Rethinking urban climate adaptation.
Psycho-environmental dimensions of Ahmedabad's Heat Action Plan

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This paper examines the psychological and social dimensions of urban heat in Ahmedabad, India, through a mixed-methods design that combined stratified household surveys, semi-structured interviews, and GIS-based Urban Heat Island (UHI) mapping conducted between April and June 2023. The findings reveal that extreme heat is closely associated with heightened anxiety, sleep disruption, and pervasive feelings of helplessness during heatwaves, with hotspot analysis confirming overlaps

1. Introduction

Urban heat is a critical climate hazard in the Global South. In Ahmedabad, extreme summer temperatures and the urban heat island effect disproportionately affect low-income and informal settlement residents. The 2010 heatwave, which produced over 1,300 excess deaths, catalysed the 2013 Heat Action Plan (HAP) but raised questions about the plan's social and psychological coverage.

One of the core physical manifestations of this crisis is the urban heat island (UHI) effect, where temperatures within the city exceed those of the surrounding rural areas. This discrepancy is attributed to a combination of dense built-up surfaces, minimal vegetation, and heat-retaining materials. And communities often lack access to basic infrastructure such as ventilation, green public spaces, cooling systems, and clean air, rendering them more susceptible to climate-induced stress and trauma.

Research indicates that the effects of extreme heat extend beyond the physical realm.

between elevated land surface temperature zones and areas of intensified psychosocial stress. While Ahmedabad's Heat Action Plan (HAP) has been instrumental in reducing heat-related mortality, it continues to operate within a largely technocratic framework. This paper proposes the incorporation of measurable psychosocial indicators and community-centred interventions as a means to operationalize eco-psychology and planetary justice within the HAP. In terms of policy relevance, the study provides concrete, time-bound recommendations for embedding psychosocial metrics into municipal heat-response frameworks, thereby advancing a more inclusive, human-centred model of climate adaptation.

Prolonged exposure can lead to a series of psychological complications, ranging from anxiety, depression, irritability, and fatigue to more complex emotional states like helplessness, alienation, and social isolation. These conditions are often underreported or neglected in climate adaptation discourse, even though the mental health consequences of ecological change are deeply embedded in everyday urban life.

To address this, scholars have turned to eco-psychology, a growing field that explores the interconnection between human psychological well-being and the health of natural ecosystems. According to Baker (2022), eco-psychology reveals how human distress is often symptomatic of environmental degradation, and how restoration of natural systems can directly support psychological healing and resilience. Drawing on this, urban eco-psychological perspectives can provide a much-needed lens to reframe how cities adapt to climate extremes. As Sahu et al. (2020) emphasize, the increasing dual pressure of climatic, physical, and psychological stressors must be addressed in tandem, particularly in cities like Ahmedabad.

Ahmedabad, with an estimated population of approximately 8.8 million (Census 2011), is characterized by significant socio-spatial disparities, and according to AMC, nearly 40 percent of residents live in informal settlements. Municipal records indicate that average summer temperatures regularly exceed 42°C, while recent land surface temperature (LST) studies suggest that Urban Heat Island (UHI) intensities can reach up to 6°C above ambient conditions in densely built wards.

Ahmedabad's Heat Action Plan (HAP), launched in 2013, stands as one of India's pioneering urban responses to heat-related hazards. The plan consists of a combination of early warning systems, awareness campaigns, and infrastructural upgrades. Its implementation has been instrumental in reducing the

number of heat-related illnesses and deaths across the city (Ahmedabad Municipal Corporation, 2017). However, while effective in mitigating physical vulnerabilities, the HAP does not yet account for the emotional and cognitive impacts of extreme heat on its population. This paper proposes that for a truly resilient and just climate adaptation strategy, mental well-being should be treated as an integral component of urban resilience. Addressing psychological health in the face of climate change is not only a matter of social justice but also of epistemic justice, one that demands we reimagine adaptation through Southern voices, values, and lived realities.

This study aims to critically examine Ahmedabad's Heat Action Plan through the theoretical and applied framework of urban eco-psychology. It focuses on evaluating the Plan's capacity to address climate-induced psychological stress, particularly among marginalized populations living in precarious environments. Through this lens, the research seeks to understand the extent to which mental health outcomes are included or excluded in the city's climate policy apparatus.

The scope of the research includes:

- Measuring the psychological effects of heat stress on urban residents in Ahmedabad;
- Evaluating the structural and programmatic gaps in the current Heat Action Plan;
- Suggesting how eco-psychological principles can be meaningfully integrated into climate policy at both design and implementation levels.

By doing so, the paper seeks to make a multi-scalar contribution, one that is rooted in the social-spatial realities of the Global South, while advancing an emerging dialogue on the intersection of mental health, environmental sustainability, and policy design. This study addresses three questions: (1) What psychosocial impacts (e.g., anxiety, sleep disruption, social isolation) do residents report? (2) To what extent does the HAP mitigate psychosocial harms? (3) How can eco-psychological frameworks and planetary justice principles be operationalized within urban heat governance?

Climate adaptation strategies in cities, particularly within South Asia, have historically prioritized physical and infrastructural interventions, such as cooling centers, shaded streets, and early warning systems. However, the mental health dimensions of climate stress, especially among vulnerable communities, remain significantly underexplored. This study addresses that gap by integrating insights from eco-psychology to advocate for psychological resilience as a core pillar of climate adaptation.

2. Literature Review

The escalating impacts of climate change, particularly extreme heat in rapidly urbanizing regions, extend far beyond physiological stress, deeply affecting the psychological health of ur-

ban populations. In cities and towns, the burden of climate-induced stress is particularly evident among residents inhabiting densely populated, underserved areas. Research increasingly associates climate change with a surge in mental health issues, including anxiety, depression, and post-traumatic stress disorder (PTSD), especially among populations in congested urban zones with limited access to cooling infrastructure and psychological support systems.

Urban Heat Islands (UHIs), phenomena where city environments register significantly higher temperatures than their rural counterparts, exacerbate these effects. In Indian cities like Ahmedabad, where unplanned urbanization meets rising temperatures, psychological pressure is acutely felt in informal settlements, where adaptive infrastructure is inadequate or altogether absent. The physiological discomfort of sustained heat often leads to emotional disturbances such as nervousness, irritability, and cognitive fatigue. These effects are intensified when compounded by other urban stressors: poor air quality, noise pollution, overcrowding, and the absence of green spaces, conditions which have been linked to the increased prevalence of mental health disorders.

Moreover, prolonged exposure to excessive heat has been shown to erode social cohesion, increase interpersonal conflict, and disproportionately impact vulnerable groups such as children, the elderly, and low-income communities. The psychological vulnerabilities of these populations often remain invisible in dominant climate adaptation narratives. A critical gap persists in urban climate frameworks: the neglect of mental health and psychosocial dimensions within mainstream Heat Action Plans (HAPs) and policy interventions.

Eco-psychology, a field exploring the reciprocal relationship between human psychological well-being and the natural environment, offers a compelling lens for understanding the impacts of climate change on mental health. It posits that emotional resilience is strongly tied to ecological connection and the quality of the surrounding environment. Yet, in many urban development paradigms, these psychological and environmental interdependencies are marginalized in favor of infrastructure-driven, growth-oriented models.

2.1 Psychosocial Frameworks for Urban Adaptation

Psychosocial frameworks offer a comprehensive approach to examining how urban populations respond emotionally and socially to climate-induced stressors. These frameworks foreground the interplay of social, emotional, and behavioral factors in shaping individual and collective resilience. One such model is the Social-Ecological Model (SEM), which emphasizes the interconnectedness of individual, community, institutional, and policy-level responses to environmental threats. SEM advocates for adaptation strategies that not only strengthen physical infrastructure (like heat

shelters and green roofs) but also foster community resilience through social support networks, psychological services, and culturally grounded well-being practices.

Recent literature links heat exposure to increased prevalence of anxiety, sleep disruption, and aggravated psychiatric conditions (e.g., Zhang & Lee, 2020; WHO, 2021). In South Asia, studies document a consistent pattern of elevated psychosocial strain in low-income neighborhoods during heatwaves (Pande et al., 2020; Bhatia et al., 2018).

In the context of heat stress, these models underscore the importance of individual coping strategies, ranging from accessing social networks to engaging in mindfulness practices and utilizing mental health resources (Miller, 2018). Evidence from the 2010 Ahmedabad heatwave reveals that residents affiliated with organized community groups demonstrated better coping outcomes, underscoring the protective role of social cohesion during climate emergencies (Ahmedabad Municipal Corporation, 2017).

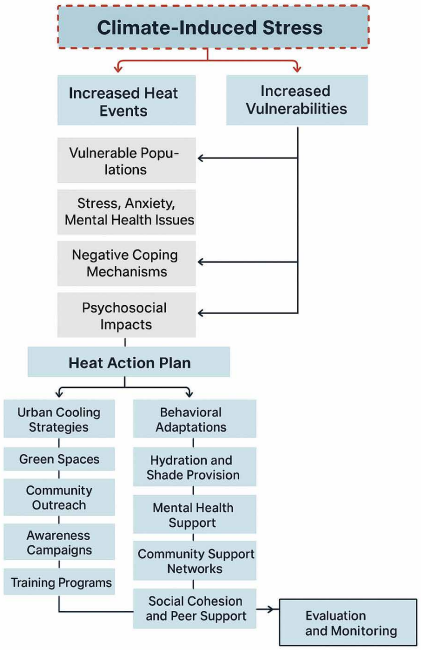
Public health communication also plays a crucial psychosocial role in framing climate change adaptation. Campaigns that portray adaptation as a collective opportunity rather than an individual burden can enhance agency and reduce feelings of helplessness. Moreover, integrating **eco-**psychological approaches, such as promoting the therapeutic benefits of green spaces, community gardening, and accessible nature-based interventions in cities, can increase emotional resilience and mitigate urban mental health stressors. These initiatives serve not just as coping strategies but as preventive and regenerative frameworks to build climate-aware, emotionally connected communities.

2.2 Heat Action Plans: Current Gaps and Emerging Directions

Heat Action Plans have emerged as key instruments in climate adaptation across urban India and beyond. However, their current formulations primarily focus on physical health risks, such as heatstroke and dehydration, with minimal attention to mental health outcomes. Cities like Paris and New York have developed progressive HAPs integrating cooling centers, early warning systems, and inter-agency protocols, but they, too, largely overlook the psychosocial consequences of heat stress, namely, anxiety, depression, and social isolation.

Ahmedabad's HAP (2013) is widely cited as a model of municipal heat governance (NRDC/IIPH reports). However, most evaluations, as per the CEPT 2021 Report, focus on mortality reduction (30–40% early estimates) and health-system preparedness; less attention has been paid to psychological and social outcomes.

In India, Ahmedabad's Heat Action Plan (HAP), first launched in 2013, represents a pioneering effort to institutionalize heat adaptation. The plan incorporates early warning dissemination, improved heat-resilient infrastructure, and pub-



Framework of psychosocial heat adaptation pathways- Linking heat stress, impacts, and adaptation.
Source: author
Fig. 1

lic outreach to mitigate heat-related mortality and morbidity. Nevertheless, its current framework remains technocratic, with a limited focus on the emotional and psychological dimensions of heat vulnerability. Although the HAP has succeeded in reducing physical harm, the lack of integrated mental health components highlights a critical limitation. There remains insufficient provision for counseling, trauma support, or community-based mental health responses during extreme heat events. Recognizing this gap, cities such as Melbourne, Australia, have begun embedding mental health outreach and psycho-educational programs within their climate response strategies. These examples suggest that Ahmedabad's HAP could significantly benefit from a similar expansion, integrating community therapy models, heat-stress counseling services, and eco-psychological urban interventions such as shaded community parks, therapeutic landscapes, and trauma-informed urban design. (Fig. 1)

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2.3 Ahmedabad's Heat Action Plan: a critical eco-psychological reading

Ahmedabad's HAP is structured through a multi-level governance model, engaging municipal authorities, health agencies, academic partners, and civil society organizations. While this integrative approach has reduced heat-related fatalities, it largely reflects a top-down public health orientation. A critical reading through the lens of eco-psychology and planetary justice reveals how the plan underrepresents the lived experiences of the city's most vulnerable groups, those inhabiting informal settlements, slum zones, and labor-intensive neighborhoods. To move towards a truly holistic adaptation strategy, future iterations of the HAP must embed eco-psychological and community-based mental health frameworks. This could involve encouraging nature-connectedness in design, community-led climate storytelling initiatives, and inclusive platforms for emotional expression during climate crises. Programs rooted in Southern epistemologies, drawing from local knowledge systems, indigenous wellness traditions, and collective care ethics, can offer culturally resonant interventions, supporting residents not just to survive climate stress but to thrive emotionally and socially amid it. We define 'Southern epistemologies' here as non-extractive, community-anchored knowledge practices privileging local narratives and mutual care. Operationalizing such epistemologies within adaptation means co-produced interventions, culturally resonant mental-health services, and reparative resource allocation.

3. Research methodology

This study employed a convergent mixed-methods design combining quantitative household surveys, qualitative interviews, and GIS-based heat exposure mapping. Data collection occurred April–June 2023.

Surveys were conducted among 412 residents across diverse socio-economic groups in Ahmedabad between April and June 2023. Standardized instruments (GHQ-12, heat-stress exposure scales, and coping checklists) measured psychological well-being, anxiety, depression, and social withdrawal. Data were

analyzed using multiple regression. Climate variables, daily temperatures, heatwaves, and humidity were obtained from the Indian Meteorological Department and the ERA5 reanalysis (2019–2023). GIS tools mapped Land Surface Temperature (LST) and overlaid these with socio-economic indicators such as housing, income, and green infrastructure access.

Semi-structured interviews with 36 stakeholders (urban planners, health professionals, policymakers, NGOs) examined institutional strengths and gaps in HAP implementation. Three case studies focused on elderly residents, slum communities, and outdoor laborers, highlighting spatial and psychosocial vulnerabilities. Remote sensing (Landsat 8, Sentinel-2) was used to derive LST, vegetation, and built-up indices. These were integrated with psychosocial data to reveal hotspots where climate stress and emotional burden converged.

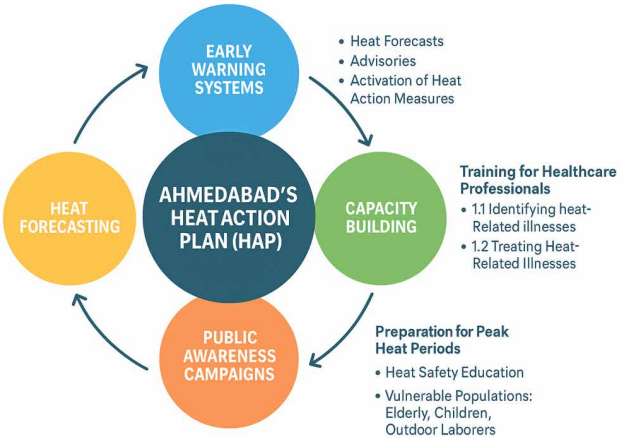
Primary data were cross-validated with government reports, prior HAP evaluations (e.g., E-S. et al., 2017), and global scholarship on climate–mental health linkages. The study adopted a critical realist paradigm to connect observed patterns with underlying structures of equity and governance. Thematic analysis of interviews identified narratives on mental health governance, community resilience, and Southern epistemologies. Integrating climate and psychosocial datasets produced a holistic framework that links adaptation with relational well-being and dignified survival. In doing so, the methodology embodies the study's overarching commitment: to offer a grounded, human-centered exploration of climate adaptation in the Global South, paving pathways for inclusive, emotionally intelligent, and just urban transitions.

4. The evolution and scope of Ahmedabad's Heat Action Plan

Ahmedabad's Heat Action Plan (HAP), launched in 2013 after the 2010 heatwave caused over 1,300 excess deaths, was India's first municipal heat adaptation strategy (AMC, 2019; Dholakia et al., 2015). Developed collaboratively with IIPH-G, NRDC, and local agencies, the plan is structured around three pillars: early warning systems, capacity building for health professionals, and public awareness campaigns. While widely recognized as a model for reducing mortality and morbidity (CEPT, 2021), its framework remains predominantly technocratic, underemphasizing the psychosocial and equity dimensions of urban climate stress (Gupta & Patel, 2022). Moreover, Ahmedabad's rapid urbanization, displacement of low-income groups, and infrastructural violence in resettlement sites intensify heat vulnerability and social stress (Desai, 2018). (Fig. 2).

4.1 Effectiveness

The HAP has achieved measurable reductions in heat-related mortality,estimated declines of 30–40% in early years (Dholakia et al., 2015; CEPT, 2021). Seasonal revisions and SMS-based alerts enhanced preparedness, while



Key Components of Ahmedabad's Heat Action Plan.
Source: author
Fig. 2

awareness campaigns improved protective practices. Yet, evaluations focus mainly on physical outcomes, overlooking the broader psychosocial costs of heat stress. Mortality reduction alone does not capture the anxiety, isolation, and emotional fatigue consistently reported in heat-vulnerable wards.

In terms of environmental and psychological impacts, heat stress in Ahmedabad manifests both physiologically and psychologically. Residents report anxiety, disrupted sleep, and helplessness during prolonged heatwaves, particularly in informal settlements with poor ventilation and limited access to cooling (Gupta & Patel, 2022; Fritz, 2025). These psychological impacts intersect with environmental deprivation, showing how heat exacerbates structural inequities.

In terms of gaps and limitations, the plan's focus remains biomedical and infrastructural. Marginalized populations, slum dwellers, outdoor workers, and the elderly continue to face compounding vulnerabilities. Institutional silos between urban planning, health, and social services limit integration of psychosocial strategies. Without attention to displacement, poverty, and ecological degradation (Desai, 2018; Mehta et al., 2019), resilience risks being narrowly defined as survival, rather than well-being.

4.2 Analytical Insights

Ahmedabad's Heat Action Plan offers valuable insights into the potentials and pitfalls of climate adaptation in the urban Global South. It represents a strong starting point for city-level action on extreme heat, demonstrating the value of collaborative governance, data-driven interventions, and iterative planning. However, its future success depends on a paradigm shift: one that incorporates eco-psychological principles, psychosocial well-being, and planetary justice into the fabric of adaptation policy. By embedding mental health support, emotional literacy, and community-based resilience practices within the HAP, urban policy-

makers can co-produce more equitable and effective responses. Initiatives could include the design of shaded green corridors, community cooling hubs with mental health services, and participatory platforms where citizens help shape local adaptation strategies.

These interventions not only reduce heat exposure but also foster social cohesion and emotional safety, both critical ingredients for long-term urban resilience. In doing so, Ahmedabad's HAP can evolve from a technocratic model to a people-centered framework that aligns with non-extractive knowledge systems, Indigenous worldviews, and climate justice narratives.

As cities across the Global South grapple with intensifying heatwaves, the Ahmedabad experience serves as both a model and a mirror, illuminating what has been achieved and what remains to be reimagined.

5. Urban Heat Stress as a Psychosocial Burden

In metropolitan places, climate-related stress, anxiety, and heat-related disorders are becoming a major public health concern. The psychological effects of heat in Ahmedabad, where excessive heat is a result of global warming, are multifaceted. They impact not just physical health but also mental health, including stress, anxiety, and despair brought on by the heat. The city's intensifying urban heat, largely driven by global warming and exacerbated by the Urban Heat Island effect, creates layered vulnerabilities, affecting both bodies and minds. In Ahmedabad, prolonged exposure to extreme heat contributes to heightened stress, irritability, and feelings of despair. Vulnerable populations, including the elderly, children, and those in poverty, are disproportionately affected. Their physiological limitations, such as weaker thermoregulation or poor living conditions, intersect with social stressors, compounding the psychological burden. Heat-related illnesses like dehydration, heat stroke, and exhaustion often act as precursors or intensifiers of mental distress. For many in low-income communities, the absence of cooling mechanisms, such as air conditioning or shaded retreats, turns each heatwave into a psychosocial crisis (Ahmedabad Municipal Corporation, 2018).

Children, for instance, experience disruptions to routines, school closures, and restricted outdoor activities, which indirectly influence their emotional well-being. Elderly individuals with pre-existing health conditions or limited mobility remain isolated and vulnerable to both physical and psychological heat stress. Similarly, the urban poor often reside in dense informal settlements, where heat is retained and amplified due to inadequate housing infrastructure. The psychological consequences here are not individual but systemic, products of environmental injustice, structural inequality, and ecological neglect.

In terms of heat stress as a psychosocial burden, Extreme heat in Ahmedabad affects not only physical health but also induces anxiety,

irritability, sleep disruption, and feelings of helplessness, particularly in informal settlements (Gupta & Patel, 2022; Fritz, 2025). Children and elderly residents face heightened vulnerability, while outdoor workers experience compounded stress due to unsafe occupational exposure. These findings resonate with global literature on climate-linked mental health risks (Zhang & Lee, 2020; WHO, 2022). Social stress is amplified by inadequate housing, ecological degradation, and infrastructural violence in resettlement sites (Desai, 2018; Mehta et al., 2019). Yet community coping strategies, such as mutual aid networks and grassroots initiatives, provide important buffers against isolation and despair (Gupta & Patel, 2022).

6. Results and Discussion

Mixed-methods data collected between April and June 2023 revealed strong links between heat exposure and psychosocial stress across Ahmedabad. Survey results (n=412) demonstrated significant correlations between land surface temperature (LST) and anxiety indices, while interviews with residents (n=36) highlighted pervasive distress, particularly in informal settlements, elderly populations, and outdoor workers. These findings reflect broader regional evidence on climate-linked psychosocial strain in South Asia (Karmacharya et al., 2024; Indian Journal of Psychiatry, 2024).

GIS-based mapping confirmed that wards with higher LSTs, often in densely built, low-income neighborhoods, had significantly higher self-reported anxiety and sleep disruption. This spatial overlay underscores how environmental exposure interacts with socio-economic vulnerability (Desai, 2018).

Vulnerable groups experienced heat stress disproportionately. Elderly respondents reported feelings of isolation, fatigue, and helplessness, while outdoor workers faced exhaustion and dehydration-induced anxiety. Children in resettlement colonies reported disrupted education routines. These findings echo global literature linking climate extremes with differentiated psychosocial impacts (Zhang & Lee, 2020; WHO, 2022).

While residents appreciated early warning systems and potable water distribution, they consistently critiqued the absence of counseling, mental health hotlines, or psychosocial outreach. The perception of HAP as infrastructurally strong but emotionally insufficient was a recurring theme (Gupta & Patel, 2022; Fritz, 2025).

Interviews with planners and health officials revealed institutional recognition of psychosocial neglect. Stakeholders admitted that HAP remains largely biomedical and infrastructural, hindered by fragmented governance and limited intersectoral coordination (Mehta et al., 2019).

This pattern is not unique to Ahmedabad. Similar adaptation plans globally emphasize mortality reduction while neglecting mental

health outcomes (Sharma & Bharti, 2022). Comparative cases in Asia and beyond illustrate the systemic bias toward physical health indicators, with psychosocial resilience rarely institutionalized (WHO, 2021).

By layering survey data, interview narratives, and spatial analysis, the study demonstrates that psychosocial vulnerability is not only individually experienced but also spatially concentrated and socially mediated. This critical realist integration highlights both measurable outcomes and lived experiences, offering methodological depth that conventional evaluations of HAP often miss (Gupta & Patel, 2022; CEPT, 2021).

7. Findings from Ahmedabad: beyond physical resilience

Ahmedabad, a city long recognized for its intense summer temperatures, has pioneered the Heat Action Plan (HAP) as a response to rising heat-related risks. While the plan has contributed to measurable reductions in heat-related mortality, the psychosocial dimensions of extreme heat remain insufficiently acknowledged. Qualitative interviews with residents revealed that around 45 percent reported heightened stress and anxiety during heatwaves, a pattern consistent with global research linking climatic stressors to mental health vulnerabilities (Wachsmuth et al., 2017). For many, particularly in informal settlements, the absence of adequate infrastructure,such as cooling centers, proper insulation, or air conditioning,amplified a sense of helplessness during peak heat episodes. These experiences resonate with wider South Asian research, highlighting how environmental stress exacerbates psychological fragility (Pande et al., 2020).

Residents frequently described irritability, fatigue, and emotional distress as recurring challenges during extreme heat. Sleep deprivation emerged as one of the most disruptive consequences, disproportionately affecting the elderly and children. Older adults, in particular, spoke of social isolation, as reduced mobility and restricted outdoor interaction deepened feelings of disconnection. These lived accounts echo Bhatia et al. (2018), who identified high temperatures as key contributors to emotional strain, underscoring that the climate crisis is not only ecological but deeply human and psychological.

Although the HAP has been widely recognized for its technocratic efficiency, particularly in areas such as early warning systems and water distribution points, its neglect of mental well-being is striking. Participants expressed a strong need for community-based counseling services, targeted awareness campaigns, and integrated psychological support during heatwaves. The absence of such provisions represents a missed opportunity, especially when compared with cities like New York and Melbourne, where mental health has been embedded in climate adaptation strategies (Sharma et al., 2020).

Insights from planners, health officials, and urban administrators further reinforce this gap. While stakeholders praised the HAP's success in reducing physical illnesses, they unanimously acknowledged that the psychological burden of heat remains under-addressed. As one urban health official observed, "While we can provide cooling spaces and early warnings, the psychological burden of heat, especially in marginalized communities, remains largely unaddressed." This reflects a broader argument put forward by the United Nations (2019), which emphasizes that emotional well-being must be central to any just and inclusive adaptation framework.

The challenge is structural. Urban planning continues to prioritize physical infrastructure and spatial resilience, while mental health is treated as peripheral. Planners admitted that resilience strategies often "stop at the physical layer," resulting in fragmented responses where planning, health services, and social welfare work in isolation. Such siloed governance has been reported not only in Indian cities but across Southeast Asia as well (Pavithran & Venkatesh, 2018).

Transformative insights from stakeholders suggest that eco-psychological frameworks and participatory approaches could help bridge this gap. Engaging communities directly in planning processes can foster coping mechanisms and build emotional resilience. Similarly, designing urban cooling interventions with psychological benefits in mind,such as shaded parks, water features, and community gardens,can simultaneously regulate urban microclimates and reduce distress while nurturing social connections (Kuo, 2017). Above all, stronger interdisciplinary coordination between planners, mental health professionals, and social workers is essential to craft an integrated and humane adaptation response.

8. Synthesis of Findings

The study revealed that while Ahmedabad's Heat Action Plan (HAP) has significantly addressed the physical health risks of extreme heat, it has largely neglected the psychosocial dimensions. Anxiety, stress, emotional fatigue, and mental distress among residents remain insufficiently addressed, aligning with global studies showing climate-induced psychological stress exacerbates existing mental health conditions (Bhatia et al., 2018; Gupta & Patel, 2019).

Interviews with residents consistently reflected dissatisfaction regarding the lack of mental health support in Ahmedabad's HAP. The findings parallel observations from similar urban adaptation strategies in New York and Melbourne (Table 1), where physical resilience continues to dominate planning narratives while mental well-being remains underrepresented. This is echoed in the assertions of Pande et al. (2020), who note that urban resilience strategies, although improving physical infrastruc-

Feature / Strategy	Ahmedabad HAP	Global Best Practice	Gap & Recommendation
Psychosocial Integration	Limited; nascent	Hotlines, counseling, and integrated mental health units	Create dedicated mental health units; track KPIs (sessions, community satisfaction); link to urban well-being
Early Warning Systems	SMS alerts, community meetings	App-based, IoT-enabled, AI-predictive alerts	Implement AI-driven alerts with app integration; connect to local support networks
Urban Cooling Strategies	Tree plantations, reflective surfaces	Vertical gardens, cooling hubs, neighborhood heat hubs	Scale neighborhood cooling hubs, shaded interactive spaces, green corridors; reduce psychological stress
Stakeholder Engagement	Public health departments, NGOs	Multi-stakeholder task forces, including the private sector, education, and communities	Expand to private, educational, and community actors; co-produce non-extractive solutions
Data Monitoring & Assessment	Periodic surveys, mortality/morbidity	Continuous environmental sensors, mental health monitoring	Upgrade to real-time monitoring; integrate psychosocial KPIs and triangulate with qualitative insights
Evaluation & Feedback	Limited	Regular quantitative & qualitative program evaluation	Introduce effectiveness metrics (heat distress reduction, resilience indices); establish feedback loops

Comparison of Ahmedabad's Heat Action Plan with Global Best Practices

Tab.1

ture, fall short in addressing mental health vulnerabilities.

The study also highlighted the heightened vulnerability of low-income residents, the elderly, and children, who are disproportionately affected by both the physical and psychological stressors of extreme heat events. This reflects a broader understanding in climate literature, which points to the intersection of socioeconomic status and mental health risks in the context of climate-induced stress (Rana et al., 2019).

Though Ahmedabad's HAP includes initiatives such as early warning systems, public cooling centers, and heat awareness campaigns, these interventions focus almost entirely on reducing heat-related mortality and illness. The psychosocial consequences, anxiety, isolation, depression, and distress, remain overlooked, even though literature consistently links them to heat extremes (Wachsmuth et al., 2017).

The study found that the absence of intersectoral integration between urban planning, public health, and community mental health services limits the overall impact of the HAP.

Interviews with urban planners and health professionals pointed to a lack of institutional capacity to embed psychosocial support systems within existing infrastructure-focused frameworks. This pattern mirrors experiences in other cities like New York and Melbourne, where mental health remains marginalized in heat resilience strategies (Ahern et al., 2017).

Respondents expressed the need for a more people-centered approach to resilience, one that combines physical safety with mental well-being. Suggestions included community-based coping strategies, psychoeducational programs, and the creation of urban green spaces that offer emotional relief during heat waves. These recommendations are in line with findings from Kuo (2017), which underscore the stress-reducing potential of shaded parks, water features, and social cohesion.

9. Implications on Urban Adaptation and Mental Health

This study offers critical insights for policymakers, urban planners, and mental health professionals working in climate-vulnerable regions such as Ahmedabad. Findings underscore the need to integrate psychosocial resilience into climate adaptation frameworks like the Heat Action Plan (HAP), aligning with principles of planetary justice and eco-psychology. In cities of the Global South, where marginalized communities often bear the brunt of climate stressors, it becomes crucial to include emotional well-being and social cohesion as essential components of climate resilience.

The implications are clear: future iterations of the HAP should incorporate counseling services, mental health awareness campaigns, and community-based psychological interventions as core strategies for adaptation, not peripheral considerations. This aligns with non-extractive, community-rooted knowledge systems, shifting the focus from mere physical infrastructure to human-centered responses that support mental and emotional health under extreme heat stress.

In particular, cities like Ahmedabad, which are experiencing rapid urbanization, must start addressing mental health as a key urban planning parameter. The development and maintenance of green spaces, including shaded parks, community gardens, and urban forests, not only contribute to microclimate regulation but also serve as critical psychological sanctuaries. Empirical evidence supports that access to such spaces fosters psychological restoration, enhances social interaction, and mitigates climate-induced stress (Kuo, 2017). These nature-integrated urban elements function as both climate mitigators and mental health enhancers, directly linking eco-psychological principles with urban adaptation strategies.

Further, the collaboration between urban planners and mental health professionals must be institutionalized. A climate-resilient city cannot be built without the inclusion of mental health workers who offer psychological first

aid, deliver psychoeducation about climate-induced trauma, and foster resilience through community-level interventions.

The communication of heat action plans should be two-way and co-produced, ensuring the lived experiences of residents are reflected in their design and delivery, thus upholding the values of Southern epistemologies and participatory justice.

9.1 The Role of Urban Design in Promoting Psychological Well-Being in Response to Climate Change

The psychosocial consequences of climate change, especially urban heat, are increasingly influencing mental well-being and shaping urban experiences. This study emphasizes the importance of urban design as a psychosocial tool in climate adaptation. Integrating strategically placed green areas, cooling infrastructure, and water-sensitive urban design can play a transformative role in mitigating both thermal and psychological stressors.

Community participation in the design and management of such infrastructure, particularly cooling centers and recreational green zones, can increase a sense of agency, control, and social empowerment. This fosters emotional resilience, which is critical when confronting climate stressors. The presence of tree-lined streets, green roofs, and water bodies not only offers physiological relief but also enhances emotional regulation, stress reduction, and a sense of environmental connection, core to eco-psychological well-being.

Such human-nature reconnections, enabled through urban design, provide a co-regulatory function during climate-induced crises. In this light, urban interventions should prioritize equity-focused access to mental health benefits, especially in underserved and vulnerable areas. This fosters both planetary care and social dignity, echoing the principles of planetary justice in urban adaptation efforts.

10. Conclusion

Ahmedabad's HAP has demonstrably reduced mortality following extreme heat, but its technocratic orientation leaves unmeasured psychosocial harms. This mixed-methods study shows that anxiety and sleep disruption are common among heat-exposed residents and cluster spatially in heat-vulnerable wards. Integrating eco-psychological approaches and measurable psychosocial metrics into HAP can improve both individual well-being and social resilience. We recommend a pilot program of neighborhood resilience hubs, embedding psychosocial KPIs in municipal dashboards, and capacity building for municipal staff. Limitations: cross-sectional design, sample size constraints, and incomplete intersectional disaggregation (gender/caste).

Future research should prioritize longitudinal studies (12–24 months) to track the mental health impacts of repeated heatwave expo-

sure in urban contexts, addressing the limits of cross-sectional data. Studies should focus on social networks, community solidarity, collective efficacy, and peer support as buffers against climate-induced psychological stress. Comparative analyses with cities like New York and Melbourne can guide holistic resilience strategies integrating psychological first aid, counseling, and awareness campaigns.

Policy must embed mental health professionals in climate governance, enabling co-design of interventions. Urban planning should extend beyond physical cooling infrastructure to include emotionally regenerative spaces, green corridors, shaded pavilions, and interactive plazas to reduce isolation and distress. Economic evaluation of psychosocial interventions is essential for scalable, sustainable implementation.

The study has some important limitations that offer valuable directions for future research. Its cross-sectional design calls for longitudinal follow-ups to better understand long-term mental health impacts. Certain populations, such as migrant laborers, may be underrepresented, highlighting the need for inclusive sampling in future studies. The absence of clinical mental health data suggests collaboration with primary healthcare centers could enrich findings, while the economic feasibility of interventions remains unassessed, emphasizing the need for cost-effectiveness analyses. Finally, given the diversity of urban contexts, comparative studies across cities would help ensure findings are relevant and adaptable, fostering interventions that are equitable, effective, and sensitive to local realities.

Ahmedabad's Heat Action Plan can be strengthened through three key measures. First, pilot five Neighborhood Resilience Hubs in the most heat-vulnerable wards over 12 months, integrating shaded cooling, potable water, and psychosocial support through tele-mental health and community facilitators trained in Psychological First Aid, with monitoring via visits, anxiety reduction, and counseling wait times. Second, embed psychosocial KPIs in the HAP dashboard, including anxiety prevalence, counseling sessions per 10,000 residents, and shaded area availability, with a target of 20% reduction in high-anxiety prevalence in pilot wards within 24 months. Third, build institutional capacity by training 50 AMC frontline staff in Psychological First Aid in Year 1 and establishing an inter-sectoral HAP committee with mental health professionals and community representatives for sustained governance.

In sum, interdisciplinary, collaborative governance spanning urban planning, mental health, environmental justice, and community organizing is crucial. Cities like Ahmedabad can thus achieve inclusive, humane, and ecologically grounded resilience, addressing both physical and psychosocial well-being amid climate change.

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Appendix A

Participant Consent Script

- □ "We invite you to participate in a study on heat and well-being. Participation is voluntary; you can stop at any time. Your answers will be anonymized; no identifying data will be published. Do you consent to participate an audio recording? (Yes / No)"

Section A: Demographics (6 items)

- □ Age (years)
- □ Gender (Male / Female / Other / Prefer not to say)
- □ Highest education attained (categories)
- □ Occupation (text; with codebook)
- □ Household size (number)
- □ Approx. monthly household income (brackets)

Section B: Heat-related psychosocial items (Likert 1–5)

Scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always

- □ "In the last month, how often have you felt anxious because of the heat?"
- □ "In the last month, how often did the heat prevent you from sleeping well?"
- □ "How often did you feel irritable during hot days?"
- □ "How often did heat make you avoid social interactions?"
- □ "How often did you feel helpless about the heat?"
- □ "How often did you rely on family/neighbour support during heat?" (reverse-coded for lack of support)
- □ "How often did heat affect your capacity to work?"
- □ "How often did you experience headaches/exhaustion due to heat?"
- □ "How often did heat make you think about moving from your neighbourhood?"
- □ "How often did you seek help from municipal services about heat?"

Section C: Coping & social cohesion (examples)

- □ "I feel that my neighbours check on each other during heatwaves." (1–5)
- □ "I know where the nearest public cooling center is." (1–5)

NOTE: compute **composite scores**: AnxietyIndex = mean(items 1,3,5); SleepIndex = item 2; SocialSupportIndex = mean(items 6, etc.). Calculate Cronbach's alpha.

Appendix B

Interview guide

- Can you describe how the heat affects your daily routine, including differences between mornings and afternoons?
- How do you and your family cope during intense heat, and are there any specific community practices you rely on?
- Have you used any services or facilities provided by the city during heatwaves, such as cooling centers, water distribution, or alerts?
- How does heat affect your mental state or emotions? Can you describe a specific recent example?
- What would you like the city to do differently to help people cope emotionally with heat,for example, therapy, community groups, counseling, or green spaces?
- How do you view the Heat Action Plan (HAP) activities? Do you find them relevant to your needs?
- Are there social tensions or conflicts that increase during heatwaves?
- Do you have any suggestions for co-producing solutions with municipal officials?