implications

Cities around the world continue to concentrate populations, yet offer little respite from climate-induced heat stress [2]. Mitigating urban heat island effects and addressing climate justice are essential policy considerations, as poverty, race, ethnic minority status, and housing tenure precipitate higher exposure and greater risk [1]. Seeking urban cooling through active intervention in the built environment remains feasible. Strategies include green infrastructure planning to enhance resilience in dryland cities and implementing additional mitigation techniques to reduce urban heat [6]. Recognizing social disparities in thermal exposure, interventions should thus target the equitable distribution of resources for active cooling and access to green spaces. Urban planning must also incorporate climate change adaptation that emphasizes environmental justice [8]. These principles further extend to policies intended to leverage heat exposure as a potential urban transformation tool, fostering notions of place-making, environmental quality, social justice, and climate collaboration in projects that tend to be perceived merely as technocratic responses to climate change [6]. Immediate measures can direct action toward those facing the most severe challenges, the paradox of excessive heat exposure coupled with limited adaptation options. Public services for emergency relief (cooling centers, transportation, and communication) in high-exposure high-sensitivity areas should expand rapidly. Digital technology can serve as an effective conduit for reaching affected populations [7]. Empowering community organizations as intermediaries to engage vulnerable groups aids in understanding additional needs. Heat-health risk communication requires factual and timely information on current and imminent heat exposure, health risks, and preventive measures to curb exposure, risk, and avoidable health consequences. Heavy rain, high humidity, electrical outages, and questions regarding the effectiveness of indoor cooling systems in many affected dwellings appear as other public service initiatives prompted by the ongoing heat situation [6]. Flexible metrics periodic monitoring through scientifically rigorous yet tractable urban heat exposure measurement studies can further evolve an understanding of exposure-sensitivity type challenges, enabling public and private sector responses through directly targeting the urban heat exposures driving sector-specific heat-health vulnerability[8].

Short-Term Relief and Emergency Response

Populations at heightened risk during heat emergencies are often subject to systemic inequities that transfer directly into heat exposure and adaptive capacity [9]. Addressing the urgent needs of low-income groups, renters, and historically marginalized communities is crucial to ensure equitable and effective disaster preparedness, response, and recovery that also support long-term mitigation and transformation [2]. The spatial distribution of residential heat exposure in 12 U.S. metropolitan areas correlates with demographic and housing characteristics associated with social vulnerability. Neighborhoods with higher concentrations of people of color, renters, lower-

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income groups, and non-college graduates are subject to disproportionate increases in heat exposure 1. Furthermore, those with limited access to air conditioning experience greater heat exposure and are more susceptible to heat-related health conditions during intense heat events [7]. Based on the analysis of urban heat inequality, several policy recommendations emerge to safeguard the well-being of vulnerable populations during extreme heat. Short-term relief measures, emergency response plans, and methods for communicating heat risk within a public health framework are especially critical [8]. Policies addressing social conditions that impede effective short-term response and adaptation, such as a lack of air conditioning, outdoor work schedules, and limited access to health services, are equally vital. Additional targeting is necessary where immediate social conditions intersect with vulnerability at other temporal scales [9].

Long-Term Urban Transformation

Inequities in urban heat exposure across social strata require attention at multiple scales to ensure equitable support for vulnerable groups [5]. The intrinsic dynamics of these systems demand that interventions be integrated into long-term planning processes and address underlying determinants of urban form and function. To maintain situational awareness of imminent health impacts, exposure monitoring should be incorporated into existing heat-response mechanisms even as bigger structural changes are pursued [6]. Social stratification, as reflected in income, race/ethnicity, housing tenure, and occupation, shapes residence within the urban system, with consequent differences in exposure to a variety of risks, including the urban heat island effect [6]. Access to affordable, quality housing constrains movement toward territories with lower ambient heat levels. Vulnerability resides not only in the prevalent heat exposure of the place but also in the other hazards concomitantly experienced there [7]. Within stratified systems, these additional stressors often combine to produce a greater prevalence of chronic stress, raising allostatic load and amplifying risk under heat stress. Furthermore, the stakes surrounding the heat hazard diverge in relation to heat thresholds and accompanying secondary risks [1].

Metrics for Monitoring Equity Impacts

Effective monitoring of equity impacts requires identifying indicators of heat exposure, population stratification, and health outcomes, as well as metrics to characterize each component [9]. Different metrics allow for analysis at multiple spatial resolutions and temporal scales [8]. Three temperature metrics are defined, targeting overall exposure, nighttime exposure, and cumulative exposure in extreme heat events. Ten socio-economic and demographic variables are proposed to assess stratification; all data are obtained from publicly available sources and harmonized to a common spatial resolution [8]. Finally, five health-related indicators are selected, each associated with the burden of disease attributable to heat exposure, and relevant data are linked while respecting privacy and confidentiality concerns [1].

CONCLUSION

Urban heat inequality represents a complex intersection of environmental, social, and structural factors. Social stratification drives differential exposure to heat, with low-income populations, racialized groups, and residents of substandard housing disproportionately affected. These disparities manifest in elevated risks for cardiovascular, metabolic, respiratory, and mental health conditions. Mitigation and adaptation strategies ranging from urban greening and reflective surfaces to equitable access to cooling and emergency preparedness must integrate an explicit equity lens to reduce vulnerability and enhance resilience. Policymakers, urban planners, and public health authorities must prioritize interventions that address underlying social determinants, monitor heat exposure at multiple scales, and engage communities in co-producing solutions. Future research should focus on high-resolution, individual-level data and standardized metrics to better understand causal pathways and inform effective, justice-oriented urban heat policies.

REFERENCES

1. Latham A, Goltz S. A Survey of the General Public's Views on the Ethics of Using AI in Education. In International Conference on Artificial Intelligence in Education 2019 Jun 21 (pp. 194-206). Cham: Springer International Publishing.
2. Rastogi D, Christian J, Tuccillo J, Christian B, Kapadia AJ, Hanson HA. Exploring the spatial patterning of sociodemographic disparities in extreme heat exposure at multiple scales across the conterminous United States. GeoHealth. 2023 Oct;7(10):e2023GH000864.
3. Hilleboe HE. Public health in the United States in the 1970's. American Journal of Public Health and the Nations Health. 1968 Sep;58(9):1588-610.
4. Li B, Mostafavi A. Beyond Quantities: Machine Learning-based Characterization of Inequality in Infrastructure Quality Provision in Cities. arXiv preprint arXiv:2403.12074. 2024 Feb 14.
5. Palinkas LA, Hurlburt MS, Fernandez C, De Leon J, Yu K, Salinas E, Garcia E, Johnston J, Rahman MM, Silva SJ, McConnell RS. Vulnerable, resilient, or both? A qualitative study of adaptation resources and

Open Access
Print ISSN: 2992-6106
Online ISSN: 2992-5789

behaviors to heat waves and health outcomes of low-income residents of urban heat islands. International Journal of Environmental Research and Public Health. 2022 Sep 4;19(17):11090.

6. Van Tol Z, Vanos JK, Middel A, Ferguson KM. Concurrent heat and air pollution exposures among people experiencing homelessness. Environmental health perspectives. 2024 Jan 23;132(1):015003.
7. Li Y, Svenning JC, Zhou W, Zhu K, Abrams JF, Lenton TM, Teng SN, Dunn RR, Xu C. Global inequality in cooling from urban green spaces and its climate change adaptation potential. arXiv preprint arXiv:2307.09725. 2023 Jul 19.
8. Madrigano J, Lane K, Petrovic N, Ahmed M, Blum M, Matte T. Awareness, risk perception, and protective behaviors for extreme heat and climate change in New York City. International journal of environmental research and public health. 2018 Jul;15(7):1433.

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