karmaanya

CII CENTRE FOR WOMEN LEADERSHIP

mssrf
M S Swaminathan Research Foundation

WOMEN'S COLLECTIVE FORUM

ALLIANCE FOR GLOBAL GOOD GENDER EQUITY AND EQUALITY

Supported by

Towards a new dawn
Ministry of Women and Child Development
Government of India

Gates Foundation

# THE IMPACT OF Heat on the Health of Women in India

## A CROSS-SECTIONAL STUDY

## Study Team

- Dr Soumya Swaminathan
- Dr Priyadarshini Rajamani
- 333Ms Nandini Sengottuvel
- Ms Roubitha David
- Mr Arun Ananthakumar

## Technical support for Analysis

- Mr Kaustav Chakraborty, International Institute for Population Sciences, Mumbai.
- Ms Laxmi Agarwal, International Institute for Population Sciences, Mumbai.
- Dr Rajalakshmi Ramprakash, Gender Consultant, MSSRF

**Suggested Citation:** MSSRF., (2025). The Impact of heat on the health of women in India – A Cross-sectional study. M S Swaminathan Research Foundation.

# Table of contents

# Foreword

India is experiencing the growing impacts of climate change in real and measurable ways, with heatwaves emerging as one of the most pressing public health challenges. Among the most affected, yet least visible, are women, particularly those from low-income and marginalized communities. Their daily lives, work, caregiving responsibilities, and health are intricately and disproportionately impacted by rising temperatures.

Despite this, gender-specific research on heat stress remains sparse, and women's experiences are often missing from climate policies and health preparedness strategies. This report sheds critical light on how extreme heat affects women's physical and mental health, their productivity and livelihoods, and their ability to access healthcare. It also captures the financial burden they bear and their efforts to adapt, often with limited resources and support.

Through a combination of data, field insights, expert consultations and lived experiences, the study presents a compelling case for integrating gender into climate resilience planning. It underscores the importance of understanding how social and economic factors such as the nature of women's work, their access to water and shelter, and their care responsibilities intersect with climate risks to produce compounded health impacts.

Importantly, the findings speak to a deeper systemic issue: the invisibility of women's health burdens in the design of urban and rural infrastructure, heat action plans, and public health services. There is an urgent need for targeted interventions that include gender-sensitive messaging, affordable cooling options, and improved access to healthcare during periods of extreme heat.

This study comes at a crucial moment. As governments and institutions across the world strengthen their climate adaptation efforts, we must ensure that gender equity is not an afterthought but a foundation. I hope the insights from this work will inform more inclusive and evidence-driven policy decisions, not just in India, but across other regions facing similar climate realities.

**Dr. Soumya Swaminathan**
Chairperson, M S Swaminathan Research Foundation

# Acknowledgments

We express our deep gratitude to **Smt. Smriti Irani**, Chairperson of the **Alliance for Global Good: Gender Equity and Equality**, for her leadership in recognising the critical need to examine the gendered impacts of climate change on women and children in India. Her vision laid the foundation for this study and guided its purpose.

We are thankful to **Devanshi Shah of Karmannya Counsel** for her contribution, from inception to timely completion. Her efforts in bringing together diverse perspectives and coordinating multiple facets of the project were critical to its success.

We also acknowledge the valuable support of **Neeraj Kumar** and **Shivani Kumar** from the **CII Centre for Women Leadership**, whose facilitation of stakeholder consultations and contributions to the study's development enriched its depth and relevance.

We gratefully recognise the **Gates Foundation** for their financial support, which made this study possible.

Our sincere thanks go to the study team — **Dr. Priyadarshini Rajamani, Ms. Nandini Sengottuvel, Ms. Roubitha David, and Mr. Arun Ananthakumar** — for their unwavering commitment and expertise, which shaped the quality and rigour of this report.

We are indebted to the participants of the stakeholder consultations held in Chennai and Ahmedabad (list appended) for their thoughtful engagement and critical insights, which significantly informed the study's analysis and findings.

We also acknowledge the contributions of **Dr. Srinivas Goli, Mr. Kaustav Chakraborty, and Ms. Laxmi Agarwal** from the **International Institute for Population Sciences (IIPS), Mumbai**, for their assistance with quantitative analysis; **Dr. Rajalakshmi Ramprakash** from **MSSRF** for her expertise in qualitative analysis; and **Mr. Sam John** for his work on the literature review.

Our thanks also go to **Dr. Aarthy Ramasamy** and **Dr. Sabu Ulahannan** from our health team for their continued support throughout the study.

Finally, we are grateful to all who contributed to this project. Despite demanding timelines and numerous requests, we received consistent support and collaboration from all involved. We hope this study advances the understanding of how climate change intersects with gender and public health and informs future research and policy action in this critical area.

**Dr. Soumya Swaminathan**
Chairperson, M S Swaminathan Research Foundation

# List of Figures



# List of Tables

# Executive Summary

## Heat Stress Is a Public Health Emergency with Serious Implications for Women's Health.

Heat represents one of the most urgent yet under-recognised public health threats of our time. Globally, it is the leading cause of weather-related mortality, exacerbating cardiovascular disease, diabetes, asthma, mental health conditions, and maternal health risks (WHO, 2024). As climate change accelerates, both exposure to extreme heat and heat-related deaths are on the rise, especially in Asia which bears nearly half of the global heat mortality burden (Zhao et al., 2021). In India, rising temperatures have led to longer and more intense heatwaves, with heat-related deaths increasing by 34% between 2013 and 2022 (Pandey, 2023). While these health consequences are increasingly well-documented, the **gendered dimensions of heat stress remain profoundly understudied and under-responded to**. Current frameworks tend to treat women as a homogenous "vulnerable group," overlooking the ways in which **gender, caste, occupation, and poverty intersect** to shape risk. Combined with pre-existing burdens such as unpaid care work, lack of sanitation access, and gender-based violence, **heat amplifies structural health inequities** in ways that are largely invisible to current policy instruments.

Representative Image: Generated using AI

This study was undertaken against that backdrop. It presents one of the **first mixed-methods investigations into the gendered health impacts of heat stress in India**, drawing on secondary data analysis, primary surveys, healthcare provider interviews, and national consultations.

## Study Design and Approach

This research deployed a **triangulated, mixed-methods design** to understand how heat affects women's physical, mental, and reproductive health, and their ability to access care:

- **Secondary Data Analysis** of NFHS-5 (2019–21) across seven heat-prone states (Rajasthan, Gujarat, Maharashtra, Bihar, Odisha, Telangana, and Tamil Nadu) examined physical health complaints and care-seeking patterns.

- **Primary Surveys** with 3,300+ women in vulnerable districts provided new evidence on heat-related symptoms, reproductive health issues, and access to public infrastructure.
- **Focus Group Discussions** with women to capture women's lived experiences and complement the quantitative findings.
- **In-Depth Interviews** with MLHPs, nurses, and doctors highlighted frontline health system constraints and gaps in institutional preparedness.
- **National-Level Consultations** brought together over 60 experts from civil society, public health, academia, and government, surfacing policy and implementation insights.

This rich dataset enabled **triangulation across perspectives and sectors**, making the findings both **deeply grounded and policy-relevant.**

## Key Findings

### Heat Doesn't Affect All Women Equally

The study confirms that women in heat-prone districts experience both unique and amplified health risks due to rising temperatures, with **70% of women reporting physical health symptoms** such as fatigue, dizziness, dehydration, and gastrointestinal discomfort during peak heat months. These symptoms were highly reported among women aged 20-45 years in high HVI districts compared to those in medium **(28%)** and low HVI districts **(24%**). Critically, **reproductive and menstrual health issues** including urinary tract infections, irregular bleeding, and cycle disruptions were widely reported, yet often **dismissed or overlooked** in both personal care-seeking and provider responses. **Women in rural areas** reported higher reproductive health impacts than women in urban areas (**55% vs. 42%** in the high HVI group).

Despite these symptoms, **a significant proportion of women did not seek care**. Among those who experienced heat-related symptoms, **24% did not seek any care at all**, while another **12% relied on pharmacists**, and **6% opted for home remedies or self-medication**.

Importantly, **psychosocial impacts of heat were profound**. Women spoke of heightened anxiety, anger, and restlessness during peak heat, often worsened by overcrowded homes, frequent power outages, and the constant physical burden of unpaid domestic labour. Women reported experiencing higher irritability or short temper **(41%)**, heightened anxiety or stress levels **(33%)**, and sleep disruption/insomnia or sleep pattern changes (**32%**). Frontline providers also observed higher in **mental distress, sleep disturbances, and cognitive fatigue**, particularly among elderly women and caregivers.

Approximately **18% of women surveyed reported experiencing some form of violence** at least once in their household, with over half of them noting a higher occurrence during the summer months. The prevalence and intensification of violence were significantly higher in high Heat Vulnerability Index (HVI) districts, where **38%** reported having experienced violence at least once in their lifetime and **72%** reported higher levels of violence during April–June; suggesting a strong association between extreme heat, economic stress, and household tensions.

These findings point to a **synergistic relationship between environmental stress, gendered labour burdens, and health vulnerability**; one that is largely unaddressed in conventional health and disaster preparedness frameworks.

### Health Systems Are Under-Equipped

Interviews with healthcare providers revealed that most **frontline workers lacked training or protocols to recognise and manage heat-related illness** beyond heatstroke. Reproductive and mental health manifestations of heat stress were **not part of routine screening**, and **no protocols existed for flagging vulnerable groups such as pregnant women, menstruating adolescents, or elderly caregivers**.

The rural and semi-urban facilities surveyed lacked **basic heat adaptation infrastructure**, including shaded waiting areas, adequate building ventilation, fans or cooling equipment, and water stations. Providers reported that they often relied on **informal coping mechanisms**, such as asking patients to sit outdoors under trees or shift visit times to avoid peak heat.

Information, Education, and Communication (IEC) materials were **either absent or overly generic**, and **no visual or locally adapted communication tools existed** to educate communities on the early signs of heat stress or preventive strategies. There is a critical need to **equip the health system not just for emergency care, but for preventive, reproductive, and psychosocial heat-health response**, particularly in underserved and high HVI districts.

### Heat Policies Exist, But Implementation Is Weak

While India has made significant strides in institutionalising heat action, with over **250 Heat Action Plans (HAPs) developed across states and cities**, most remain **weakly implemented and poorly tailored to local realities** (Pillai & Dalal, 2023). The majority of HAPs **do not incorporate climate projections, granular vulnerability assessments, or local temperature thresholds**. As a result, they fail to address the full spectrum of heat risks, particularly **compound exposures to humidity, poor ventilation, night-time heat, and occupational conditions**.

From a gender lens, most HAPs **treat women as a uniform group**, with occasional references to pregnancy but little attention to how **caste, class, occupation, disability, or caregiving roles** shape women's risk profiles. **Pregnant street vendors, home-based workers in tin-roofed houses, and elderly women in urban slums**—among the most vulnerable to heat stress—are virtually absent in existing heat-health planning.

Communication strategies embedded in HAPs are also limited. **Digital dissemination remains the default**, despite evidence from this study and others that **women are significantly less likely to own mobile phones, access the internet, or possess digital literacy**, especially in rural and low-income households. This **digital gender gap** has created critical barriers to timely information access during heatwaves.

Finally, **structural weaknesses in governance and financing persist**. Stakeholders at the national consultations highlighted fragmented inter-departmental coordination, absence of dedicated budget lines for heat-health initiatives, and weak enforcement mechanisms. Despite the availability of recent national guidelines and potential funding instruments, **awareness and accessibility of these mechanisms remain low** at the state and district levels.

## A Roadmap for Policy Reform: 10 Priorities for Gender-Responsive Heat Action

Grounded in field research and national consultations, this roadmap outlines ten actionable priorities to strengthen India's response to extreme heat. Each domain highlights systemic gaps and proposes scalable, gender-equitable solutions for policymakers and practitioners.

### 1. Strengthen Institutional Leadership and Governance

Heat must be reframed as a long-term public health and development priority, not only a disaster-response issue. Dedicated Environmental Health Departments at the state and national level can coordinate cross-sectoral efforts, while annual reviews of HAPs can institutionalise adaptation and learning. City-level "heat budgets" should be introduced to enable structured, evidence-based investments. Stronger institutional anchoring will enhance accountability, drive convergence, and improve policy uptake.

## 2. Improve Cross-Sectoral Convergence and Local Implementation

Fragmentation across departments weakens heat action at the ground level. HAPs must align with national missions like Swachh Bharat Mission and Jal Jeevan Mission, while engaging key actors such as urban planners, labour departments, and local governments. Civil society and grassroots organisations can facilitate interdepartmental coordination and ensure last-mile delivery. Locally tailored action plans must be developed through bottom-up planning and community co-creation to ensure relevance and sustainability. Empowering local governance structures will foster more integrated and context-responsive heat resilience.


Representative Image: Generated using AI

## 3. Adapt and Strengthen Health Systems

Primary health systems remain underprepared to address heat-related illness, especially among vulnerable women. Facilities need shaded waiting areas, cooling infrastructure, hydration stations, and trained frontline staff. Menstrual, reproductive, and mental health must be embedded in summer care protocols, particularly in rural and informal settings. Building system capacity for both prevention and treatment is essential to reduce the health burden of rising temperatures.

## 4. Generate and Apply Gender-Sensitive Data and Research

Despite growing exposure, heat-health interventions remain poorly guided by data. Retrospective analyses of mortality trends, mapping of Urban Heat Islands, and cost-effectiveness studies of mitigation strategies like cool roofs and ORS stations are urgently needed. Qualitative research, especially on lived experiences, can illuminate behavioural adaptations and system gaps. Participatory research and co-designed studies can strengthen evidence-use in programs and policies. Independent evaluations of HAPs must be encouraged to foster accountability and learning.

### 5. Embed Gender-Responsive Adaptation Across Interventions

Women face unique heat-related risks due to unpaid care burdens, informal work, and limited access to infrastructure. Public spaces and markets should be equipped with shade, toilets, drinking water, and childcare facilities. Women-led enterprises need access to credit, climate insurance, and capacity-building on heat mitigation. Heat-linked gender-based violence must be addressed through cross-sectoral programs and support services. Adaptation measures must be co-created with women and women's groups to reflect their lived realities and diverse needs.

### 6. Improve Workplace Heat Safety and Informal Worker Protection

Informal and outdoor workers are among the most heat-exposed yet least protected. Workplace standards must mandate shaded rest zones, water access, and shift adjustments during peak heat. Heat safety should be embedded in labour codes and urban design regulations. Welfare schemes and insurance must include heat-related illness and productivity loss. Worker-centric solutions, developed in collaboration with trade unions and informal worker collectives, will ensure higher uptake and compliance.

### 7. Expand Access to Climate-Resilient Infrastructure and Services

Heat-resilient infrastructure remains severely lacking in both urban and rural areas. Priorities include improving piped water access, subsidising energy-efficient cooling appliances, and ensuring electricity reliability during summer months. Shaded pedestrian routes, drinking water stations, and heat-adapted housing must be integrated into housing and transport policy. Nature-based solutions such as tree plantation, green corridors, and rooftop gardens must be scaled to enhance resilience and co-benefits for health, biodiversity, and local livelihoods.

### 8. Integrate Mental Health into Heat-Health Responses

Heat stress has serious psychological effects, particularly among women, caregivers, and the elderly. Frontline workers need training to recognise and manage heat-aggravated anxiety, fatigue, and irritability. Community cooling and wellbeing hubs can offer physical relief and mental health support during heatwaves. Mental wellbeing modules and IEC materials must be adapted for low-literacy and high-stress settings.

### 9. Build Strategic, Inclusive Communication Systems

Current communication strategies often fail to reach digitally excluded populations, especially low-income women. Heat education must expand to non-digital channels like radio, TV, community theatre, and visual tools. Messaging should be locally adapted, inclusive, and rooted in behavioural insights. Partnering with civil society and Panchayats can help co-create and disseminate relevant, community-driven knowledge.

### 10. Adopt a Proactive, Equity-Centered National Strategy

As heat risks intensify across the country, HAPs must be expanded beyond traditionally heat-prone regions. A national strategy is needed that centres heat within development planning, gender equity, and health security. Ministries must work collaboratively to embed heat resilience into urban development, labour welfare, housing, and public health frameworks. Nature-based solutions and bottom-up approaches must be mainstreamed into climate adaptation efforts to ensure long-term resilience. Viewing heat not just as a hazard but as a systemic inequality issue is key to sustainable adaptation.


Representative Image: Generated using AI

## Looking Ahead: Embedding Equity in Climate Adaptation

This study confirms what frontline workers and affected communities already know: **heat is a health emergency**, and one that disproportionately affects those with the least power, mobility, and protection. As India builds its climate resilience, **gender-transformative, community-driven solutions must be central; not peripheral.**

The way forward must prioritise:

- **Longitudinal research and seasonal tracking:** Invest in long-term, mixed-methods studies that track women's health outcomes across seasons, enabling a clearer understanding of the cumulative and cyclical impacts of heat exposure.
- **Intersectional programme design:** Design interventions that account for how gender intersects with caste, class, occupation, disability, geography, and other axes of marginalisation, ensuring that the most vulnerable are not just included, but centred.
- **Community-led co-creation:** Ground programme design and implementation in the lived realities of affected populations through participatory research and sustained engagement, enhancing local relevance, ownership, and impact.
- **Actionable uptake of recommendations across governance levels:** Translate the study's recommendations into actionable frameworks for Panchayats, municipal bodies, state departments, and national ministries ensuring accountability and alignment across scales. This includes operational guidelines for frontline workers, budget lines for local governments, and institutional mandates at the central level to embed gender-responsive heat action into core policy agendas.
- **Strengthening multi-tiered implementation mechanisms:** Ensure that national policy commitments cascade effectively into state-level schemes, district implementation plans, and village-level action. Dedicated monitoring and feedback loops are essential to close the gap between policy and practice.

Representative Image: Generated using AI

The time has come to shift the conversation on heat from reactive response to systemic reform. Heat is no longer just a matter of rising temperatures. It is a matter of equity, access, and rights. India's climate response must go beyond protection to ensure that women are visible, valued, and prioritised in the policies that shape their lives.

# 1. Background

Heat represents a significant and growing environmental and occupational health hazard, with wide-ranging implications for public health systems and policy. According to the World Health Organization, heat stress is the leading cause of weather-related mortality and is known to exacerbate a range of pre-existing health conditions, including cardiovascular disease, diabetes, respiratory illnesses such as asthma, and mental health disorders. It can also increase the likelihood of accidental injuries and the transmission of certain infectious diseases. Among the most severe health outcomes, heatstroke constitutes a medical emergency with a notably high case fatality rate (WHO, 2024).


Representative Image: Generated using AI

The number of people exposed to extreme heat has risen dramatically across all global regions due to the accelerating impacts of climate change. Between 2000–2004 and 2017–2021, heat-related mortality among individuals aged 65 years and older increased by approximately 85% (Romanello et al., 2023). Evidence from 2000–2019 estimates that around 489,000 heat-related deaths occur globally each year, with the burden disproportionately concentrated in Europe (36%) and Asia (45%) (Zhao et al., 2021).

## 1.1. The Indian Context

Between 1901 and 2018, India experienced an increase of approximately 0.7°C in its average annual temperature, reflecting a long-term warming trend (Singh et al., 2021; Press Information Bureau [PIB], 2023). Rising temperatures and shifts in meteorological conditions have contributed to an increase in the frequency, intensity, and duration of heatwaves—often referred to as a "silent killer" due to their severe but under-recognized health impacts (Aadhar & Mishra, 2019; Lee et al., 2023). According to data from the India

Meteorological Department, heatwave-related mortality in the country rose by 34% between 2013 and 2022 (Pandey, 2023). These escalating trends point to the urgent need to recognize heat as a critical public health threat that disproportionately affects vulnerable populations. It is more important than ever to acknowledge these disproportionate risks and to develop targeted, equity-focused strategies to safeguard their health in a rapidly warming world.

## 1.2 Heat and Women's Health

Extreme heat disproportionately affects women, particularly those engaged in informal outdoor work and those who are pregnant or breastfeeding. Studies suggest that each 1°C increase in temperature is associated with a 1.05-fold increase in the risk of stillbirth and a 1.16-fold increase in the odds of preterm birth during heatwaves (Chersich et al., 2020). Heat stress is also linked to rising rates of gender-based violence; a 1°C increase in average annual temperature correlated with a 6.3% rise in physical and sexual domestic violence across India, Pakistan, and Nepal. A study conducted in Puducherry found that women over the age of 60 were more vulnerable to heat-related health risks than men, primarily due to spending longer durations indoors in poorly ventilated or non-air-conditioned environments. These findings underscore the significance of both environmental conditions and time spent in heat-exposed settings in determining health outcomes. In addition to these contextual factors, physiological differences such as sex-specific thermoregulation thresholds and the effects of menopausal transition further elevate

**Seeking Shade: A Mother and Child Rest Under a Tree Canopy in Peak Summer Heat, Ahmedabad.**

women's risk of heat-related cardiovascular conditions (Shrikhande et al., 2023; MSSRF, 2024).

Economic losses are similarly gendered. Female-headed households lose significantly more income due to heat stress, with an annual income gap of 8%, and women farmers experience a 3% greater reduction in crop value per extreme heat day compared to men. The compounding effect of unpaid caregiving responsibilities further constrains women's ability to rest or seek protection from heat, especially during school closures or peak caregiving periods. Pregnant women in low- and middle-income countries, especially those with underlying conditions such as malaria, HIV, or mental illness, face elevated risks but have limited access to mitigation options like cooling or rest breaks (Asian Development Bank [ADB], n.d.). For instance, among migrant construction workers, limited access to sanitation was reported to contribute to heat-related urinary tract infections (Venugopal et al., 2016). Moreover, the dual impact of food insecurity and increased work pressures often takes a toll on women's physical health, as well as their mental and emotional well-being. These intersecting vulnerabilities demand targeted interventions that account for the unique physiological, occupational, and social risks faced by women under extreme heat conditions.

While women are often depicted as a homogenous group in the climate discourse, it is crucial to recognize that their experiences are shaped by factors such as socioeconomic status, caste, and geographical location. In particular, women in marginal communities are more vulnerable to the health impacts of extreme heat. Recognising this diversity is essential for designing effective, context-sensitive interventions that safeguard both physical and emotional well-being. Although the health impacts of extreme heat are increasingly well-documented and largely predictable, they remain profoundly preventable through targeted public health measures and coordinated, multi-sectoral responses. Despite this, critical research and policy gaps persist, particularly in understanding psychological impacts, disaggregating mortality data, and accounting for environmental and social determinants of heat vulnerability. This report presents findings from a rapid assessment conducted to examine how heat impacts the physical and mental health and livelihood status of women, alongside insights from national consultations, healthcare workers and women across India.

The objectives of the study undertaken were as follows:

1. To assess the impact of heat stress on the physical and mental health, work productivity and livelihoods of women
2. To assess the extent of their knowledge of heat stress mitigation and their current practices.
3. To assess the health-seeking behaviour, hospital visits and out-of-pocket expenditure during the hot season, especially during heat waves and days of extreme heat.

# 2. Approach

This report is informed by a study that employed a multi-pronged methodology to examine the intersection of extreme heat exposure and women's health in India. The study integrated three components: (1) a primary cross-sectional study, (2) secondary data analysis using national datasets, and (3) stakeholder consultations. Together, these methods provide a comprehensive, multi-scalar understanding of the issue.

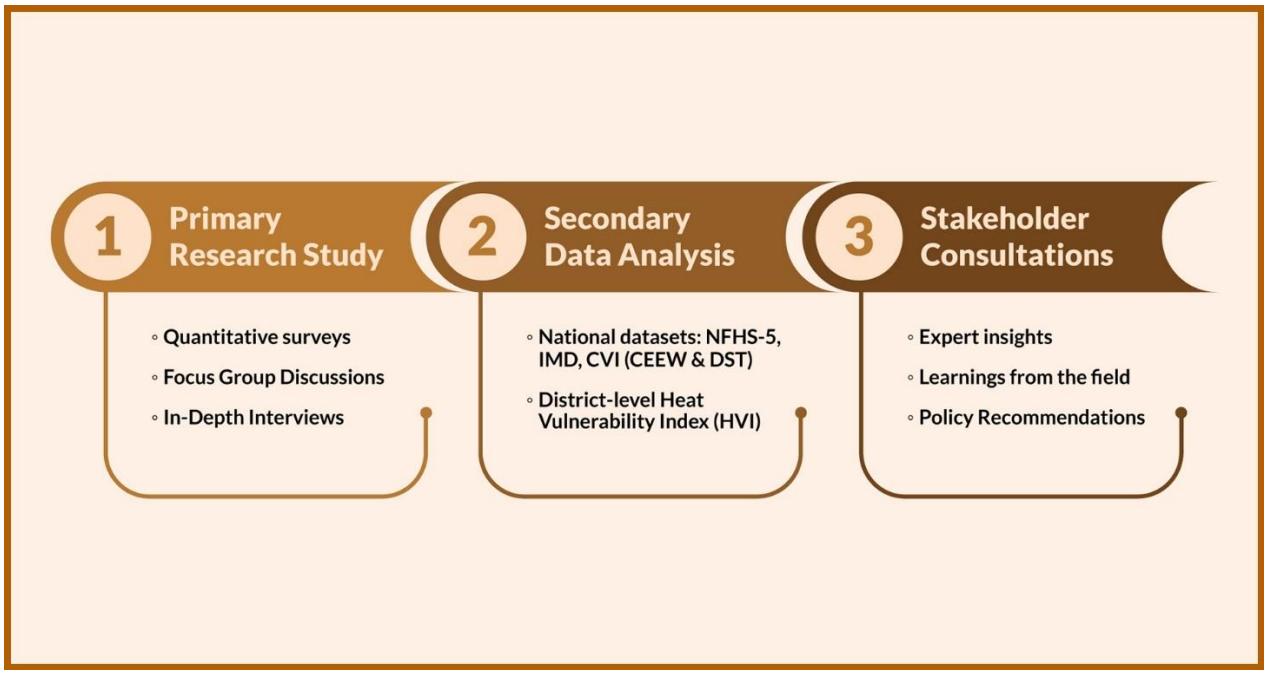



**Figure 1:** Methodology Framework

## 2.1 Primary Research Study

**Study Design:** This study adopted a cross-sectional, mixed-methods design to assess the impact of heat on women's health in India. This approach combined quantitative household

surveys with qualitative data collected through focus group discussions (FGDs) with women and in-depth interviews (IDIs) with healthcare workers. This mixed approach enabled a nuanced understanding of women's lived experiences of heat exposure and the pathways through which it impacts their physical, mental, and occupational health.

**Study Setting:** The study was implemented across 15 districts in seven states, Andhra Pradesh, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu, and Uttar Pradesh selected to reflect India's geographic and climatic diversity.

**Table 1:** States and Districts used in the Study Sample.

| State | High Heat Districts | Low Heat Districts |
|---|---|---|
| **Tamil Nadu** | Tiruvallur[1] | Ariyalur |
| | Chennai | |
| **Kerala** | Kottayam | Idukki |
| **Andhra Pradesh** | Vizianagaram | Anatapur |
| **Karnataka** | Udupi | Rural Bengaluru |
| **Uttar Pradesh** | Banda | Saharanpur |
| **Rajasthan** | Churru | Sawai madhopur |
| **Maharashtra** | Nagpur | Nanded |

As seen in *Table 1*, from each state, two districts were chosen to represent relatively high and low heatwave exposure, based on historical records from the India Meteorological Department (IMD).

**Study Population:** The study comprised women aged 20 years and above who had resided in the same state for a minimum of five years, ensuring contextual familiarity and adequate exposure to local climatic conditions. The sample included women from diverse occupational backgrounds, including homemakers, informal sector workers, agricultural

[1] While two districts were selected from each state, Tamil Nadu includes three districts in total. This is because Chennai district, as per Census 2011, is entirely urban with no rural population. Therefore, for the purposes of this study, the rural sample for Tamil Nadu was drawn from Tiruvallur district, which borders Chennai and shares similar agro-climatic and socio-economic characteristics. This approach ensured rural-urban comparability within the state.

labourers, and those in formal employment, to capture diverse vulnerabilities and adaptive capacities, across socio-economic groups.

### 2.1.1 Sampling Strategy

A stratified, multistage sampling approach was adopted to ensure representation across diverse geographic, demographic, and climatic contexts. In the first stage, states and districts were selected based on historical heatwave exposure, as identified through IMD data, as well as operational feasibility for fieldwork implementation. The second stage involved the selection of three urban wards and five rural villages per district using Probability Proportional to Size (PPS) sampling, ensuring proportionate representation of high- and low-density areas ensuring proportionate representation of high- and low-density areas.

In the third stage, households were selected within each site using systematic random sampling techniques. From each selected household, one eligible woman aged 20 years or older, who had resided in the same state for at least five years, was selected.

### 2.1.2 Data Collection Tools and Procedures

Quantitative data were collected using a structured household questionnaire developed by the research team administered via mobile devices using KoboToolbox. Trained field investigators collected data on demographics, housing and environmental conditions, access to services (water, electricity, sanitation), and self-reported physical, reproductive, and mental health symptoms related to heat exposure. The questionnaire also captured information on coping mechanisms, healthcare access, and individual perceptions of seasonal and climatic changes in relation to personal and household well-being.

The qualitative component included FGDs and IDIs conducted with a purposively selected subset of women and key healthcare workers as healthcare workers as Accredited Social Health Activists (ASHAs), nurses, and medical officers. These sessions explored sociocultural norms influencing women's heat exposure, community perceptions of risk, and gaps in institutional preparedness and health system response.

### 2.1.3 Training and Field Protocol

Field investigators underwent a two-day training that covered research ethics, digital data collection techniques, consent procedures, and culturally sensitive engagement with communities. All field protocols were pilot-tested and refined prior to full-scale deployment to ensure clarity, feasibility, and contextual appropriateness.

### 2.1.4 Ethical Considerations

The study received ethical approval from the Institutional Ethics Committee (IEC) of M.S. Swaminathan Research Foundation (MSSRF). Written informed consent was obtained from all participants. Participation was voluntary, and confidentiality and the right to withdraw at any time were ensured throughout the study.

### 2.1.5 Data Management and Analysis

Quantitative data were cleaned and analysed using Stata and Microsoft Excel. The analytical approach included descriptive statistics such as frequencies, means, and proportions, followed by bivariate and trivariate analyses exploring prevalence and associations between key socio-demographic variables like caste, education, and place of residence, wealth, age groups with heat related outcomes.

**Data Collection in Rural Karnataka.**

The analysis further explored the variation of heat impact across the different heat vulnerability levels by varying categories of defined socio-demographic variables. To examine the net effect of heat vulnerability on women in terms of their general, physical health, reproductive health, and other heat related outcomes, logistic regression with marginal effects was employed.

To support the primary data analysis, a **Heat Vulnerability Index, House Quality Index** and a **Wealth Index** were also developed to help identify patterns of vulnerability and disparities across the surveyed population. Further details on the construction and methodology of these indices are provided in *Annexure I*.

**Focus Group Discussion (FGD) in Rural Vizianagaram, Andhra Pradesh.**

The thematic analysis of the qualitative component of the study is currently underway. Preliminary insights from interviews have been included in this report to complement the quantitative data and provide a more nuanced understanding of the lived experiences and gender-specific impacts of heat exposure. A comprehensive analysis of the qualitative findings will be shared in a supplementary publication.

## 2.2. Secondary Data Analysis

To complement the primary fieldwork, a secondary data analysis was conducted to assess heat vulnerability and women's health outcomes across districts in India. This analysis enabled comparison between the study districts and broader national patterns, strengthening the relevance and applicability of the findings for policy and planning.

The analysis drew upon multiple nationally representative datasets, including the National Family Health Survey (NFHS-5), the Climate Vulnerability Index (CVI) developed by the Council on Energy, Environment and Water (CEEW) and the Department of Science and Technology (DST), and long-term meteorological data from the IMD.

Using these sources, a Heat Vulnerability Index (HVI) was constructed at the district level, incorporating three components:

- Exposure (based on frequency and intensity of heatwaves),
- Sensitivity (reflecting demographic, environmental, and health system-related vulnerabilities), and
- Adaptive Capacity (capturing access to education, institutional delivery, and household wealth).

Each component were normalised using the standard linear scaling method and the aggregate Vulnerability Index was calculated using the following formula:

$$HVI = \frac{Exposure * Sensiitivity}{Adaptive\ Capacity}$$

This index provided a composite snapshot of district-level heat vulnerability, allowing for an evidence-based identification of high-risk regions. The approach also enabled examination of how vulnerability varied in relation to women's health indicators such as nutritional status, access to healthcare, and reproductive health outcomes.

Key findings indicated wide variation in vulnerability across districts, with exposure and sensitivity scores being highest in districts with historically poor access to health services and high climatic risk. The HVI ranged from 0 to 1, with higher values indicating greater vulnerability. Districts with both low adaptive capacity and high heatwave exposure were flagged as critical priority areas for targeted intervention.

This analysis could inform policy by offering a scalable and replicable model for district-level climate-health risk profiling. Full details on computation steps are provided in *Annexure II.*

# 3. Key Findings and Insights

## 3.1. Findings from Secondary Data

This section presents findings from the secondary data analysis conducted to empirically assess the association between heat vulnerability and adverse health outcomes among women in India. The analysis focused on three categories of health outcomes that are

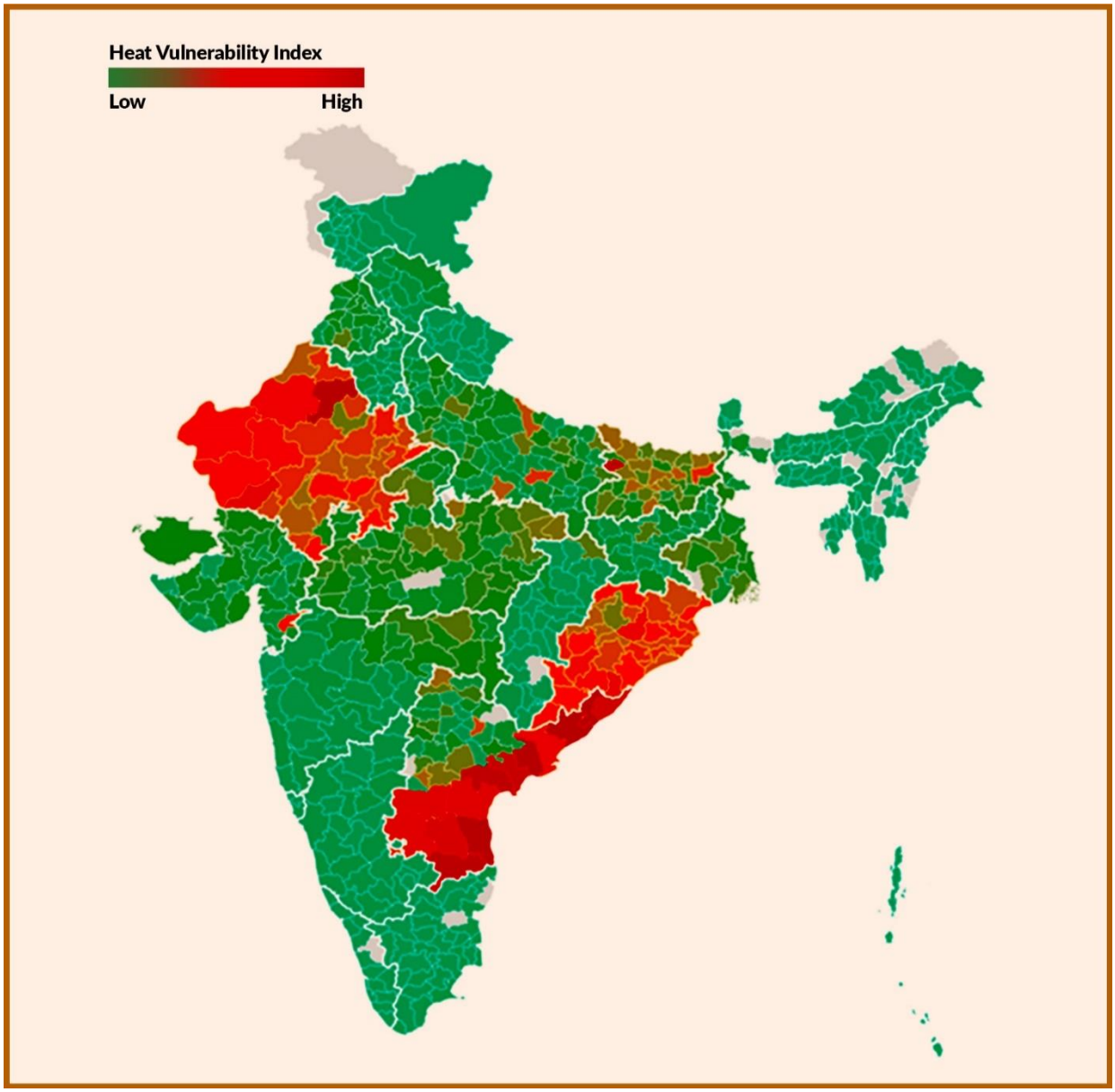



**Figure 2**: District-level Heat Vulnerability Profile of India

particularly sensitive to environmental stressors: (1) nutritional status, measured through prevalence of anaemia and underweight; (2) reproductive outcomes, specifically miscarriage and stillbirth; and (3) access to and utilisation of maternal healthcare services.

### 3.1.1. Key Findings

The descriptive analysis provided a district-level overview of the spatial distribution of heat vulnerability and its intersection with key women's health indicators across India. Based on the constructed Heat Vulnerability Index (HVI), districts were classified into five categories: *very low*, *low*, *moderate*, *high*, *and very high vulnerability*.

The spatial mapping of the HVI revealed that districts with very high vulnerability were concentrated in parts of Rajasthan, eastern Uttar Pradesh, Bihar, Jharkhand, Odisha, and Andhra Pradesh. In contrast, districts in the northeastern region and sub-Himalayan states such as Uttarakhand and Himachal Pradesh exhibited negligible vulnerability, largely due to the infrequent occurrence of heat wave events.

Regions such as Vidarbha and Madhya Pradesh demonstrated heightened heat-related vulnerability, consistent with reported heat wave patterns. Southern states like Kerala and Tamil Nadu showed relatively low vulnerability, likely due to both lower heat wave incidence and stronger adaptive capacities.

### 3.1.1.1. Nutritional Status and Underweight

The prevalence of anaemia among women aged 15–49 was significantly higher in districts with high and very high HVI scores *(Annexure III)*.

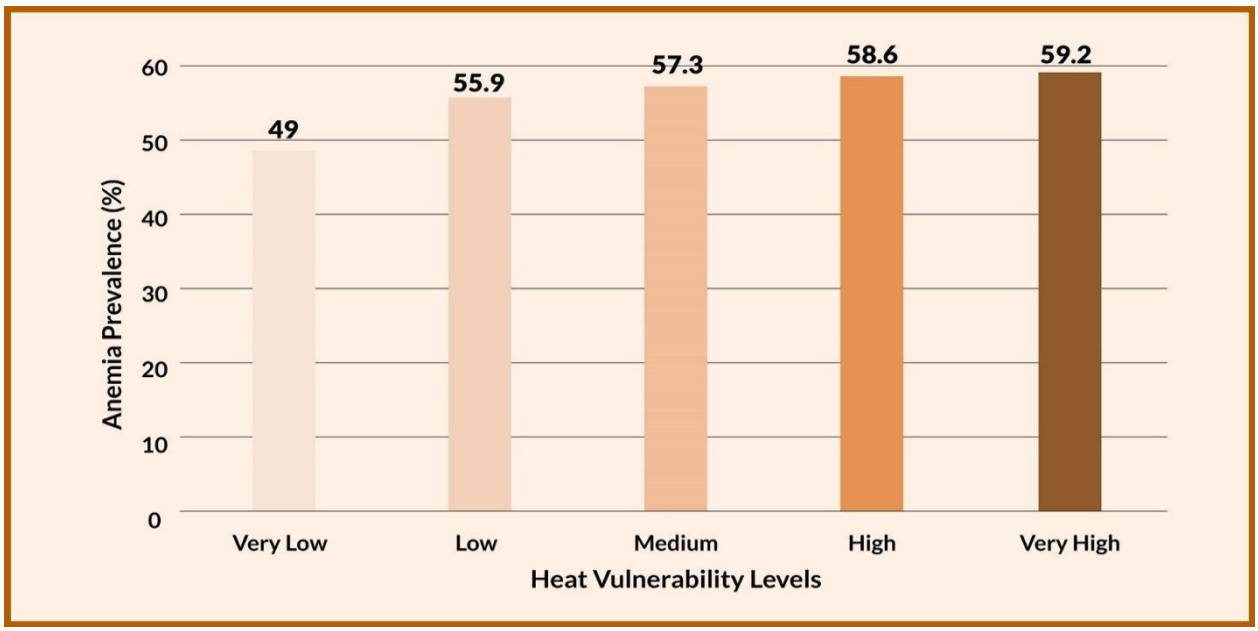



**Figure 4** : Predicted prevalence of maternal anaemia across Levels of Heat Vulnerability. *Note: Level of significance is <0.05.*

- While the national average for anaemia stood at approximately **57%,** this figure exceeded **60%** in very high vulnerability districts, with some districts reporting rates above **65%.**
- The predicted prevalence of maternal anaemia was **higher in very high HVI areas (59%) than in very low HVI areas (49%)** as seen in *Figure 4*. This 10-percentage point increase suggests a clear gradient, with maternal anaemia becoming more prevalent as heat vulnerability intensifies.
- This suggests that women in heat-vulnerable districts may face compounded nutritional disadvantages, possibly driven by reduced food security, poor dietary diversity, and higher physiological stress due to extreme heat.

Similarly, underweight prevalence (BMI < 18.5) showed a distinct upward gradient *(Annexure III)*.

- In low-HVI districts, underweight prevalence was approximately **14%,** rising to **over 20%** in districts with very high vulnerability.

- This upward trend points to the broader intersection of climate vulnerability and chronic undernutrition among women, indicating a need for integrated interventions that address both environmental and nutritional determinants of health.

Multivariate analysis further supported these findings. After controlling for education, wealth, caste, religion, and place of residence, women in very high HVI districts were 6.9 percentage points more likely to be anaemic than those in very low HVI districts ($p < 0.01$). This association remained statistically robust across alternative model specifications. Notably, the adjusted prevalence of anaemia slightly higher after accounting for confounding variables, suggesting a potential direct physiological link between ambient heat stress and anaemia in women.

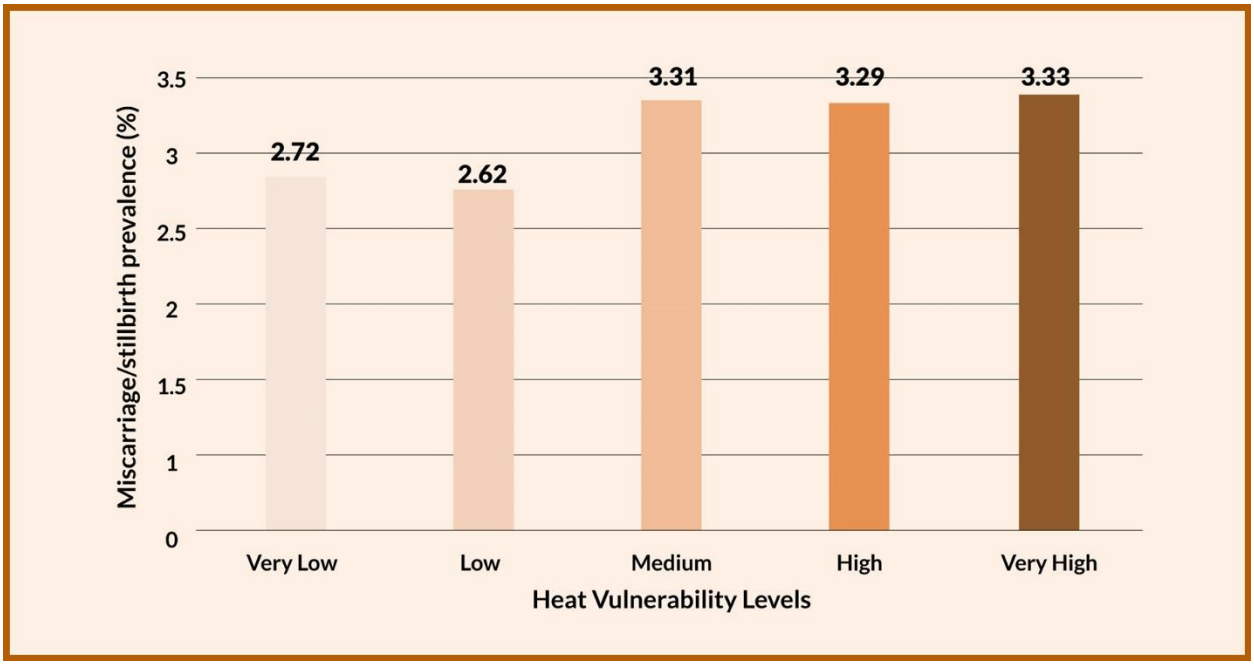



**Figure 5:** Predicted prevalence of underweight women (15-49 yrs) across Levels of Heat Vulnerability.
Note: Level of significance is <0.05.

Underweight status also showed a statistically significant association with heat vulnerability. Women in very high HVI districts had a 6.1 percentage point higher likelihood of being underweight than their counterparts in very low HVI districts. Even after adjusting for socio-economic factors, the prevalence of underweight remained consistently higher in high to very high HVI zones, suggesting that prolonged environmental stress may be contributing to nutritional depletion.

### 3.1.1.2. Access to Maternal Healthcare

**Antenatal Care (ANC)**

Access to maternal healthcare services was notably lower in areas with higher heat vulnerability *(Annexure II)*.

- The percentage of women receiving at least four antenatal care (ANC) visits was lower in very high HVI districts (**49%**) compared to low HVI districts (**80%**), reflecting a 39% relative decrease.

This significant disparity underscores how environmental stressors such as extreme heat may act as barriers to essential maternal healthcare access either by limiting mobility, straining health system capacity, or deprioritising care, thereby posing serious risks to maternal and fetal health.

### 3.1.1.3. Menstrual Health

- Use of sanitary napkins was lower in very high-HVI districts (**60%**) compared to low-HVI districts (**79%**), reflecting a 23.9% relative reduction. *(Annexure III)*.
- Overall menstrual hygiene coverage fell by nearly 10 percentage points, suggesting worsening menstrual health management with rising environmental vulnerability.

This emerging trend, with studies showing that climate-related water stress and sanitation inadequacies disproportionately affect women's ability to manage menstruation safely and with dignity (Muralidharan et al., 2025).

### 3.1.1.4. Reproductive Health

- Although the absolute difference in miscarriage and stillbirth rates across HVI categories appears small, with rates approximately **0.5 percentage points higher**, this translates to a nearly 50% relative difference from the baseline. (Annexure IV).

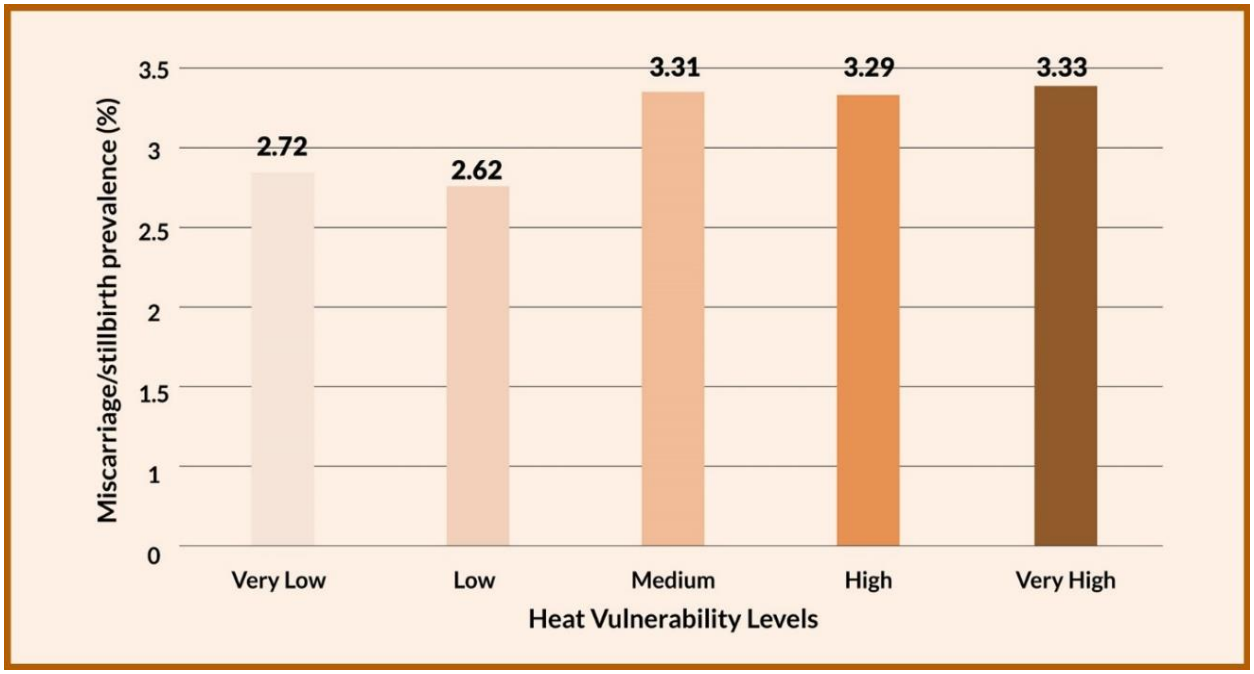



**Figure 5:** Predicted Prevalence of Pregnancy Loss across Levels of Heat Vulnerability.
Note: Level of significance is <0.05.

This pattern suggests a potential link between environmental heat stress and adverse pregnancy outcomes, highlighting the need for further investigation into climate-sensitive reproductive risks and the integration of heat risk management into maternal health programs.

Multivariate analysis reinforced these findings: women in very high HVI districts were 0.5 percentage points more likely to report miscarriage or stillbirth compared to those in very low HVI districts ($p < 0.05$). While modest in absolute terms, this relative increase was statistically significant and aligns with emerging biomedical research suggesting that high ambient temperatures may interfere with placental development, increase uterine contractions, and raise systemic inflammation—all of which can elevate miscarriage risk (Han et al., 2021).

Hysterectomy rates were also found to be significantly higher in districts with greater heat vulnerability.

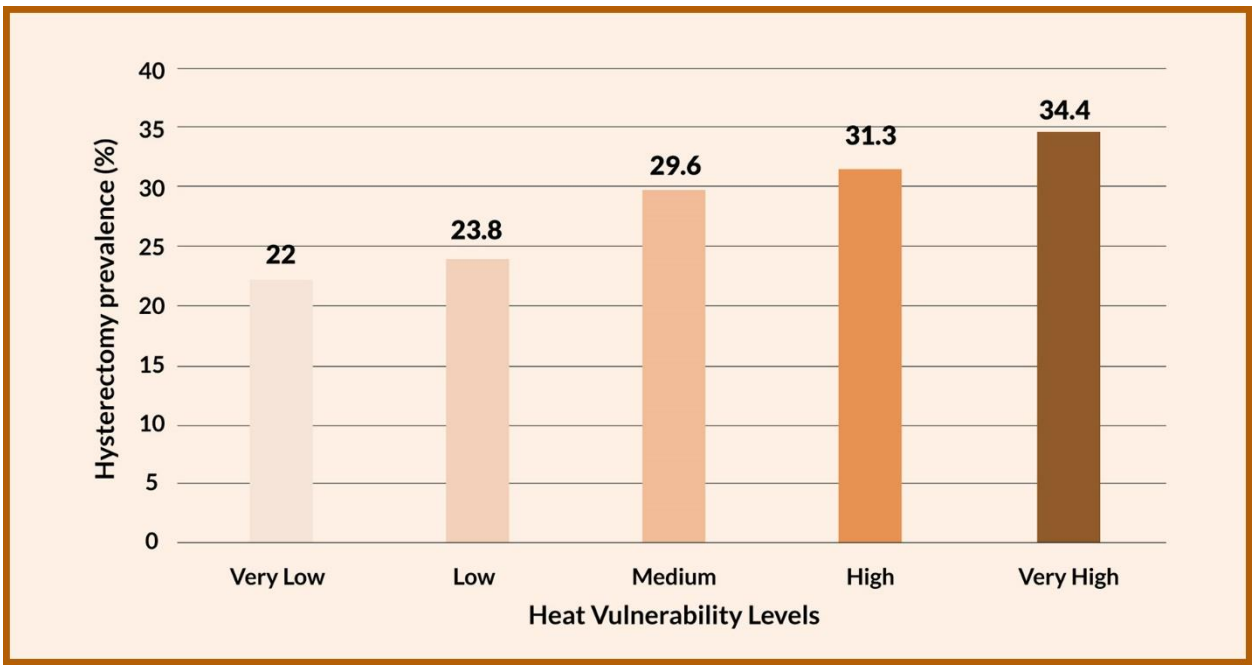



Figure 6: Predicted Prevalence of Hysterectomy across Levels of Heat Vulnerability.
Note: Level of significance is <0.05.

- In the most vulnerable districts, the prevalence of hysterectomy more than doubled among the poorest women—from **11.9%** in very low HVI districts to **25%** in very high HVI districts *(Annexure IV)*.

Multivariate results also showed a strong and monotonically increasing association between heat vulnerability and hysterectomy prevalence. Women living in high and very high HVI regions were significantly more likely to report undergoing a hysterectomy compared to those in low-vulnerability districts. This consistent trend across the vulnerability gradient suggests that ambient heat stress may play a contributing role—either directly or by intensifying pre-existing gynecological burdens in poorly resourced health systems.

While these findings align with recent evidence showing that economically vulnerable women may opt or be advised to undergo hysterectomy as a coping mechanism to manage reproductive stress or maintain labour productivity in heat-exposed occupations (Bharadwaj, Karthikeyan, Deulgaonkar & Patil, 2024), the steep rise observed in this study underscores the need for further research to unpack the underlying drivers of this trend.

### 3.1.1.5. Gender-based Violence and Empowerment

**Violence Against Women**

- Reports of physical or sexual violence in the past year were higher in very high HVI districts (25.5%) compared to very low HVI districts (18.3%), indicating a potential compounding effect of environmental and social stressors on women's safety and agency (Annexure III).

The finding reinforces that climate stress is also linked to heightened household tensions, economic strain, and reduced institutional oversight—all of which can elevate the risk of gender-based violence in vulnerable communities (Desai & Mandal, 2021; Anjum & Aziz, 2025).

This suggests that environmental vulnerability may exacerbate existing gender inequalities and social vulnerabilities, reinforcing the need for climate adaptation strategies to integrate gender-sensitive protection and support mechanisms.

**Exposure to Mass Media**

Mass media exposure, used as a proxy for awareness and empowerment, was lower in very high-HVI districts **(53%)** compared to very low-HVI districts (**78%**), highlighting significant information and access gaps that may hinder timely health-seeking behaviour. *(Annexure III).*

Lower exposure to mass media in high-HVI districts may limit women's access to critical health, safety, and climate-related information, weakening their ability to respond to heat risks and make informed decisions regarding their health and wellbeing.

### 3.1.1.6. Housing Conditions and Heating Exposure

**Infrastructure and Amenities**

- Access to basic amenities such as clean cooking fuel was lower in high-HVI districts **(48%)** compared to low-HVI districts (**76%**). (*Annexure III).*
- Similarly, the proportion of pucca housing was substantially lower in high and very high HVI districts (**49% and 53%**) compared to **70%–77%** in less vulnerable areas *(Annexure III).*

This suggests that districts facing higher heat vulnerability also contend with weaker physical infrastructure and limited access to essential resources, which likely reduce their adaptive capacity and increase the health burden of heat exposure, particularly for women engaged in household-level caregiving and cooking tasks.

**Outdoor Cooking and Indoor Crowding**

- The percentage of households where cooking occurred outdoors, i.e., directly increasing heat exposure for women, rose from **5%** in very low HVI areas to **12%** in very high HVI districts *(Annexure III).*
- Average room availability per household, which is a crude indicator of indoor crowding and thermal discomfort was lower in high-HVI districts (**1.87**) compared to low-HVI districts (**2.09**). *(Annexure III).*

These findings indicate that both direct (outdoor cooking) and indirect (indoor crowding) exposure pathways to heat are more pronounced in vulnerable districts, intensifying thermal stress for women and exacerbating existing gendered health risks.

#### 3.1.1.7. Social Differentials and Intersectionality

**Caste, Wealth, and Education**

Women from Scheduled Caste (SC) and Scheduled Tribe (ST) communities consistently reported poorer outcomes across all indicators.

- For example, anaemia among ST women rose from **52%** in very low HVI districts to **67%** in very high HVI districts *(Annexure IV).*

Women in the lowest wealth quintiles faced disproportionate disadvantages. Hysterectomy prevalence among the poorest women more than doubled in the highest vulnerability districts, reinforcing the intersection of environmental stress with existing socioeconomic and structural inequalities. This intersectional layering of vulnerability has been observed globally, where climatic stressors compound with caste, race, and class disadvantage to exacerbate health risks (Berberian, Gonzalez, & Cushing, 2022).

## 3.2. Findings from Primary Data

The relationship between extreme heat and mortality is not uniform across society. A growing body of evidence highlights the importance of context-specific risks, which are shaped by spatial, climatic, and population-level characteristics. Vulnerability to heat is strongly influenced by a range of demographic, social, and economic factors. As emphasized by the World Health Organization (WHO), advancing our understanding of these effect modifiers is critical to identifying the axes of inequality and protecting the most vulnerable population groups (Ellena et al., 2020). In this context, the quantitative and qualitative arms of this study examined intersecting vulnerabilities across domains such as housing, occupation, health, and access to basic services, in order to provide a comprehensive picture of heat-related impacts on women and other at-risk groups.

### Quantitative Analysis: District Profiling and Sociodemographic Diversity of the Sample

The study covered 15 districts across seven states: Andhra Pradesh, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu, and Uttar Pradesh, selected to reflect variations in heat vulnerability, socio-economic status, and rural-urban composition.

**Table 2:** Sociodemographic Characteristics of the Study Participants.

| Socio-demographic characteristics | Number (N) | Percentage (%) |
|---|---|---|
| **Age group** | | |
| 20-45 years | 2307 | 68.13 |
| 46-60 years | 772 | 22.80 |
| Above 60 years | 307 | 9.07 |
| **Education Level** | | |
| No formal education | 638 | 18.84 |
| Primary | 588 | 17.37 |
| Secondary | 959 | 28.32 |
| Higher education | 1201 | 35.47 |
| **Caste** | | |
| SC | 914 | 28.11 |
| ST | 91 | 2.80 |
| OBC | 1469 | 45.19 |
| Others/General | 777 | 23.90 |

| Socio-demographic characteristics | Number (N) | Percentage (%) |
|---|---|---|
| **Work Sector** | | |
| Home maker | 2339 | 69.30 |
| Formal | 321 | 9.51 |
| Informal | 715 | 21.19 |
| **Marital status** | | |
| Never married | 275 | 8.15 |
| Married | 2742 | 81.22 |
| Widow | 327 | 9.68 |
| Divorced/Separated | 32 | 0.95 |
| **Place of residence** | | |
| Urban | 1221 | 36.06 |
| Rural | 2165 | 63.94 |
| **Workplace** | | |
| Indoor | 363 | 32.15 |

| Wealth Index | | |
|---|---|---|
| Poor | 1160 | 34.26 |
| Middle | 1101 | 32.52 |
| Rich | 1125 | 33.23 |
| **Religion** | | |
| Hindu | 2577 | 78.33 |
| Muslim | 224 | 6.81 |
| Others | 489 | 14.86 |

| | | |
|---|---|---|
| Outdoor | 485 | 42.96 |
| Both | 281 | 24.89 |
| **Household size** | | |
| Up to 4 members | 1793 | 52.95 |
| 5-7 members | 1414 | 41.76 |
| 8 or more members | 179 | 5.29 |
| **House Quality Index** | | |
| Poor | 1235 | 36.47 |
| Better | 1105 | 32.63 |
| Good | 1046 | 30.89 |

### Age and Education

Most respondents were women aged 20–45 years, with districts in Uttar Pradesh and Andhra Pradesh showing particularly high proportions of younger women. Educational attainment varied significantly: while districts like Kottayam and Chennai had high shares of women with higher education, districts such as Sawai Madhopur and Saharanpur had over one-third of respondents with no formal education, indicating structural disadvantages.

### Caste and Wealth Distribution

Caste and wealth patterns revealed sharp disparities. SC women formed a large part of the sample in Saharanpur (66.1%) and Bhanda (62.8%), while ST representation was more prominent in parts of Karnataka and Kerala. Districts such as Churu and Idukki had the highest concentrations of poorest households, whereas Nagpur and Kottayam had relatively wealthier samples.

### Rural-Urban Split, Occupation & Housing

Most respondents were rural and engaged in unpaid care or informal labour, particularly in Rajasthan and Uttar Pradesh. Housing quality also varied widely, with over 90% of women in Ariyalur and Bhanda living in poor-quality housing, compared to better infrastructure in Nagpur and Kottayam.

This demographic and infrastructural diversity across districts provided critical context for understanding the differentiated health impacts of heat exposure reported in the primary findings. These details are presented in *Annexure V.*

## Heat and Women's Health: Social, Economic and Heath System Perspectives

This section presents the key findings from the study. While grounded in the study's primary data collection and secondary analysis, the findings also draw on existing literature, insights from two national consultations held in Chennai and Ahmedabad. By integrating quantitative data, qualitative narratives, insights from the two national consultations, and secondary indicators, we hope to provide a holistic understanding of how women in diverse socio-economic, occupational, and geographic contexts are affected by heat stress.

Each subsection below synthesizes insights across data sources, drawing attention to systemic gaps, patterns of vulnerability, and opportunities for targeted policy action. Where relevant, comparisons between high and low heatwave–affected districts are highlighted to underscore differential exposure and adaptive capacities.

**Table 3:** Self-Reported Impacts of Heat on Women's Health, Daily Life and Social Wellbeing.

| Impacts | Number (N) | Percentage (%) |
|---|---|---|
| **General Physical Health** | 2355 | 70 |
| **Reproductive health issues** | 1698 | 51 |
| **Menstrual Health Issues** | 1004 | 35 |
| **Mental health issue** | 2194 | 66 |
| **Interpersonal issues at work** | 437 | 39 |
| **Interpersonal issues at home** | 1681 | 50 |
| **Heat affecting daily routine** | 2924 | 88 |
| **Ever experienced violence** | 615 | 18 |
| **Increase in violence during summer** | 164 | 56 |
| **Perceived Social Wellbeing[2] (Perception of life during Summer)** | 2704 | 80 |

[2] For Perceived Social Wellbeing, the values refer to women reporting life during summer as more difficult or less difficult.

### 3.2.1. Social Inequities in Heat Vulnerability

Income is a critical determinant of health, and income-related disparities are particularly pronounced under conditions of extreme weather and climate change (Min, Lee, Choi, & Min, 2021). Heat waves pose serious health risks, especially for vulnerable groups such as economically disadvantaged populations, the elderly, and individuals with chronic illnesses. Low-income households are disproportionately sensitive to heat and have a lower adaptive capacity than their higher-income counterparts (Osberghaus & Abeling, 2022).

This heightened vulnerability stems from both direct factors such as limited access to health-promoting material resources and indirect factors shaped by broader social, political, and economic contexts. For instance, poorer individuals are more likely to reside in high-risk environments, such as flood-prone or poorly ventilated housing, face greater mortality during heat waves, and have limited capacity to recover from climate-induced loss and damage. In contrast, wealthier individuals typically live in more resilient settings and are better positioned to manage and adapt to climate stressors (Min, Lee, Choi, & Min, 2021).

**Low-Income Housing with Improvised Roofing in an Urban Settlement in Tamil Nadu.**

#### 3.2.1.1. Study Findings

##### Caste

Our analysis revealed a strong caste-based gradient *(Annexure VI)* in women's health outcomes under heat stress, reflecting underlying social inequalities that shape vulnerability.

- Women belonging to SC communities reported the highest prevalence of heat-related health impacts across all domains, including general physical health **(73%),** reproductive health **(58%)**, menstrual health **(44%)**, and mental health **(76%)**.
- These figures exceed those reported by women from the Other Backward Class (OBC) and General category across every outcome.
- Women belonging to ST communities, while reporting lower prevalence in some areas, particularly general physical health **(45%)** and reproductive health **(28%)**, still face significant health impacts in terms of mental health **(60%**), highlighting a different pattern of marginalisation likely tied to geographic and service access factors rather than symptom perception alone.

While ST women report lower prevalence across most health outcomes, this may reflect differences in health-seeking behavior, symptom recognition, or reporting practices shaped by historical marginalization and structural exclusion, rather than indicating lower vulnerability to heat.

##### Wealth

- Across all four domains: general physical health, reproductive health, menstrual health, and mental health, women from the poorest wealth quintile reported the highest prevalence of heat-related health impacts *(Annexure VI).*
- For instance, **75%** of poor women reported general physical health issues compared to **67%** among the richest.
- Similarly, reproductive health impacts were reported by **65%** of women in the poor category, nearly double the rate among the rich (**38%)**.

These disparities underline how economic status directly shapes a woman's exposure, resilience, and capacity to cope with heat stress. The findings clearly illustrate that poverty

amplifies climate-related health risks, making economic vulnerability a central axis in understanding and addressing gendered heat impacts.

### 3.2.2. Heat and Housing Conditions

Research consistently highlights the critical role of housing in shaping vulnerability to extreme heat. During high-temperature events, individuals tend to remain indoors for extended periods, making indoor thermal conditions a key determinant of heat-related health risks. Prolonged exposure to elevated indoor temperatures has been linked to a range of adverse health outcomes, including heat exhaustion, heatstroke, and hyperthermia, and can exacerbate chronic cardiovascular and respiratory conditions (Hu et al., 2022). Evidence synthesised in Samuelson et al. (2020) estimates that between 50% and 85% of heat-related mortality during extreme events is attributable to indoor heat exposure. Specific housing characteristics such as the presence and type of air conditioning, building age, number of storeys, roof albedo, and insulation quality significantly influence the relationship between outdoor temperature and indoor thermal stress, and can either mitigate or amplify health risks during heat events.

**Temporary Blue Tarpaulin Roofing Used for Heat Protection in a Rural Household in Udupi, Karnataka**

Despite this, housing is often approached primarily as a means to address immediate shelter needs, with limited attention to thermal comfort or climate responsiveness. In India,

research suggests that government-led social housing projects are frequently designed and constructed without sufficient consideration for indoor thermal performance. The planning and delivery of low-income housing schemes have historically been shaped by political and bureaucratic priorities, with cost and quantity often taking precedence over long-term occupant wellbeing. However, emerging research underscores the need for climate-responsive design, particularly in low-income settings, to reduce population-level vulnerability to rising temperatures (Berger et al., 2022).

#### 3.2.2.1. Study Findings

To understand how environmental and infrastructural factors influence women's health and well-being during periods of extreme heat, the survey asked participants a series of questions on household access to cooling appliances (e.g., fans, ACs, refrigerators), water availability and collection burdens, cooking conditions, power reliability, and access to basic services like piped water and clean fuels. It also explored awareness levels regarding heat stress symptoms and preventive measures, information sources on heat-health, and whether women had access to any institutional or informal support systems. Insights from these questions reveal the multifaceted nature of vulnerability while the absence of cooling infrastructure and frequent power outages heightened physical discomfort and heat-sensitive illnesses, prolonged water collection routines significantly impacted both physical and mental health.

Limited awareness, inadequate communication from public systems, and the absence of social protection further compounded women's exposure to heat-related risks. Qualitative interviews added nuance, highlighting how infrastructure gaps intersect with gendered routines, privacy, and emotional stress, underscoring the urgent need for holistic and gender-responsive adaptation strategies.

**Cooling Infrastructure and Health Impacts**

- Women with access to household cooling appliances such as air conditioners, coolers, and refrigerators reported slightly lower rates of general physical health issues **(70%)** compared to those without such appliances **(74%).**
- Notably, the presence of a refrigerator was associated with a **22-percentage point decrease** in vulnerability to gastrointestinal and heat-sensitive conditions like diarrhoea, flu-like symptoms, vomiting, and nausea.

**Elderly Women Resting Outdoors Under Tree Shade to Cope with Midday Heat, urban Ahmedabad.**

Only **30%** of women in households with a refrigerator reported these symptoms, compared to **52%** in those without, highlighting the protective role of basic cooling infrastructure in reducing heat-related health risks.

Many women reported that being indoors during extreme summer heat offered little respite, particularly in households with poor ventilation or inadequate cooling.

> "Staying at home also is problematic in summer due to heat. The heat is unbearable and there is no air." — 55-year-old Female, Rural Andhra Pradesh

In shared living spaces, the need to cluster around limited cooling appliances like a single cooler also had social implications, including compromised privacy and strained family dynamics:

> "Everyone sleeps in one room due to a single cooler. No privacy for the husband and wife. With kids and in-laws in the same room, we rarely get alone time." — *35-year-old Female, Rural Rajasthan*

### Water Collection Burden and Health

A significant association was observed between time spent on water collection and the prevalence of dehydration-related and mental health symptoms among women.

- Around **62%** of women who spent approximately two hours collecting water reported signs of dehydration.
- Furthermore, **77%** of women with extended water collection responsibilities reported mental health concerns such as sadness, irritability, anxiety, and loneliness.

These symptoms appear to stem from the chronic physical strain, psychological stress, and social isolation linked to the daily burden of water collection. In response, some women may consciously reduce their water intake to avoid the repeated effort and emotional toll of water collection; an adaptive but potentially harmful behaviour, especially in high-heat contexts with inadequate infrastructure.

**An Elderly Woman waiting to collect water,Shares Her Experience During Survey Interaction in Nanded, Maharashtra.**

### Access to Basic Amenities and Health

- Approximately **67%** of surveyed households with electricity reported experiencing power outages on a daily basis, with **41%** indicating that these outages typically lasted between one to three hours per day.
- While **66%** of households reported exclusive use of clean cooking fuels, **13%** relied on unclean fuels, and **21%** reported using a mix of both.

- Access to piped water supply remains limited, with only **58%** of households connected to a piped network; the remainder depend on alternative sources such as tube wells, protected or unprotected wells, tanker deliveries, or municipal water supply systems.

- Regarding water-related concerns, **40%** of women reported lower water availability. Additionally, various forms of water quality deterioration were reported, including **21%** reporting a change in taste, **17%** a change in odour, **14%** a change in colour, and 9% an increase in water contamination, indicating significant implications for health, hygiene, and household burden.

**An outdoor view of a rural dwelling with visible signs of heat exposure and temporary roofing adjustments in Udupi, Karnataka.**

Women from rural Rajasthan described these challenges vividly:

> "Cattle also suffer. They need water and shade. We buy water tankers. A tanker costs ₹700 and lasts 2–3 days. Bathing water comes from wells." — 30-year-old Female, Rural Rajasthan.

> "Well water smells and has insects and other visible impurities. Quality deteriorates in summer. We fetch water early, strain it, and use it. RO filters are rare in villages." — *55-year-old Female, Rural Rajasthan*

- Among women within households where the cooking place was outside the house, **88%** reported mental health issues, whereas **65%** women cooking inside the house reported mental health issues.

While outdoor cooking increases direct heat exposure, indoor cooking in poorly ventilated spaces may also contribute to elevated ambient temperatures, potentially aggravating thermal discomfort and mental health stress.

### 3.2.3. Heat Impact on Occupation, Livelihood & Economic Impact

In India, both outdoor work and indoor occupations without adequate cooling or ventilation contribute significantly to human heat strain. Exposure to excessive workplace heat can lead to a wide range of health impacts, from mild conditions such as heat rash to life-threatening outcomes like heat stroke. Documented physiological effects include excessive sweating, dehydration, elevated core body temperature, and heat exhaustion. These symptoms can impair perceptual and motor performance, reduce physical work capacity, and increase the risk of occupational accidents. Prolonged exposure without adequate mitigation measures poses serious risks to worker safety and productivity (Srinivasan, Maruthy, Venugopal, & Ramaswamy, 2016).

Heat waves reduce labour productivity by impairing the ability of workers in physically demanding occupations to operate efficiently, primarily due to excessive sweating, exhaustion, and dehydration. Estimates suggest that India lost up to 3.6% of daylight working hours in 2015 due to high temperatures (ILO, 2019). Further, a global study by Kjellstrom et al. (2022) assessed labour productivity losses due to heat exposure across 40 countries, using wet bulb globe temperature (WBGT) thresholds and economic output data. The study found that labour losses were most pronounced in India, which accounted for nearly half of the global total. India experienced over four times the productivity losses of the second most affected country, China, highlighting its heightened vulnerability to rising temperatures and humid heat stress.

Projections by the International Labour Organization (ILO, 2019) suggest that by 2030, India could lose around 5.8% of its total labour hours to heat stress. This poses a significant risk to the Indian economy, where roughly 90% of the labour force is employed in the

informal sector, with a large proportion engaged in outdoor or physically intensive work. The sectors expected to bear the greatest burden of lost work hours are agriculture and construction, making them particularly vulnerable to the escalating impacts of extreme heat (SPRF, 2022).

#### 3.2.3.1 Study Findings

To understand how women coped with extreme heat in their workplaces and homes, the survey included questions on coping strategies such as taking rest, drinking cold water, changing into comfortable clothing, using cooling methods like fans or AC, and shifting work to cooler parts of the day. Participants were also asked about the temperature conditions of their workplace during summer (April–June), availability of basic amenities like drinking water, rest provision, clean toilets, and whether uniforms, especially non-breathable ones, were mandatory. In addition, the survey explored how heat affected their ability to carry out household chores and whether wage loss was a concern if they were unable to work. Findings from focus group discussions further revealed the financial burden of coping with heat, including additional expenses on water, electricity, and transport, as well as how extreme temperatures often made it difficult for women to step out for work, especially those without access to shade or reliable transport.

**Gendered Labour Burden and Informal Work**

- Among the women surveyed, **66%** identified as homemakers, and **55%** reported that extreme heat adversely affected their ability to carry out routine household responsibilities, including caregiving for children and the elderly.
- Approximately **27%** indicated that they changed their mode of transport during the summer months to cope with rising temperatures.
- Additionally, **39%** experienced interpersonal conflicts which they perceived was due to heat stress.
- Within the household, **50%** reported strained family interactions, and **20%** specifically noted challenges in managing children.
- **59.4%** of respondents with high Heat Vulnerability reported that heat had an impact on their interpersonal relationships at workplace, whereas only **16.1%** women in low levels of Heat Vulnerability reported the same.

- Similarly, **42.4%** and **69.3%** of respondents with low heat vulnerability and high heat vulnerability respectively reported that heat had an impact on their interpersonal family relationships. *(Annexure VII)*

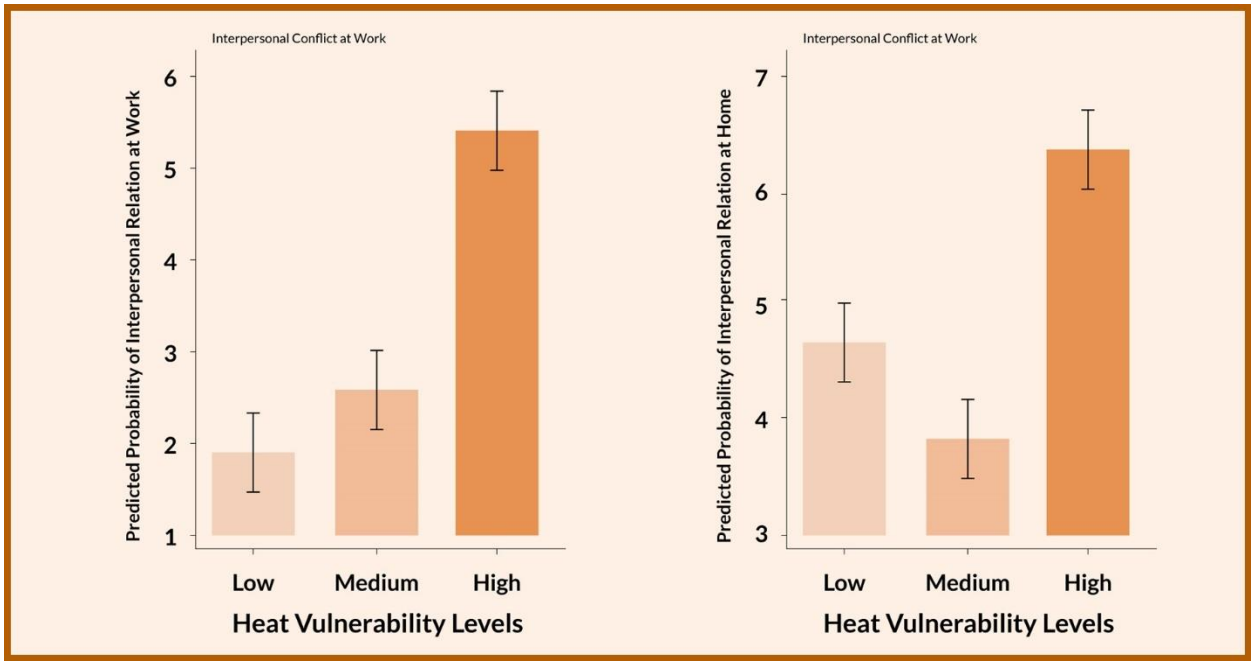



**Figure 7**: Predicted Probabilities for Interpersonal Relationship-Related Adverse Heat Impact Outcomes.[3]

- The **predicted probability of interpersonal conflict at work** was higher with heat vulnerability, nearly tripling from low to high vulnerability districts. This suggests that as heat-related stress increases, so does workplace tension, with potential implications for productivity, team cohesion, and job retention.
- At the household level, the **predicted probability of experiencing interpersonal conflict at home** demonstrates a clear upward trend with increasing heat vulnerability. Specifically, this predicted probability is highest among women in districts categorized with 'High' heat vulnerability, where estimates exceed 60% (approximately **65%**). This finding suggests a positive association between higher

[3] The above figures are based on the results obtained from Logit Regression Model, after controlling for age, educational level, caste, wealth index, religion, occupation, marital status, household size, house quality index and place of residence. Note: Level of significance is <0.05.

levels of environmental stress, as captured by the Heat Vulnerability Index, and a higher likelihood of household conflict.

- Interestingly, women in **medium heat vulnerability** districts had a slightly lower probability of reporting conflict at home than those in low vulnerability districts after controlling for the background variables. Further research, particularly qualitative explorations, may be required to understand this trend.

**Field Interaction with a Vegetable Vendor in a Tin-walled Shop at, Anantapur, Andhra Pradesh**

### Economic Impact and Wage Loss

- Nearly all respondents (**97%**) reported **wage losses exceeding ₹1,500** over the time period of April-June (peak summer months).
- In addition, **40%** said they had no family member who could compensate for the lost income when they were unable to work or fell ill.
- Among respondents from the low wealth index, **38%** reported spending an **extra ₹5000 - ₹10,000 per month** on electricity, water, food and medical care.

Women engaged in informal labour, such as waste picking or street vending, reported significant reductions in their working hours during extreme summer conditions, which directly impacted household income.

As one 20-year-old participant from rural Chennai shared:

> "We usually pick up plastic water bottles from morning to evening. People who are selling snacks have to go out and they wander around all places selling from morning to evening. (In the summer) we can't do that. So, we go early in the morning and come back around 10 am. Our income gets small. Eating a single meal and starving for the rest of the day will be the only option left." — *20-year-old Female, Rural Chennai*

In addition to lost earnings, women highlighted additional expenditures during the summer months. These included higher electricity bills due to cooling needs and increased water consumption. A participant from urban Chennai noted:

> "Current bill would be extra in summers when compared to other days. You would be charged double the amount. Water bill would increase too. (Usually) if we buy one tank (of water) for ₹1000, we can use it for 15 days. If we maintain it, it can last for even 20 days...Now in summer, it won't even last for 10 days. — *36-year-old Female, Urban Chennai (Pilot FGD)*

### Occupational Heat Exposure and Workplace Conditions

- Heat-related occupational risks were evident, with **43%** of respondents reporting unbearably high temperatures at their workplaces.
- Access to basic workplace amenities remained limited; only **14%** had access to toilet facilities, **24%** to clean drinking water, **3%** to designated rest areas, and another **3%** to on-site medical support.

**Indoor vs Outdoor**: Approximately **79%** of the working population reported experiencing general physical health issues due to heat, regardless of whether they worked indoors or outdoors. Among indoor workers, those with access to cooling amenities such as clean drinking water, rest breaks, WASH facilities, and medical support reported fewer heat-related health symptoms **(79%)** compared to those without such amenities (**86%).**

Street vendors at Anantapur, Andhra Pradesh.

**Informal workers vs formal workers**: Heat-related illnesses were significantly more prevalent among informal workers (**83%),** including agricultural labourers, street vendors, tailors, sanitation and construction workers, factory workers, and domestic help, compared to formal workers (**67%).** Overall, working women reported heat-related health symptoms at rates 13 percentage points higher than their non-working counterparts.

In some cases, women reported being compelled to work through extreme conditions, even when unwell, due to the financial precarity of daily-wage labour.

> We get money only if we work. So, there won't be any days off. The wages are cut if we are absent. So even if we have health issues, we have to go for work... It's so hot, we feel scared to step out. But we have no choice, no work means no money. So we work even in the sun. If it gets too much, we ask the boss and come back." *— 47-year-old Female, Rural Andhra Pradesh*

**Uniform Material:** Women with the cotton as their uniform material reported having skin issues the least (**19%)**, whereas **32%** of the women reported skin issues when the uniform was a mix of materials.

### Mobility and Commute-Related Heat Risks

- Women commuting shorter distances (3–6 km) reported a higher incidence of **81%** of heat-related symptoms than those travelling longer distances of over 6 km (**66%**).

This disparity is likely attributable to transport modes: short-distance commuters predominantly rely on walking, cycling, or motorbikes, which entail direct sun exposure, whereas long-distance commuters are more likely to use shaded or enclosed modes such as buses, auto-rickshaws, or cars, offering greater protection from heat stress. These findings underscore the need for gender and commute-sensitive heat mitigation strategies, including shaded pathways and improved public transport access.

## 3.2.4. Physical Health Impacts of Heat

High temperatures, both in the form of long-term summer averages and acute heat events such as heatwaves, have been consistently associated with excess mortality. In high-income countries, heat ranks among the leading causes of weather-related deaths. Beyond mortality, high temperatures are linked to increased rates of emergency room visits, hospital admissions, and deaths due to cardiorespiratory and other pre-existing conditions. Evidence also points to heightened risks of mental health issues, adverse pregnancy and birth outcomes, and rising healthcare costs during periods of extreme heat. Importantly, much of this heat-related morbidity and mortality is considered preventable through improved preparedness, public health interventions, and measures that reduce exposure. Across contexts, certain population groups, including older adults (aged 65+), individuals with chronic cardiopulmonary conditions, and young children are consistently identified as particularly vulnerable to the health impacts of extreme heat, regardless of income level or geographic location (Ebi et al., 2021 & Liu et al., 202).

Exposure to heat stress during pregnancy has been linked to a range of adverse maternal and neonatal outcomes. Elevated ambient temperatures have been associated with increased risks of preterm birth, stillbirth, reduced gestational length, and lower birthweight and length. A recent systematic review and meta-analysis synthesising evidence from 70 global studies reinforces these associations, underscoring the sensitivity of pregnancy to climate-related heat exposure. However, only about one-quarter of the included studies were conducted in low- and middle-income countries (LMICs), where vulnerabilities may be compounded by limited access to healthcare and environmental

protections. This highlights the need for more context-specific data from LMICs to accurately assess the global burden of heat-related pregnancy risks and to inform responsive maternal health and climate adaptation policies (Shankar et al., 2024).

**Inside a Rural Health Sub Centre, Vizianagaram, Andhra Pradesh.**

#### 3.2.4.1. Study Findings

The study captured physical health outcomes across three domains: general physical health, maternal health, and reproductive and menstrual health.

##### General Physical Health

As part of the survey, participants were asked to report if they had any pre-existing health conditions such as diabetes, hypertension, respiratory illness, or thyroid-related disorders. They were also asked whether they experienced any heat-related physical symptoms during the summer months (April–June), including heat cramps (muscle spasms), heat rash (itchy rashes/skin issues), heat exhaustion (dehydration, dizziness, heavy sweating, headache, nausea and vomiting), flu-like symptoms, diarrhea and respiratory issues. These questions aimed to capture how rising temperatures may aggravate physical health, especially among those with existing vulnerabilities. Interview accounts helped contextualize these findings by capturing lived experiences of heat-related symptoms such as exhaustion and loss of appetite.

- Heat-related symptoms was widely reported: among the respondents, **70%** experienced one or more symptoms which they perceived was due to high temperatures.
- The most common complaints included dehydration-related symptoms (**47%)**, flu-like symptoms (**19%)**, and dermatological issues (**4%)**.
- Of those affected, **63%** sought medical attention.
- **Among women aged 20–45 years**, who represent the core of the working-age population, reported heat related symptoms were highest in high HVI districts **(49%),** compared to medium **(28%)** and low HVI districts **(24%**). This suggests that heat vulnerability disproportionately affects women in their most economically and reproductively active years.
- **Older women (60+ years)** reported the **highest rates of heat-related physical health symptoms** in low HVI districts (**40%**), suggesting that age-related frailty may raise heat sensitivity even in less exposed regions.
- **Women with no formal education** and **those with only primary schooling** reported the highest heat-related symptoms in high HVI areas (**57% and 51%**), while rates lowered with higher education (**47%** for secondary, **26%** for higher education), indicating that educational attainment may offer some protective effect against heat-related health impacts.

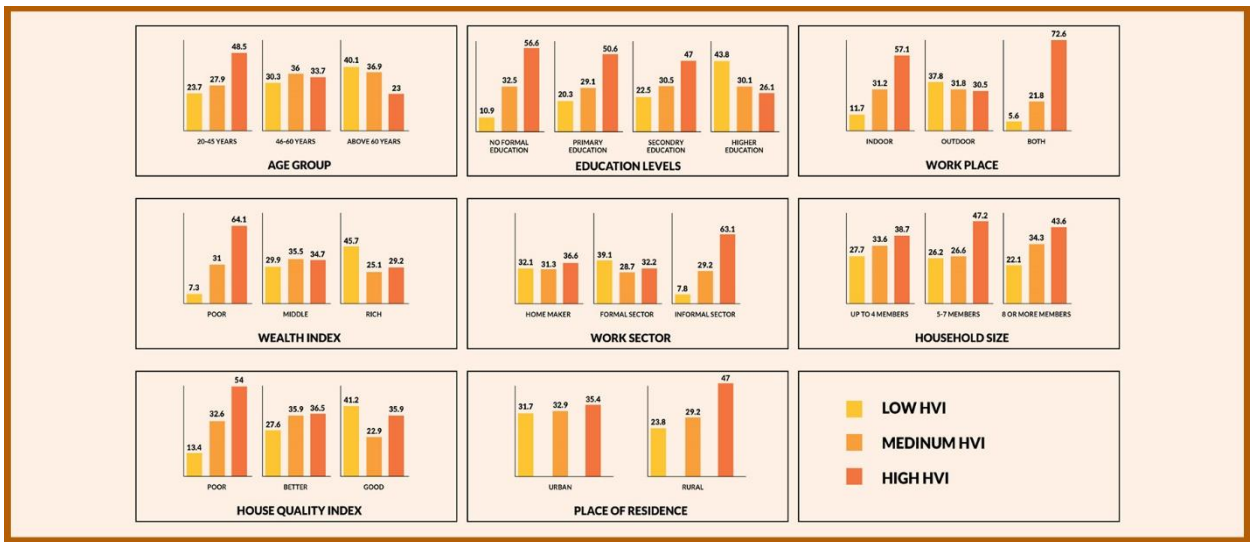



**Figure 8**: General Physical Health Impacts by HVI and Socioeconomic Indicators[4]

[4] All values shown are in percentage. Note: Level of significance is <0.05.

- In high HVI districts, **63%** of **informal sector women** reported heat-related symptoms compared to **32%** in the formal sector, highlighting how insecure and unregulated work conditions intensify exposure and risk.
- Only **8%** of informal sector women in low HVI areas reported symptoms, indicating that vulnerability is significantly amplified by environmental context.
- Women **working both indoors and outdoors** had the highest reported symptoms—**73%** in high HVI districts vs. **6%** in low HVI—showing how compounded exposure drives acute health impacts.
- In high HVI areas, **women in rural areas** reported higher symptom rates than urban counterparts (**47% vs. 35%**), suggesting rural infrastructure and service gaps heighten vulnerability.
- **Across wealth tiers**, among high-HVI respondents, **62%** of poor households reported symptoms compared to **29%** of rich households, reinforcing the role of economic disadvantage in shaping adaptive capacity.
- In high HVI districts, reported symptom rates lowered from **54%** in **poor-quality housing** to **36%** in good housing, suggesting that while better housing offers protection, it does not fully eliminate risk.
- **Larger households (8+ members)** in high HVI districts reported **44%** symptom prevalence, and even 5–7-member households showed **47%**, indicating that factors such as caregiving responsibilities and household crowding may contribute to heightened heat stress.

- The analysis of social differentials revealed persistent disparities across household size, house quality, place of residence, occupation, caste and age groups. **23.7%** women of the age group 20-45 years with **low Heat Vulnerability** reported Impact on General Physical Health issues during summer months, which rose to **27.9%** for medium and **48.5%** for high heat vulnerability. *(Annexure VIII)*

Regression-based estimates visually depicted in the *Figure 9* reinforce these patterns: women residing in high heat vulnerability districts demonstrated a predicted probability of approximately **89%** of reporting physical health impacts, whereas this probability was around **55%** for those in low vulnerability districts. This sharp gradient underlines the disproportionate burden on those already structurally disadvantaged, and reinforces the urgency of targeted adaptation measures.

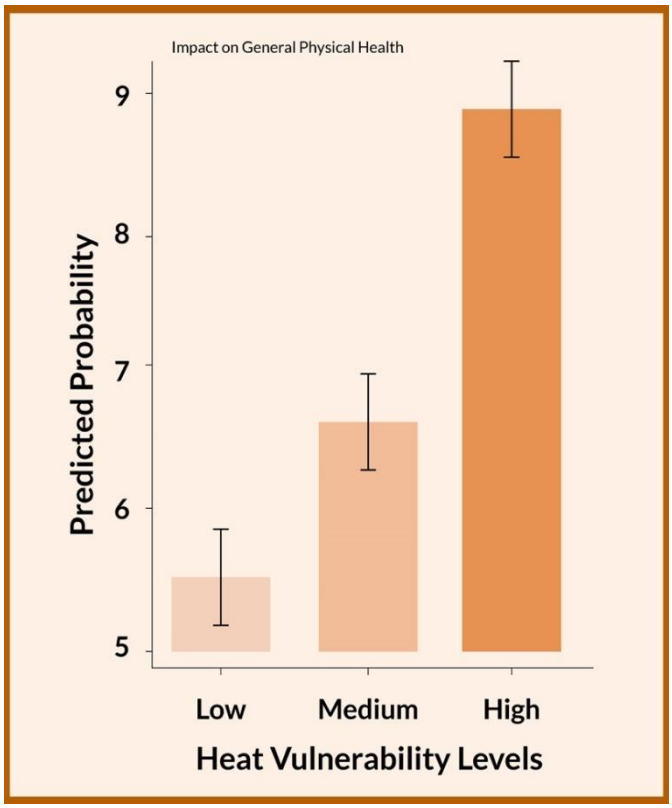



**Figure 9:** Predicted Probabilities for Health-Related Adverse Heat Impact Outcomes.[5]

Many women reported excessive sweating and physical exhaustion that limited their ability to work, particularly among those engaged in outdoor or manual labour:

> "Sweat is pouring and then we get very tired... We get tired and then just sit, unable to work further." — *28-year-old Female, Rural Chennai*

Routine domestic activities also became increasingly burdensome during peak summer heat, with some women describing even basic tasks like cooking as physically and mentally overwhelming:

> "Cooking a meal and eating it in home feels like a great task everyday." — *50-year-old Female, Rural Chennai*

[5] The above figures are based on the results obtained from Logit Regression Model, after controlling for age, educational level, caste, wealth index, religion, occupation, marital status, household size, house quality index and place of residence. Note: Level of significance is <0.05.

Heat appeared to reduce appetite for many, shifting dietary patterns toward more liquid intake, though not always in a nutritionally adequate form:

> "But due to the heat, there's no mood to eat anything." — *45-year-old Female, Urban Andhra Pradesh*

- The reporting of general physical health issues was **14 percentage points lower** among women who sleep 6–8 hours, suggesting a positive association between adequate sleep and physical health.

### Maternal Health

To assess the effects of extreme heat on maternal health, the survey captured responses from women who were pregnant, lactating, or had delivered during the summer months (April–June). It explored challenges faced during pregnancy, such as disturbed sleep, reduced food intake, or difficulty maintaining daily routines. The survey also examined whether heat impacted their ability to attend prenatal check-ups, if healthcare providers gave specific heat-related advice (e.g., hydration, avoiding outdoor activities), and whether heat influenced the timing, mode, or place of delivery. Access to nearby healthcare facilities and the distance to the nearest center were also recorded to understand systemic barriers in heat-sensitive periods.

- Among the women surveyed, 180 were pregnant between April and June of the previous year—a period of peak summer heat.
- Of these, **56%** reported that extreme heat adversely affected their antenatal care (ANC).
- Notably, **15%** of respondents reported experiencing preterm deliveries, **12%** delayed labour, and **20%** Caesarean sections—many of which they attributed to heat exposure. While these self-reported outcomes are not clinically verified or medically linked to heat, they reflect women's own perceptions of how extreme temperatures may have affected their pregnancies and deliveries.

### Reproductive and Menstrual Health

For this domain, survey participants were asked whether they experienced any changes in their menstrual cycle during the summer months (April–June), including irregular periods, heavier or lighter bleeding, and increased pain or discomfort such as cramps and bloating.

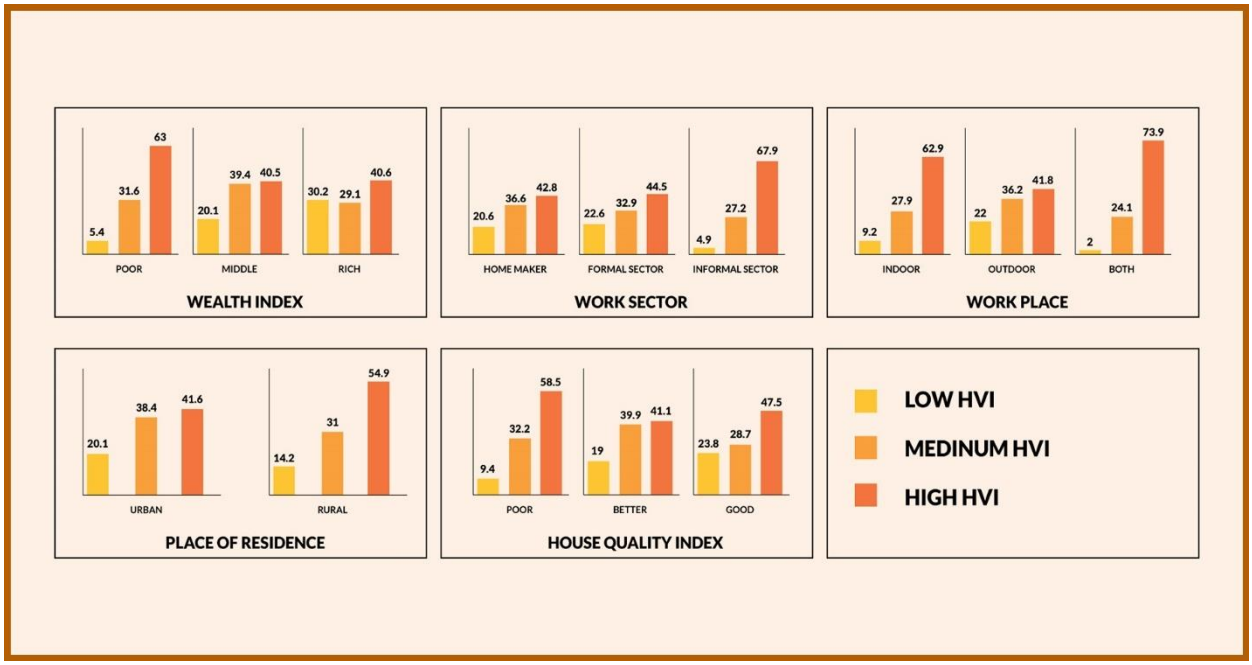



**Figure 10:** Reproductive Health Impacts by HVI and Socioeconomic Indicators.[6]

In addition, the survey captured the presence of reproductive and urinary symptoms that may be exacerbated by heat, such as burning or frequent urination, unusual discharge, vaginal infections, reproductive tract infections (e.g., pelvic pain, fever), and increased menstrual discomfort. This domain was further explored through the focus group discussions where women reflected on the physical discomfort surrounding menstruation during peak summer months.

- Women working in the **informal sector** reported the **highest reproductive health impacts**, with **68% of those in the high HVI districts** affected. This underscores the critical need for occupational safeguards, including shade, rest breaks, and hydration access in unregulated work environments.

[6] All values shown are in percentages. Note: Level of significance is <0.05.

- Those with **both indoor and outdoor workplace exposure** reported the most severe impacts (**74% in high HVI districts**), suggesting that cumulative exposure with little rest or cooling opportunities worsens reproductive health symptoms.
- **Women working indoors in high HVI districts** reported greater reproductive health impacts **(63%)** than those working outdoors (**42%**), indicating that prolonged indoor exposure, often in poorly ventilated, heat-trapping environments can be just as harmful.
- **Women in rural areas** reported higher reproductive health impacts than women in urban areas (**55% vs. 42% in the high HVI group**), highlighting the intersection of environmental exposure and barriers to timely, quality reproductive healthcare in rural areas.
- A stark **wealth gradient** was visible: **63% of women from poor households** in the high HVI group reported reproductive health impacts, compared to **41% in the richest households**. This suggests that socioeconomic status shapes both exposure and coping capacity.
- **Poor housing quality** was also strongly associated with impact, with **59% of women** in the high HVI group living in poor housing reporting reproductive health symptoms, compared to **48% in good housing**. This highlights the importance of ventilation, materials used for house construction, and crowding in influencing thermal stress.
- Across work categories, **homemakers** and **formal sector workers** reported reproductive health impacts as well (43% and 45% respectively in high HVI), indicating that indoor labour and domestic settings are not automatically protective.
- Women in the low wealth tertile experienced disproportionately worse outcomes in highly vulnerable districts, reinforcing the intersectionality of disadvantage. For example, the prevalence of impact on Reproductive Health jumped sharply among the poor; showing an increase of more than ten-fold, from **5.4%** (Low HVI) to **63.0%** (High HVI) *(Annexure VIII).*
- Even among those in "better" or "good" housing conditions, **41% to 48%** of high HVI respondents still reported reproductive health issues, particularly among those simultaneously engaged in outdoor or informal work, showing that housing improvements must be paired with workplace protections.

This is consistent with modelled probabilities, which indicate that the **probability of reporting reproductive health impacts was significantly higher with heat vulnerability**; from just over **25%** in the low vulnerability districts to over **65%** in the high vulnerability districts. These findings point to a strong correlation between cumulative exposure and reproductive risks, meriting inclusion in maternal health strategies and occupational safeguards.

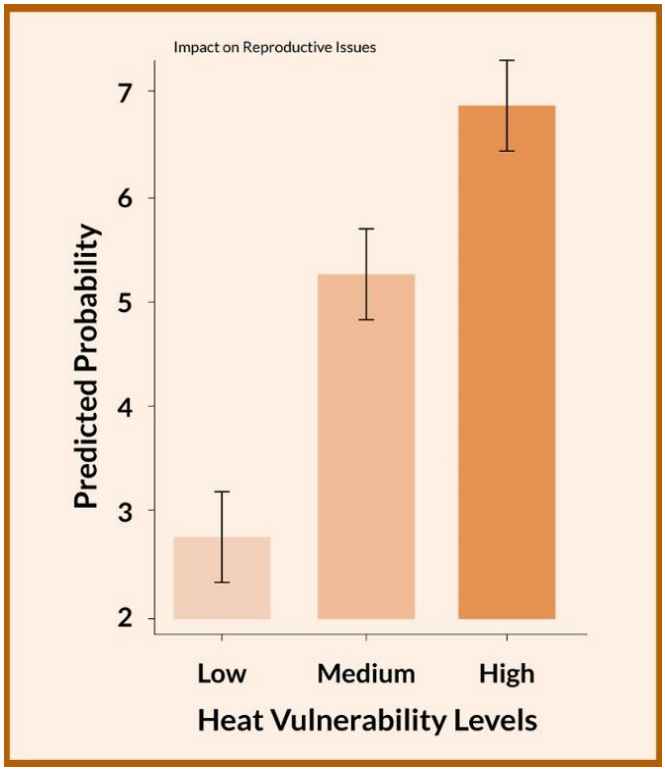



**Figure 11:** Predicted Probabilities for Reproductive Health Impact.[7]

Qualitative accounts reinforced the emotional and physiological toll of elevated indoor temperatures during pregnancy. One participant shared how pregnancy-related heat distress was not only physical but also affected interactions within the household:

> "...for my sister's daughter, she already has a small child, now she is pregnant. They gave (due) date in this month. Now as heat increases, when there is so much hot air inside the home, her BP would rise and she shows her anger towards her little child." — *40-year-old Female, Urban Chennai (Pilot FGD)*

- Around **40%** of women reported experiencing menstrual disturbances during summer months. These disturbances included irregular periods **(15%)**, higher levels of discomfort or pain **(11%)**, heavier bleeding than usual **(9%)**, and lighter bleeding than usual **(5%)**

[7] The above figures are based on the results obtained from Logit Regression Model, after controlling for age, educational level, caste, wealth index, religion, occupation, marital status, household size, house quality index and place of residence. Note: Level of significance is <0.05.

- The impact on Menstrual Health among SC women rose from **19.0%** (Low HVI) to **48.7%** (High HVI)—a 29.7 percentage point increase, suggesting that marginalised groups face compounding disadvantages under heat stress. These disparities were compounded in high HVI districts, suggesting a possible interaction between environmental vulnerability and social marginalisation *(Annexure VIII)*.

These challenges were also often compounded by dermatological and hygiene-related issues, particularly for women who used sanitary pads while navigating the heat:

> "When we use pad and walk in the heat, because of heat and sun, both sides of thighs become completely wet and begin to irritate and itch. For those three days, it is very difficult." — *29-year-old Female, Urban Chennai (Pilot FGD)*

> "Because body is heating up, periods is becoming heavy. If periods did not come for two months, it would be nice." — *29-year-old Female, Urban Chennai (Pilot FGD)*

- Urinary symptoms such as frequency, burning, and painful urination were reported by **29**%, while **6%** experienced gastrointestinal issues such as haemorrhoids and constipation.
- Reproductive tract infections (RTIs) were reported by **15%**, including symptoms like pelvic pain, vaginal irritation, unusual discharge, and menstrual discomfort.

Women in high heat vulnerability districts had an approximate **53%** chance of experiencing menstrual disturbances, which is roughly **3.5 times higher** than the approximate **15%** chance observed among those in low vulnerability districts. This underscores the need for menstrual hygiene interventions that account for environmental stressors like heat, especially in vulnerable populations.

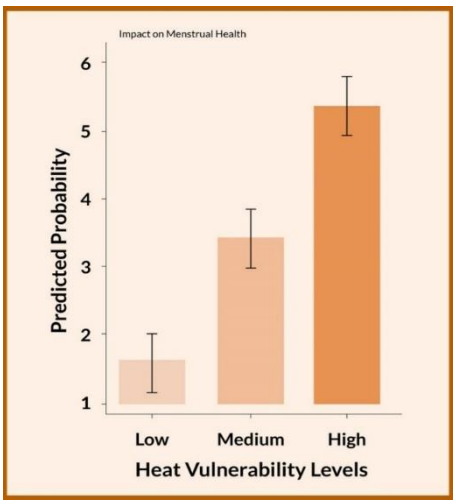



**Figure 12:** Predicted Probabilities for Menstrual Health Impact.[8]

[8] The above figures are based on the results obtained from Logit Regression Model, after controlling for age, educational level, caste, wealth index, religion, occupation, marital status, household size, house quality index and place of residence. Note: Level of significance is <0.05.

#### Health Seeking Behaviour

- Around **56%** of the women reporting general physical health issues consulted a physician, whereas **24%** of them did not opt for any measures.
- **12%** of women approached local pharmacists for over-the-counter medication.
- **6%** opted for self-medication and home remedies
- **3%** consulted with traditional medicine practitioners.

The finding that **24%** of women with general physical health issues did not seek any form of care is concerning, particularly in the context of rising heat-related morbidity. This suggests possible barriers such as limited access to healthcare facilities, financial constraints, or normalization of symptoms. It may also reflect competing domestic and caregiving responsibilities that deprioritize women's health needs.

### 3.2.5. Mental Health Impacts of Heat

Rising global temperatures, along with increased sunlight exposure, air pollution, and shifting seasonal patterns, have significant implications for mental health. Evidence increasingly links heat exposure and heatwaves to heightened mental health morbidity, including increased psychiatric emergency visits, hospital admissions, and crisis calls (Shoib et al., 2023). Studies from countries such as Sweden, Portugal, and Australia have found associations between extreme heat and elevated rates of mood disorders, anxiety, and dementia-related complications (Bando et al., 2017; Burke et al., 2018; Kim, Kim, & Kim, 2011; Schneider et al., 2020). Excessive heat has also been shown to contribute to physical and mental fatigue, with workplace heat stress in particular associated with increased psychological distress, as seen in a study from Thailand (Shoib et al., 2023). These findings underscore the need to integrate mental health considerations into climate and occupational health policy frameworks.

A systematic review and meta-analysis of 53 studies by Liu et al. (2021) found that for each 1°C rise in temperature, mental health-related mortality increased by 2.2% and morbidity by 0.9%, underscoring the significant psychological burden associated with rising temperatures and extreme heat events. Research also indicates that a 1°C rise in ambient air temperature has been associated with a 1.1% to 2.3% increase in suicide rates (Carlsen,

Oudin, Steingrimsson, & Oudin Åström (2019); Almendra, Loureiro, Silva, Vasconcelos, & Santana (2019); Nitschke et al. (2011)).

**A semi-pucca house with an asbestos sheet roof, Data Collection at Udupi, Karnataka.**

### 3.2.5.1. Study Findings

#### General Psychological Distress

Participants were asked if they experienced changes in their mental health during the summer months (April–June) compared to other times. This included symptoms such as increased anxiety or stress, feelings of depression or sadness, sleep disturbances, irritability, and heightened feelings of isolation or loneliness. For those who reported such symptoms, follow-up questions explored whether these changes affected their daily functioning and if any pre-existing mental health conditions had worsened during the heat period. Emotional responses from qualitative interviews also revealed how caregiving responsibilities and fatigue contributed to distress during heat waves.

Analysis of self-reported experiences indicated a significant prevalence of mental distress symptoms during the summer months.

- The most commonly reported concerns include increased irritability or short temper **(41%)**, heightened anxiety or stress levels **(33%)**, and sleep disruption/insomnia or sleep pattern changes (**32%**).

- Additionally, **21%** of respondents reported feelings of depression or sadness.
- A smaller proportion reported higher feelings of isolation or loneliness (**7%**), and **2%** disclosed thoughts or behaviours related to self-harm, collectively highlighting the psychological burden of prolonged heat exposure.

- These self-reported experiences are supported by regression models as seen in *Figure 13*, which show that **predicted probability of mental health impacts reached 80%** among women in high heat vulnerability districts, compared to **50%** in the low vulnerability district group. This quantifies the amplified psychological burden on women with compounding structural and environmental stressors.

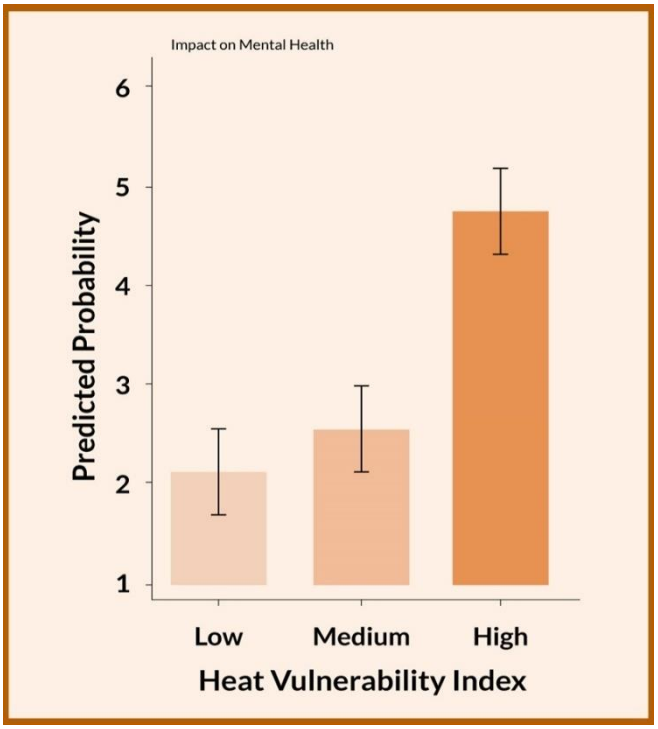



**Figure 13:** Predicted Probabilities for Mental Health Impact.[9]

[9] The above figures are based on the results obtained from Logit Regression Model, after controlling for age, educational level, caste, wealth index, religion, occupation, marital status, household size, house quality index and place of residence. Note: Level of significance is <0.05.

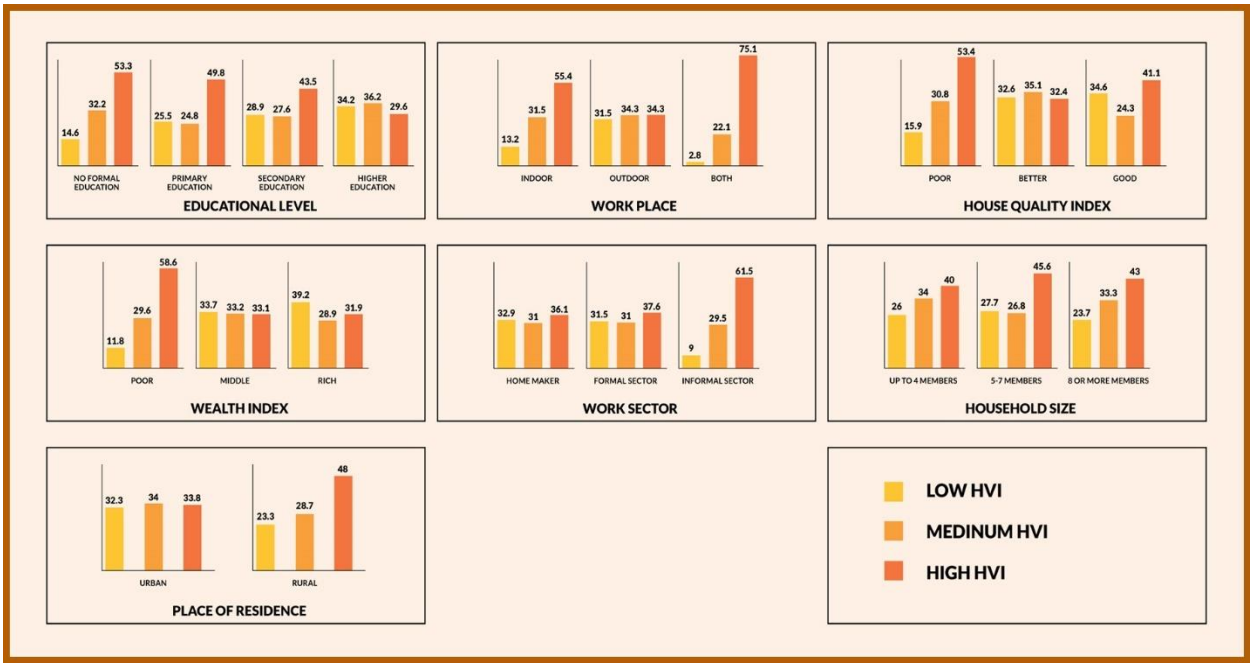



**Figure 14:** Mental Health Impacts by HVI and Socioeconomic Indicators[10].

- Mental health impacts were highest among women with **no formal education** (**53%** in high HVI districts), followed by those with primary education **50%**. The gap between low and high HVI districts is stark—only **15%** of women with no formal education reported mental health impacts in low HVI areas, compared to **53%** in high HVI areas.
- **Women from poor households** reported the highest mental health impacts (**59%** in high HVI areas), while those from middle and rich households showed similar and lower levels (around **33% and 29% respectively** across HVI categories). The sharp shift in impact from low to high HVI areas (**12% to 59%** among the poor) suggests that financial precarity, when combined with climate stress, is associated with **higher levels of mental health impact**.
- Mental health impacts was notably higher among **women in poor-quality housing**, with **53%** in high HVI districts compared to **16%** in low HVI districts.
- **Women in rural districts** reported higher mental health impacts than women in urban districts (**48% vs. 34%** in high HVI districts).

[10] All values shown are in percentages. Note: Level of significance is <0.05.

- **Mental health impacts were highest among informal sector workers**, especially in high HVI districts (**62%**), compared to **38%** among formal sector workers and **36%** among homemakers. Notably, in low HVI districts, only 9% of informal sector workers reported distress, suggesting that both the nature of employment and place-based vulnerability matter.
- **Women working indoors or in both indoor and outdoor** environments reported the highest distress (**55%** and **75%** respectively in high HVI areas). This contrasts with outdoor-only workers in HVI areas, who reported relatively lower impact (**34%**), pointing to the compounding effects of confined spaces, poor ventilation, and continuous exposure without rest.
- **Households with 5-7 members** were associated with greater mental health impacts (**46%** in high HVI districts), possibly due to caregiving strain and lack of personal space. However, impact was notable across all household sizes in high HVI areas, suggesting that household structure alone does not confer protection.

Qualitative narratives highlighted how chronic heat exposure influenced emotional well-being, strained interpersonal relationships, and led to behavioural changes within the household. Women described a pervasive sense of frustration, physical discomfort, and loss of motivation to perform routine activities like cooking or going outdoors:

> "There is anxiety because of this heat. We can't even think about cooking food and eating food. Also, how can we go out? We can't go out too because of this heat. It feels so bad when it is hotter. If we stay inside home, we feel irritated and frustrated. That also does not feel good." — *20-year-old Female, Rural Chennai*

Higher feelings of aggression and conflict within families during summer months were frequently reported, especially in overcrowded or poorly ventilated homes. Women spoke about reduced tolerance levels, emotional dysregulation, and a tendency to lash out at children or other family members:

> "We get irritated quickly during the hot summer, often we take our irritability on the mother-in-law, children or even on animals. Husband also irritable after coming from work. So it may or may not end up in physical fight." — *34-year-old Female, Rural Rajasthan*

> "Like, if I'm already sweating and someone asks something, I just snap. Even my kids know not to talk to me when I'm cooking during summer — they stay silent because they know I get angry in the heat." — *39-year-old Female, Urban Rajasthan*

These accounts illustrate the compounding effects of environmental stressors on emotional regulation, caregiving capacity, and domestic harmony, particularly for women who shoulder disproportionate household responsibilities.

#### Sleep Disruption

- Additionally, among the 1,053[11] women surveyed on sleep patterns, **63%** reported sleeping less than six hours per night during the summer, suggesting a significant disruption to rest and recovery during high-heat periods.

## 3.2.6. Access to Government Resources and Support

Access to timely, accurate information and institutional support plays a critical role in shaping adaptive capacity to extreme heat. Public awareness of heat risks, health-seeking behaviour, and availability of social protection schemes are all essential components of a community's resilience. However, systemic gaps in communication, outreach, and program delivery may limit the ability of vulnerable populations, especially women, to protect themselves and their families from the adverse impacts of rising temperatures.

### 3.2.6.1. Study Findings

To understand how women perceive, access, and respond to heat-related risks, the survey explored three interlinked domains: awareness and knowledge of heat stress, sources of information, and access to institutional support systems. Respondents were asked whether they had heard of heat stress, understood its symptoms and health impacts, knew how to

[11] Only 1,053 participants were asked this question, as they had reported experiencing sleep disturbances, prompting follow-up questions on sleep duration.

prevent or manage it, and where they typically received such information. The survey also examined access to health or social insurance and the presence (or absence) of any formal support, public or private, to cope with extreme heat.

#### Awareness and Risk Communication

- Only **24%** of respondents demonstrated full awareness of heat stress, including its causes, symptoms, and potential health impacts.
- Moreover, **75%** reported lacking knowledge on effective strategies to manage or mitigate heat-related health risks, indicating substantial gaps in public education and risk communication efforts.

#### Sources of Information

- In terms of information channels, **13%** of respondents reported receiving information about heat stress from government sources, while **15%** cited medical professionals as their primary source.
- A larger proportion of **31%** relied on social media platforms, with the remaining respondents obtaining information through informal networks such as family members, relatives, and neighbours.

#### Access to Social Protection and Support

- A significant proportion of respondents **(58%)** reported lacking any form of health or social insurance coverage, leaving them financially vulnerable to heat-related illnesses.
- Furthermore, **88%** stated that they did not receive any support, either from public systems or private entities, to cope with heat-related challenges, underscoring critical gaps in institutional safety nets and adaptive assistance mechanisms.

### 3.2.7. Beyond Exposure: The Invisible Gendered Burden of Heat

This section draws on survey questions about lifetime experiences of violence, changes during summer months, and broader qualitative insights into daily routines and gender roles. While the quantitative data focuses on physical, verbal, sexual, and emotional abuse and whether such violence worsened during April–June, interviews revealed deeper gendered burdens.

### 3.2.7.1 Study Findings

- Approximately **18%** of respondents reported of experiencing some violence at least once in their lifetime, including physical, verbal, sexual, or emotional abuse.
- Among these individuals, over half **(53%)** noted a high frequency or severity of such violence during the summer months, suggesting a potential link between extreme heat and heightened household or interpersonal tensions.
- In terms of associations with heat vulnerability, **38%** of respondents in low HVI districts and **72%** women in high HVI districts reported that violence has higher during April-June. All these outcomes are suggestive of strong positive association between the adverse effects on livelihood and violence and high heat vulnerability levels. (*Annexure IX*)
- A striking **80%** of **older women (60+ years)** in high HVI districts reported having experienced some form of violence at least once in their lifetime[12].
- **Women with no formal education, primary education and secondary education** experienced a high lifetime prevalence of violence (72%, 75% and 72%).

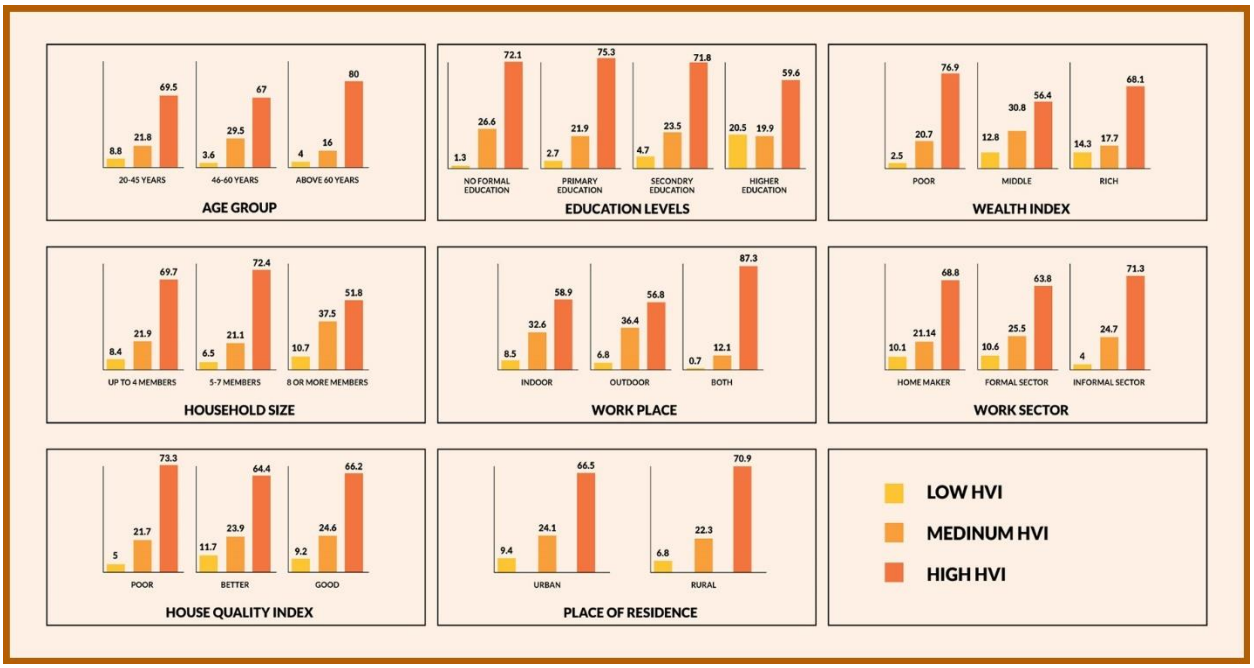



**Figure 15:** Prevalence of having ever experienced violence by HVI and Socioeconomic Indicators.[13]

[12] Having experienced some form of violence atleast once in their lifetime will also be referred to as *lifetime violence* in this report.
[13] All values shown are in percentages. Note: Level of significance is <0.05.

- Across work sectors, **women in the informal sector** consistently reported the highest levels of both lifetime violence (**71%)** and higher rates of heat-related violence (**66%)**, with a steep rise in medium to high HVI districts. Informal workers often lack legal protections, grievance redressal, and job security, increasing their exposure during periods of domestic or environmental stress.
- **Dual workplace exposure (indoor + outdoor) was strongly associated** with violence aggravated by heat. Around **87%** of women in this group living in high HVI districts reported lifetime violence and **92%** in high HVI districts said they experienced higher levels of violence during summer months the highest across all categories.
- **Women in rural areas** reported higher levels of lifetime violence compared to women in urban areas, with these differences most pronounced in high HVI areas.

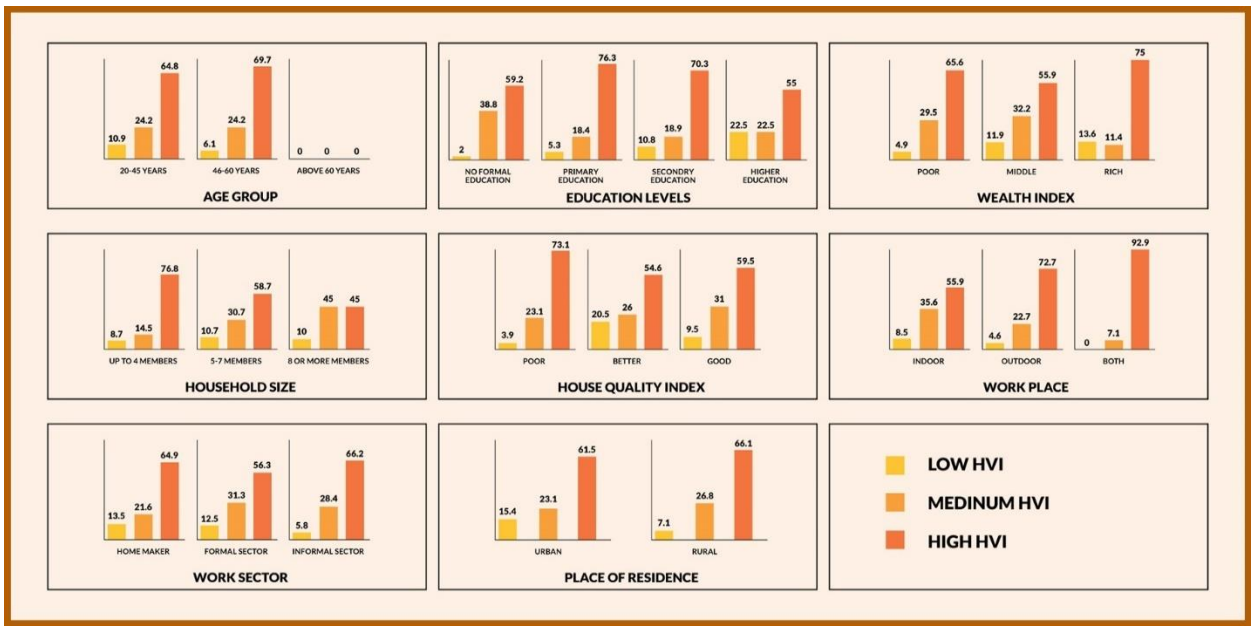



**Figure 16:** Prevalence of increased violence in summer months by HVI and Socioeconomic Indicators.[14]

[14] All values shown are in percentages. Note: Level of significance is <0.05.

- **Women in smaller households (up to 4 members)** reported the **highest levels of violence during heat (77%)** in violence during heat (**77%**) in high HVI regions. This challenges assumptions that crowding alone drives risk—interpersonal strain and limited buffers may play a greater role.

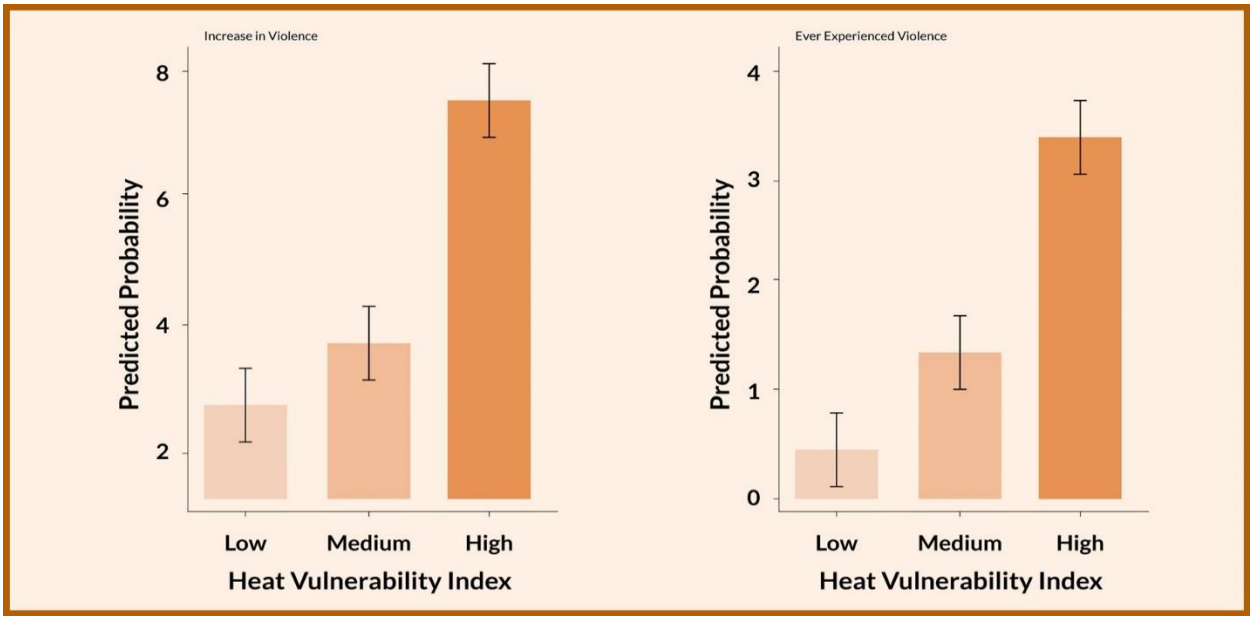



**Figure 17:** Predicted Probabilities for Experiencing Violence in lifetime and Increased Violence in Summer Months.[15]

- Finally, violence during heat periods was reported even among middle- and high-wealth groups (**56%** and **75%** respectively in high HVI districts), showing that climate-linked gendered violence cuts across socio-economic lines.

These trends are strongly supported by regression-based analysis. The predicted probability of having ever experienced violence rose from just **5% among women in low heat vulnerability districts** to **32% among those in high vulnerability districts**. Similarly, the predicted probability of increased violence during heat rose steeply from **approximately 30% (low vulnerability districts)** to **more than 70% (high vulnerability**

[15] The above figures are based on the results obtained from Logit Regression Model, after controlling for age, educational level, caste, wealth index, religion, occupation, marital status, household size, house quality index and place of residence. Note: Level of significance is <0.05.

**districts)**, reinforcing the sharp escalation in conflict in already vulnerable households during extreme heat events.

Qualitative narratives revealed how intense heat conditions compound the already demanding responsibilities women shoulder, particularly in unpaid care work and domestic labour.

> "I pray the sun should not rise, let it be night all the time." — *40-year-old Female, Rural Chennai*

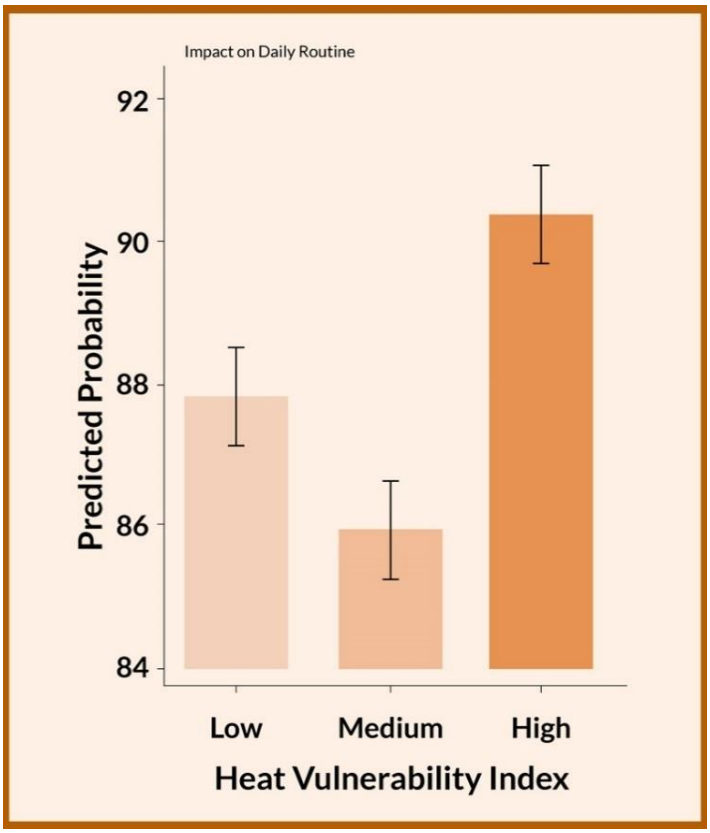
Multiple respondents reflected on the stark contrast in recovery time between men and women, noting how gendered expectations around caregiving leave women with little opportunity for rest, even after hours of physically taxing outdoor labour.

> "Men take rest madam. But we have children. Even if we go out and come back, we don't have space to rest. We have to take care of children in home, we cannot take rest. But men will rest." — *28-year-old Female, Rural Chennai*

This lack of recuperation time further heightened women's vulnerability to mental distress, fatigue, and conflict at home. One woman described the crushing nature of combining paid and unpaid work during the hottest parts of the year:

> "We wake up at five and go out for work. From that side, we come back home around 11 am or 12 pm. So we need to cover long distance in a short time and we become tired too in the heat. After returning home, we cannot sleep. Because we need to attend to children. It is like that." — *35-year-old Female, Rural Chennai*

**Figure 18:** Predicted Probabilities for Impact on Daily Routine.[16]




In line with this, the predicted probability of daily routine being affected by heat rose from approximately **88% in women from low-vulnerability districts** to nearly **91% among those in high vulnerability districts**, confirming that even basic daily functioning is compromised under conditions of heat stress for the most exposed.

Gender norms and biological differences also shaped how heat was experienced. One woman emphasised how managing menstruation and household responsibilities simultaneously worsened the burden of heat exposure:

> "Men, they just walk out in the shade wearing light pajamas… they manage. But we go through more. Especially during our menstrual cycle, doing household chores becomes even harder, and doing those same tasks in the heat is doubly difficult." — *38-year-old Female, Urban Rajasthan*

[16] The above figures are based on the results obtained from Logit Regression Model, after controlling for age, educational level, caste, wealth index, religion, occupation, marital status, household size, house quality index and place of residence. Note: Level of significance is <0.05.

These voices collectively illustrate how extreme heat acts as a multiplier of gendered burdens fuelling fatigue, frustration, and, in some cases, escalating household tensions into violence. The findings call for urgent attention to the intersection of climate vulnerability, gender inequality, and mental health, particularly in designing climate-resilient social protection systems and community-based mental health services.

**Focus Group Discussions, Rural Rajasthan.**

### 3.2.8. Health Provider's Perspectives

Healthcare providers like Community Health Officers (CHOs), Auxiliary Nurse Midwives (ANMs), Mid-Level Health Providers (MLHPs) as well as community health workers like Accredited Social Health Activists (ASHAs) and Multipurpose Health Workers (MPHWs) form the backbone of India's primary healthcare system. Their deep community embedment, especially in rural and underserved areas, positions them as trusted first points of contact for healthcare delivery. In the context of rising heat stress, community health workers are uniquely placed to serve as early responders, health educators, and care navigators; identifying symptoms, counselling patients, and referring cases to higher levels of care.

This study foregrounds the experiences of healthcare providers and community health workers - a perspective often underrepresented in climate and health research. By centering their voices, it sheds light not only on community health-seeking behaviours but also on health system preparedness and operational gaps under climate-induced stress. Preliminary insights from interviews reveal significant challenges and emerging opportunities in frontline response to heat, ranging from infrastructural deficits to training needs.

#### 3.2.8.1 General Impact of Heat on Health and Healthcare Delivery

Healthcare providers across both rural and urban settings consistently reported that summer conditions have become more intense and are beginning earlier each year. As one nurse in Chennai observed:

> "The heat starts earlier now. It's a lot more intense than it used to be."

This escalating heat intensity has led to a noticeable higher number of outpatient visits during peak summer months, with common complaints including fatigue, dizziness, dehydration, gastrointestinal issues, urinary tract infections, and aggravation of pre-existing chronic conditions such as hypertension. An MLHP from rural Andhra Pradesh noted:

> "Due to increase in temperature, recently we observed increased number of cases related to skin allergies."

In rural settings, providers noted that indoor environments offer minimal relief from rising temperatures. One nurse from a rural setting remarked:

> "Indoor environments offer little relief… fans only circulate hot air."

Clinics continued to see a high burden of non-communicable diseases and skin infections, with symptoms often worsening during the summer. These insights point to the growing strain on frontline health services and the urgent need for climate-responsive adaptations in healthcare delivery infrastructure, especially in high-risk districts.

#### 3.2.8.2 Gendered Health Impacts and Health-Seeking Behaviours

Providers noted gendered differences in both heat-related symptoms and care-seeking. Women, especially those engaged in fieldwork, reported higher rates of sweating, urinary discomfort, itching, and heat rashes. These symptoms were often compounded by tight or synthetic clothing.

As one MLHP/CHO from rural Tamil Nadu explained:

> "Female patients, particularly those working outdoors, report more infections due to sweat and inner clothing. Many women complain of severe itching at night and lower abdominal pain."

Another MLHP from rural Andhra Pradesh noted:

> "In females, out of 10 cases we attend, around 20% are related to Urinary Tract Infections."

Delays in care-seeking among women were also widely noted by providers. Cultural expectations, limited autonomy, and caregiving responsibilities often led women to deprioritise their own health needs. As one urban doctor from Tamil Nadu observed:

> "There's a mindset that they can manage simple symptoms… and they prioritize family responsibilities over their own health. "

The doctor also added:

> "Seeking help early even just for symptoms can prevent complications. People shouldn't wait until it becomes serious."

These insights underscore the need to address both structural and behavioural barriers to timely healthcare access for women, particularly in high-heat contexts.

#### 3.2.8.3 Vulnerable Groups: Pregnant Women and Elderly

Pregnant women were identified by providers as a particularly vulnerable group, with many presenting symptoms such as anaemia, vomiting, and fluid loss—conditions that may be aggravated by high ambient temperatures. In rural settings, health staff reported that women often delayed antenatal visits to avoid peak heat hours. As one MLHP/CHO noted:

> "They will postpone the visit since they cannot come during the hot times of the day."

Elderly patients also experienced pronounced heat-related symptoms, including dizziness and diarrhoea. However, many did not perceive these symptoms as requiring medical attention, resulting in delays in care-seeking.

These insights highlight the importance of adapting service delivery models such as flexible facility timings, targeted outreach, and improved transportation support for heat-vulnerable populations.

#### 3.2.8.4 Mental Health and Irritability

While not formally diagnosed, healthcare providers across both rural and urban settings consistently noted heightened emotional distress and irritability among patients during the summer months. Heat appeared to contribute to higher levels of tension, verbal outbursts, and in some cases, physical aggression—particularly within households.

As one MLHP/CHO from rural health Tamil Nadu described:

> "People get tensed quickly, shout… sometimes even beat children during this time."

Providers themselves also reported experiencing stress and emotional fatigue while working in overcrowded and overheated health facilities. As one nurse from urban Tamil Nadu shared:

> "Even I get stressed in that heat and crowd… sometimes I end up raising my voice."

Although not always directly attributed to heat alone, these accounts suggest that rising temperatures may exacerbate underlying emotional strain. These findings underscore the need to integrate mental health considerations into climate and health strategies, especially for frontline workers and heat-affected communities.

#### 3.2.8.5 Provider Capacity and Preparedness

While most healthcare providers reported offering basic advice on hydration, sun avoidance, and rest, they acknowledged that community adherence remained low. Time

constraints and workload pressures limited their ability to engage in proactive or preventive health education. As one doctor from urban Tamil Nadu reflected:

> "We've learned through experience… but regular training is essential."

An ASHA worker from rural Andhra Pradesh added:

> "We need more training to learn. We will learn and share the information with people."

Although some had received information, education, and communication (IEC) materials and general guidelines, many called for more structured and interactive training. Health education on heat-related illness was often reactive and delivered after patients presented with symptoms, rather than preventive. Several providers expressed the need for regular orientation sessions, improved job aids, and clinical algorithms specific to heat-related health conditions.

Representative Image: Generated using AI

> "I think regular training and capacity-building sessions are essential. Every hospital should train its staff to recognize and manage heat-related conditions more effectively." — Male doctor, urban Tamil Nadu.

Providers did report following basic protocols such as checking vitals, administering oral rehydration salts (ORS), and referring cases through telemedicine platforms. However, awareness of formal government policies or programs on heat-related illness was limited.

No provider interviewed could recall specific heat-health interventions at the local level, indicating a gap in institutional communication and program reach.

#### 3.2.8.6 Infrastructure and Working Conditions

Inadequate infrastructure was identified as a major constraint affecting both healthcare delivery and provider well-being during high-heat periods. Many frontline providers reported working in poorly ventilated, congested facilities with limited cooling mechanisms. These conditions affected not only patient comfort but also staff efficiency and morale.

Providers described adapting to the heat by conducting patient consultations outside the facility.

> "Only four people can fit inside at once," noted one MLHP from rural Tamil Nadu who shifted consultations outdoors under a tree due to lack of space.

Even in better-equipped facilities, heat posed a challenge.

> "The first floor gets too hot—it's hard for us to manage even though we have most facilities," shared a nurse from urban Tamil Nadu.

Staff shortages and irregular posting schedules were also highlighted as barriers to consistent service delivery, further straining the system during periods of peak heat stress. These conditions underscore the urgent need for climate-resilient health infrastructure, including better ventilation, shaded waiting areas, and regular staffing support to ensure uninterrupted and safe care delivery in heat-prone regions.

#### 3.2.8.7 Barriers to Health System Preparedness

Overall, preliminary findings from interviews with frontline health workers point to several systemic gaps that compromise both provider well-being and patient care during periods of extreme heat. The key areas of intervention reported were:

- Inadequate infrastructure, including poorly ventilated, overcrowded buildings and lack of backup power during outages.
- Shortages of essential supplies, particularly ORS stock and printed IEC materials for community outreach.

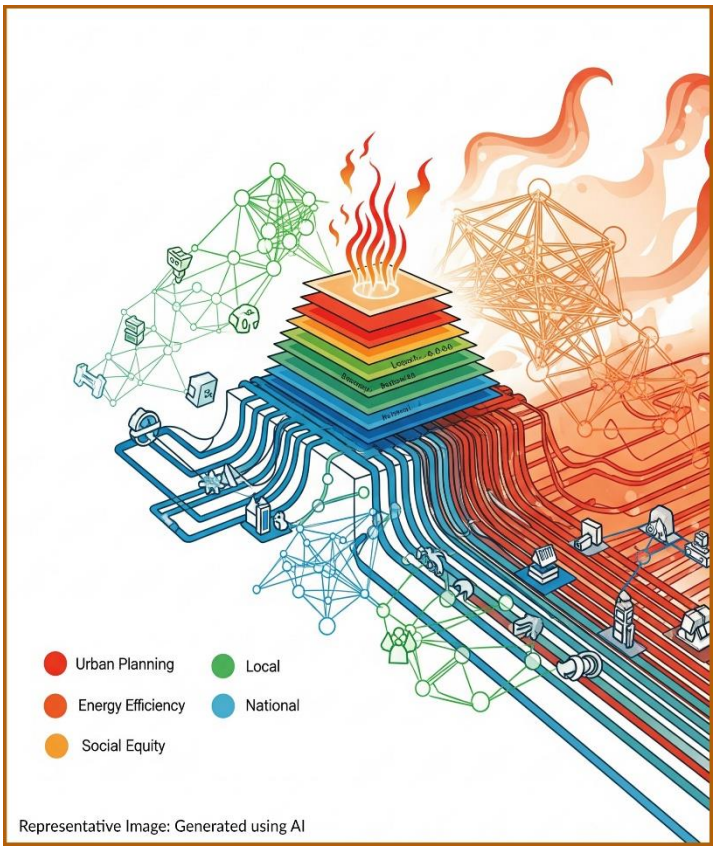
- Limited institutional preparedness, with no regular, structured state- or district-level coordination, orientation, or refresher trainings on heat-related health risks.
- Insufficient occupational safety measures for frontline health workers, including lack of rest breaks, shaded spaces, and hydration kits.

Addressing these gaps is essential not only to improve health system readiness for rising temperatures, but also to safeguard the health workforce that serves on the frontlines of climate-related public health challenges.

## 3.3. The Heat Policy Landscape: Existing Frameworks and Opportunities

The study also involved examining existing policies and programmes, highlighting best practices, and identifying key gaps in the current landscape to inform more gender-responsive and climate-resilient interventions.

### 3.3.1. Policies and Programmes




In response to rising temperatures and heat-related mortality, India has developed a varied and evolving landscape of policies and institutional responses. At the national level, the *National Action Plan on Climate Change (NAPCC)* from 2008 initially made no explicit mention of heatwaves. However, climate adaptation measures, particularly those intersecting with health, have gradually been incorporated into policy frameworks. Notably, the Ministry of Health and Family Welfare launched the National Programme on Climate Change and Human Health, which issued a *National Action Plan on Heat-Related Illnesses* in 2021 and later, in 2024, introduced guidelines on emergency cooling and death certification (NCDC, 2024). The

National Disaster Management Authority (NDMA) released its National Guidelines for Preparation of Action Plan - Prevention and Management of Heat Wave around 2019, encouraging state and city-level administrations to develop HAPs (NDMA, 2019).

Further, India's Smart Cities Mission was launched in 2015, and various urban climate strategies have begun promoting open green spaces and sustainable transport. In Ahmedabad, Gujarat, the city has invested in "Oxygen Parks" designed to lower ambient temperatures (UN-Habitat & MoHUA, 2023).

#### 3.3.1.1. Innovations in Heat Resilience: The Ahmedabad Heat Action Plan

On the ground, much of India's heat response has taken its cue from Ahmedabad's pioneering HAP, launched in the aftermath of the 2010 heatwave. Developed collaboratively by the Ahmedabad Municipal Corporation, public health authorities, and academic institutions, the plan introduced colour-coded heat alerts (yellow, orange, red based on temperature thresholds) and coordinated multi-sectoral responses (Ahmedabad Municipal Corporation, Indian Institute of Public Health-Gandhinagar, & NRDC, 2019). These included public awareness campaigns, early warning systems, and enhanced healthcare system preparedness. The Ahmedabad Municipal Corporation also institutionalized heat-death audits into its public health monitoring as part of its HAP.

Evaluations of this HAP have demonstrated clear benefits: one pilot study estimated it prevented approximately 1,190 deaths annually after implementation (Hess et al., 2018). The success of Ahmedabad's model catalyzed broader adoption of HAPs across India and the NDMA facilitated this diffusion through capacity-building workshops with state authorities (NDMA, 2022).

In Ahmedabad, civil society initiatives also contributed, reinforcing the critical role that community-based organisations and grassroots networks play in bridging last-mile gaps, raising awareness, and supporting vulnerable populations during periods of extreme heat. The Mahila Housing Trust, in collaboration with scientists and researchers, implemented an affordable and sustainable cooling solution for low-income slum communities: solar-reflective white paint for rooftops. This simple-to-apply paint was found to reduce indoor temperatures by 4-5°C and was highly popular among residents for its cost-effectiveness and accessibility (Escarcega, 2024). Another organization, namely the Self-Employed

Women's Association (SEWA), offers weather-indexed microinsurance to allow street vendors to pause work during extreme heat (One Billion Resilient, 2023).

## 3.3.2. Key Areas for Policy Attention

Despite the existence of these national guidelines and state-level efforts and HAPs, significant implementation and awareness gaps persist.

### 3.3.2.1. Heat Action Plans: Gaps in Design, Implementation, and Targeting

Despite the growing adoption of HAPs across Indian states and cities, many **remain limited in their scope and effectiveness.**

- An assessment of 37 HAPs by the Centre for Policy Research (CPR) (Pillai & Dalal, 2023) concluded that most HAPs are **not tailored to local climate realities** and oversimplify the definition of heat hazards, focusing predominantly on dry heat while neglecting critical factors such as humidity, night-time temperatures, and seasonal shifts.


- Only a minority of HAPs have locally defined thresholds, and climate projections are rarely integrated into planning. Vulnerability assessments that are key to targeting interventions are largely missing.

- As a result, HAPs often identify broad vulnerable groups but fail to offer specific, data-driven solutions. **Weak institutional anchoring, limited clarity on funding, and an absence of legal mandates** further dilute their accountability and enforcement.
- Funding sources are poorly outlined, with most departments expected to self-allocate resources, undermining implementation on the ground (Pillai & Dalal, 2023).

#### 3.3.2.2. Heat Action Plans: Gender Blind Spots and Missed Opportunities for Structural Change

- While some HAPs acknowledge gendered vulnerabilities, particularly among pregnant women, the elderly, and children, they often **treat women as a monolithic group** without considering how intersecting factors like caste, occupation, or income heighten vulnerability.
- Indoor workers and women managing large households, for example, face significant heat-related risks due to their work and living conditions, but receive little attention in current heat response efforts.
- Proposed interventions tend to focus on awareness and care provision rather than structural change. This reflects a broader trend where HAPs target individuals rather than addressing the socio-economic systems that underpin differential vulnerability.
- There remains a clear opportunity for HAPs to adopt gender-transformational approaches that not only recognize intersectional risks but also institutionalize solutions through gender budgeting, alignment with SDG 5, and stronger engagement with cross-cutting actors in governance and civil society (Pillai & Dalal, 2023).

This report reinforces the insights highlighted in the report by the CPR, aligning with its call for more nuanced and inclusive heat action planning. Our findings also underscore the same **critical need for gender-responsive strategies that go beyond identifying women as a homogenous vulnerable group.**

#### 3.3.2.3. Gendered Barriers in Communication and Access

The national consultations held to inform this study also brought forward important insights on gendered disparities in access to information.

- Multiple participants noted that **digital dissemination strategies often fail to reach women**, as smartphone ownership and digital literacy tend to be concentrated among men in many communities. This has created a significant access gap.
- Experts emphasised the need to develop and implement alternative communication approaches that are both gender-sensitive and tailored to local languages and cultural contexts.

These insights were reinforced by the secondary data analysis, which showed lower levels of media exposure among populations in high-heat vulnerability zones, pointing to broader structural barriers to information access in these areas. This underscores the urgency of gender-sensitive, locally adapted communication strategies.

#### 3.3.2.4. Inadequate Integration and Coordination Across Sectors

A recurring theme that emerged from participant discussions and expert presentations during the national consultation held in Ahmedabad was the l**ack of integration and coordination among key sectors** in the development and implementation of HAPs. Several speakers noted that critical departments such as urban planning and labour, essential for addressing occupational and infrastructural vulnerabilities to heat, are often not involved in the planning process.

- Urban planners were described as focusing largely on long-term, futuristic projects, with **limited attention to the immediate, localised, and gendered impacts of heat stress.**
- Participants also highlighted the absence of cross-sectoral collaboration, noting that current efforts remain fragmented across departments.
- At the district level, administrative staff such as collectors and counsellors were reported to be overburdened with competing priorities, which limits their capacity to prioritise heat-related initiatives.
- Concerns were also raised about limited institutional support: the National Disaster Management Authority (NDMA) was perceived as under-resourced, while State

Disaster Management Authorities (SDMAs) were viewed as even weaker, resulting in significant gaps in operational leadership and response mechanisms.

#### 3.3.2.5. Financing and Resource Allocation

Participants at the consultation generally agreed that financing is not the primary constraint in the current implementation of HAPs, as most ongoing activities are not resource-intensive.

- However, the **lack of dedicated and structured financing mechanisms** was identified as a key barrier to scaling up or sustaining interventions in the long term.
- Experts pointed to the recently released national mitigation fund guidelines as a potentially useful development to address these financial gaps.
- Still, concerns were raised around the need for greater awareness, dissemination, and accessibility of such funds at the state and local levels.

#### 3.3.2.6. Lack of Community Awareness and Demand

A significant concern raised during the consultation was the **limited public recognition of heat as a health issue.**

- Participants noted that the absence of community-level demand contributes to low political and administrative prioritisation.
- Additionally, experts pointed out the near-total lack of IEC materials related to heat and health, especially within rural health facilities.
- This has further reinforced the perception of heat stress as primarily an urban issue, despite growing evidence of its impact on rural communities.

#### 3.3.2.7. Integrating Heat Resilience into Urban Planning and Housing Policy

While some HAPs reference infrastructure adaptations such as building codes or urban greening, literature points out that they rarely specify who is responsible for funding or enforcing these interventions.

- In practice, **heat planning remains siloed**. One analysis, for instance, found that most HAPs focus on “temporary cooling” solutions such as provision of water, shaded

buses, or cooling clinics, rather than systemic changes to urban design and infrastructure (Pillai & Dalal, 2023).

- Insights from the national consultations and findings from our study also indicate that large informal settlements continue to lack tree cover, green spaces, and affordable, heat-adapted housing.
- Rural areas fare even worse as farm workers often reside in tin-roof structures with minimal ventilation.

Overall, **heat-resilient urban and housing planning remains in its infancy** and must be more deeply embedded within building codes, land-use plans, and housing policy frameworks

#### 3.3.2.8. Mortality Surveillance

Preliminary insights from our interviews with healthcare providers suggested that many health professionals remain unfamiliar with heat-related protocols, and **official surveillance remains inconsistent**.

- For instance, while government records reported 360 heat-related deaths between March and June 2024, data from HeatWatch suggested that the actual toll was more than double that, at 733 deaths (HeatWatch, 2024).

These discrepancies underscore the urgent need to strengthen frontline training, surveillance systems, and institutional accountability.

#### 3.3.2.9. Data and Evidence Gaps

Several experts and participants from the national consultations highlighted the **underutilisation of existing data** in informing heat-related planning and interventions.

- Despite the availability of relevant datasets, many felt that these were rarely analysed or integrated into policy decisions.
- There was also a broader concern that independent reviews and evaluations of HAPs are either discouraged or viewed with apprehension by authorities, thereby limiting opportunities for transparency, accountability, and institutional learning.

- Finally, local capacity building, particularly in regional languages and with a focus on grassroots stakeholders, was recognised as both underfunded and under prioritised.

# 4. The Call to Action: Policy Recommendations

The national consultations surfaced a wide range of strategies and policy suggestions for improving heat resilience, particularly for vulnerable populations such as women and informal workers. These insights were further enriched by findings from in-depth interviews with healthcare providers, focus group discussions, and community surveys with women in heat-vulnerable districts. Together, these complementary data sources highlighted the need for coordinated institutional reforms, targeted programmatic interventions, and locally grounded innovations to strengthen heat adaptation across both health systems and communities.

## 4.1. Strengthen Institutional Mechanisms and Governance

Establishing robust leadership and accountability systems is foundational to all other heat-related interventions. Experts at our national consultations highlighted institutional gaps and the need for empowered coordination beyond disaster management.

- **Establish a dedicated Environmental Health Department** to coordinate heat mitigation and adaptation efforts across sectors.
- **Create a nodal ministry or agency** to oversee heat-related policies beyond a disaster-response framing.
- **Institutionalise annual reviews of Heat Action Plans** to enable learning, adaptation, and accountability.
- **Integrate a heat budget** within city finances to fund cost-effective, evidence-based interventions.
- **Foster scientific collaboration** to prioritise physically and economically sound solutions.

## 4.2. Enhance Multi-Sectoral Convergence and Local Governance

There is an urgent need to address fragmentation in implementation by strengthening convergence across departments and aligning with ongoing missions and schemes. Urban policies in particular present opportunities for impactful, visible interventions that can be scaled and replicated.

- **Promote integration of HAPs with national missions** such as the Swachh Bharat Mission (SBM) and Jal Jeevan Mission (JJM) to break siloed functioning.
- **Encourage city-level policies** such as early school closures during heatwaves, installation of green shade nets at traffic signals, and solar-reflective painting on police booths.
- **Leverage partnerships with civil society** to build trust and facilitate interdepartmental collaboration.
- **Engage urban planners and labour departments** more actively in heat mitigation efforts, given their crucial roles in infrastructure and occupational health.

## 4.3. Strengthen Health System Preparedness and Service Delivery

Primary care providers and community health workers across settings highlighted urgent systemic gaps that limit their ability to respond effectively to rising heat-related health risks. These challenges ranging from infrastructural deficits to insufficient community engagement tools directly impact both service quality and health-seeking behavior.

- **Upgrade facility infrastructure** to include ventilated consultation rooms, shaded waiting areas, and sufficient building space to manage outpatient loads in peak heat months.
- **Expand hydration infrastructure,** including ORS counters and accessible water stations within and around health facilities.
- **Enhance training and Information Education and Communication (IEC) efforts,** particularly visual tools for frontline workers and locally appropriate materials for community sensitization.
- **Prioritize community education,** especially on early warning signs of heat stress, dehydration, and heat stroke, tailored to the needs of women, the elderly, and outdoor workers.

- **Include reproductive and menstrual health challenges** as key components of heat-health communication and provider training, particularly for informal workers, low-literacy populations, and rural residents.
- **Strengthen PHC-level awareness and support** for antenatal, menstrual, and urogenital symptoms during summer months.
- **Ensure age-specific screening and support** for elderly women, who face high physical and psychosocial vulnerability during heatwaves.

### 4.4. Strengthen Data, Evidence, and Research

One of the key barriers to effective heat action, as highlighted in both stakeholder consultations and existing literature (Pillai & Dalal, 2023), is the limited utilisation of available data and the lack of context-specific research approaches. Despite existing datasets, there is limited application of this evidence for programmatic decision-making. Moreover, qualitative insights remain underexplored, limiting understanding of ground realities.

- **Increase the use of existing data** to generate actionable insights on heat impacts, particularly for informal workers and small businesses.
- **Collect targeted data on financial support** accessed by small businesses, behavioural changes due to heat, and economic costs of heat-related illness.
- **Invest in qualitative research methodologies** such as ethnography to capture lived experiences and adaptive behaviours.
- **Establish baseline studies** to monitor outcomes of heat adaptation interventions.
- **Shift research framing from vulnerability** alone to include empowerment and resilience.
- **Foster transparency and learning** by encouraging independent evaluations and reviews.
- **Promote participatory research and co-designed studies** can strengthen evidence-use in programs and policies.

### 4.5. Strengthen Evidence-Driven Planning and Impact Evaluation

Robust data needs to drive more targeted and cost-effective interventions, and bridge the gap between research and implementation. Discussions at our consultations also emphasized the need to move beyond fragmented or anecdotal data and invest in strategic

research and monitoring systems to inform heat resilience policies. A critical priority is the establishment of granular, local datasets that enable cross-sectoral decision-making, particularly in urban planning, labour welfare, and public health.

- **Conduct retrospective analyses** in state capitals, major cities and district headquarters across the country to link 10 years of daily temperature and mortality data, generating local evidence on heat- and cold-related excess deaths and identifying data system gaps.
- **Evaluate the implementation of 250+ Heat Action Plans** to understand what drives or hinders uptake. Use insights to inform national-level standards and cross-state learning.
- **Map Urban Heat Islands and Exposure Inequity** by mapping intra-city temperature variation and overlay with population vulnerability indicators to identify high-risk zones, enabling targeted, equity-driven urban heat interventions.
- **Assess the health impact of workplace heat-mitigation strategies** (e.g., shaded zones, hydration kits, shift timing) across sectors to inform occupational safety standards and heat-smart urban planning.
- **Generate comparative cost-effectiveness data on mitigation strategies** like cool roofs, ORS stations, tree cover etc., to help cities prioritize low-cost, high-impact solutions for heat resilience.

## 4.6. Promote Gender-responsive and Community-driven Approaches

Stakeholders at our consultations, particularly those with deep community engagement and field-based experience, strongly emphasised the need for bottom-up, co-created solutions that integrate lived experiences with technical knowledge, particularly to design gender-sensitive strategies. They highlighted the importance of developing adaptation and mitigation measures tailored for women running small businesses. These strategies should aim to build resilience and economic well-being while addressing gender-specific barriers to heat exposure.

- **Capacity building for leadership and resilience** among women entrepreneurs through targeted training and awareness on heat risks and protective behaviours, including appropriate clothing and hydration.

- **Improve access to credit, climate insurance, and social protection schemes** to enhance economic stability during heat events.
- **Provision of essential infrastructure,** such as access to shade, drinking water, and adequate washroom facilities in marketplaces and workplaces.
- **Integration of social and behaviour change (SBC) approaches,** drawing on behavioural insights and nudge theory, with successful examples from government programmes like SBM and JJM.
- **Promotion of participatory planning and co-creation processes** that combine lived experiences with technical expertise to ensure locally relevant and effective interventions.
- **Address the rising prevalence and severity of gender-based violence** during heat events through frontline worker training and cross-sectoral programs linking social protection, legal awareness, and women's safety frameworks.
- **Recognise how heat-related routine disruption and unpaid domestic labour disproportionately affect women** by creating respite services such as shaded Anganwadis with creche support and subsidised access to time-saving appliances for low-income households.
- **Acknowledge and support caregiving burdens** during peak heat through home-based outreach, targeted check-ins for high-burden families, and peer support mechanisms via SHGs and women's collectives.

Participants also underscored the critical role of behaviour change communication (BCC) strategies, grounded in SBC theory, to foster heat-safe practices within communities, highlighting the need for collaboration with local stakeholders

## 4.7. Improve Workplace Heat Safety and Informal Worker Protection

Recognise occupational heat risks and strengthen safeguards for informal and high-exposure workers.

- **Mandate heat-safe workplace standards** (shade, ventilation, water, first-aid), especially in informal sectors.
- **Integrate occupational heat safety** into labour codes and urban planning regulations.

- **Promote time-bound work adjustments** (e.g., staggered hours, compulsory breaks) during extreme heat.
- **Prioritise informal workers in heat action planning,** with targeted outreach and service delivery.
- **Extend welfare schemes and insurance coverage** to include heat-related illness and productivity loss. Link such schemes to existing social protection platforms, ensuring ease of access and claim processing through self-help groups, community-based organisations, or local health workers.
- **Facilitate informal worker registration** and data systems for tailored interventions.

## 4.8. Expand Access to Heat-Resilient Infrastructure and Services

Design climate-adaptive urban and transport infrastructure that reduces exposure and improves access.

- **Ensure reliable electricity supply,** especially during peak summer months, to support heat adaptation.
- **Subsidise energy-efficient appliances** (e.g., fans, refrigerators) for vulnerable households.
- **Improve piped water access and rainwater harvesting** to reduce water-collection burdens on women.
- **Enhance last-mile public transport** and shade options for vulnerable commuters.
- **Create shaded walk/cycle paths and drinking water stations** near transit hubs.
- **Promote nature-based solutions** such as urban greening, tree plantation drives, and green roofs to reduce urban heat and enhance environmental resilience.

## 4.9. Integrate Mental Health into Heat-Health Responses

Literature and findings from our study reinforce the need to acknowledge and address the mental health impacts of heat stress. Particularly, it is critical to address the psychological burden of extreme heat, particularly for caregivers and vulnerable communities.

- **Include mental health indicators** in heat surveillance systems to monitor and respond to spikes in heat-related distress, especially in women, the elderly, and caregivers.

- **Train community health workers** to identify and support mental distress linked to heat and dehydration.
- **Establish community cooling and wellbeing centers** in Anganwadis, health sub-centres, or schools, designed not just for physical cooling but also as psychosocial support hubs during heatwaves
- **Introduce short-format mental wellbeing modules** (10–15 mins) into ongoing health worker training programs, focusing on recognising heat-aggravated anxiety, irritability, and cognitive fatigue.
- **Develop IEC materials** on coping with heat-induced psychological stress, including simple breathing techniques, hydration reminders, and safe rest practices customised for low-literacy and high-stress contexts.
- **Integrate mental health check-ins into routine consultations** during peak heat months at primary health centres (PHCs), especially for patients presenting with fatigue, dizziness, or sleep disturbances.
- **Incorporate psychosocial dimensions of heat stress** such as interpersonal conflict, isolation, and family strain into communication and mental health outreach through tailored IEC, counselling modules, and frontline worker training.
- **Provide specialised support for elderly women** experiencing heat-related distress and isolation through home-based mental health visits, community peer-support groups, and age-inclusive wellbeing spaces.

## 4.10. Strengthen Communication, Education, and Knowledge Products

Experts and healthcare providers underscored the importance of raising public awareness and educating communities about heat risks and protective measures. There is a need for tailored, accessible, and locally relevant knowledge dissemination strategies that overcome barriers such as gendered access to digital media.

- **Develop dedicated heat health education programming** through radio, television and offline medial.
- **Produce educational materials** that illustrate how consumer behaviour and health outcomes change with temperature variations.
- **Partner with local universities and civil society** to create context-specific knowledge products and gather community stories.

- **Implement awareness campaigns** that explain the importance of heat-resilience measures in accessible language.
- **Expand communication channels beyond smartphones**, considering gender and rural-urban disparities.

A final recommendation of this study as reiterated by national-level experts at our consultations is that HAPs should not be restricted to traditionally heat-prone states. As heat events increase in frequency and intensity, a proactive and inclusive national strategy is necessary. A strategy that views heat resilience not merely through the lens of disaster response, but as a **developmental and equity issue**.

# 5. Reflections & The Way Forward

This study offers one of the first empirical explorations of the gendered health impacts of heat stress in India, combining nationally representative secondary data analysis with primary quantitative and qualitative research across heat-prone districts. By integrating multiple data sources and perspectives, the study provides a holistic understanding of how heat stress affects women's health, agency, and access to care.

## 5.1. Strengths

This study offered a comprehensive and multi-layered understanding of gendered heat-health vulnerabilities by combining quantitative data from over 3,300 women across seven heat-stressed states with in-depth qualitative insights from communities and the health system. The large and diverse sample allowed for meaningful trend analysis across geographies and socio-economic contexts. By integrating both qualitative and quantitative approaches, the study enabled triangulation of findings and a nuanced understanding of lived realities. It also included perspectives from frontline health providers, offering a critical lens into system-level preparedness.

A notable strength was also the extensive consultations with civil society organisations and sectoral experts, which grounded the findings in real-world experiences and helped shape actionable, context-specific recommendations. As a first-of-its-kind gendered heat-health study in India, this co-created, mixed-methods approach significantly enhanced the policy relevance and utility of the findings.

## 5.2. Limitations

Despite its significant contributions, the study also has limitations that should be acknowledged. First, geographic coverage was limited to seven states, with no representation from the eastern region of India, restricting the generalisability of findings. Second, while the study focused on women's experiences, it did not include men's perspectives, which limits comparative insights across genders. Third, the survey relied on a researcher-designed, non-standardised questionnaire and a retrospective reference period, making it susceptible to recall and memory bias. Additionally, while the study initially selected districts based on IMD's historical heatwave data to ensure variation in heat exposure levels (i.e., low and high exposure districts), the recently released CEW district-level Heat Index (Prabhu et al., 2025) classified all selected districts of this study as "high" and "very high" exposure zones. This discrepancy in heat exposure classification between data sources limited the intended comparability between districts and may have influenced exposure-based analyses.

Data collection was also impacted by operational constraints. In particular, securing permissions to engage frontline health providers proved challenging, which led to a smaller sample of health system stakeholders than intended. Combined with a restricted timeline for fieldwork, these barriers limited both the depth of institutional insights and the overall representativeness of perspectives from the health system side.

## 5.3. Way Forward

The triangulated findings from this study spanning secondary datasets, primary surveys, and qualitative interviews offer critical insights into how heat stress intersects with gender, poverty, nutrition, reproductive health, and access to care. However, given the cross-sectional nature of the data, causal pathways remain difficult to establish. To build on this foundation, the research team strongly recommends **future longitudinal studies with robust, mixed-methods designs.** These should aim to track women's health outcomes over time, capture seasonal variability in heat exposure, and investigate biological and social pathways through which environmental stress affects women's wellbeing. Future research and interventions should also focus on addressing the compounded vulnerabilities faced by women from marginalised caste groups, low-income households, and poorly served geographies.

There is also an **urgent need to invest in gender-sensitive, climate-resilient public health systems**. Priorities include: **(1) strengthening heat-health surveillance systems** with gender-disaggregated data**; (2) building capacity of healthcare providers and community health workers** to identify and respond to heat-related illness in women; **and (3) incorporating thermal comfort measures in housing schemes**, and **(4) improving menstrual and reproductive health services in high-risk districts**. To operationalise the study's recommendations, it is essential to **translate them into actionable frameworks** for Panchayats, municipal bodies, state departments, and national ministries, supported by clear institutional mandates, budget lines, and operational guidelines. **Strengthening multi-tiered implementation mechanisms,** with dedicated monitoring and feedback loops, will help ensure national commitments are effectively translated into local action and accountability.

As climate risks intensify, this study makes a strong case for **embedding gender equity within India's heat action and climate adaptation frameworks**, grounding policy responses in both data and lived realities.

# References


1. Aadhar, S., & Mishra, V. (2019). A substantial rise in the area and population affected by dryness in South Asia under 1.5 C, 2.0 C and 2.5 C warmer worlds. *Environmental Research Letters*, *14*(11), 114021. https://doi.org/10.1088/1748-9326/ab4862
2. Ahmedabad Municipal Corporation, Indian Institute of Public Health-Gandhinagar, & Natural Resources Defense Council. (2019). *Ahmedabad Heat Action Plan* (First released 2013; updated 2019). https://www.nrdc.org/sites/default/files/ahmedabad-heat-action-plan-2019.pdf
3. Almendra, R., Loureiro, A., Silva, G., Vasconcelos, J., & Santana, P. (2019). Short-term impacts of air temperature on hospitalizations for mental disorders in Lisbon. *Science of the Total Environment*, *647*, 127-133. https://doi.org/10.1016/j.scitotenv.2018.07.337
4. Anjum, G., & Aziz, M. (2025). Climate change and gendered vulnerability: A systematic review of women's health. *Women's Health*, *21*, 17455057251323645. https://doi.org/10.1177/17455057251323645
5. Asian Development Bank. (n.d.). *ADB Challenge: Gender and heat*. https://challenges.adb.org/en/challenges/genderandheat
6. Bando, D. H., Teng, C. T., Volpe, F. M., Masi, E. D., Pereira, L. A., & Braga, A. L. (2017). Suicide and meteorological factors in Sao Paulo, Brazil, 1996-2011: a time series analysis. *Brazilian Journal of Psychiatry*, *39*, 220-227. https://doi.org/10.1590/1516-4446-2016-2057
7. Berberian, A. G., Gonzalez, D. J., & Cushing, L. J. (2022). Racial disparities in climate change-related health effects in the United States. *Current Environmental Health Reports*, *9*(3), 451-464. https://doi.org/10.1007/s40572-022-00360-w
8. Bharadwaj, R, Karthikeyan, N, Deulgaonkar I and Patil, A (2024) Women paying the cost of the climate crisis with their wombs: quantifying loss and damage faced by women battling drought, debt and migration. IIED, London. https://www.iied.org/sites/default/files/pdfs/2024-02/22281IIED.pdf
9. Berger, T., Chundeli, F. A., Pandey, R. U., Jain, M., Tarafdar, A. K., & Ramamurthy, A. (2022). Low-income residents' strategies to cope with urban heat. *Land Use Policy*, *119*, 106192. http://dx.doi.org/10.1016/j.landusepol.2022.106192

10. Bhuyan, B., Sahoo, B. K., & Suar, D. (2020). Food insecurity dynamics in India: A synthetic panel approach. *Social Sciences & Humanities Open*, *2*(1), 100029. https://doi.org/10.1016/j.ssaho.2020.100029
11. Burke, M., González, F., Baylis, P., Heft-Neal, S., Baysan, C., Basu, S., & Hsiang, S. (2018). Higher temperatures increase suicide rates in the United States and Mexico. *Nature climate change*, *8*(8), 723-729. https://doi.org/10.1038/s41558-018-0222-x
12. Carlsen, H. K., Oudin, A., Steingrimsson, S., & Oudin Åström, D. (2019). Ambient temperature and associations with daily visits to a psychiatric emergency unit in Sweden. *International Journal of Environmental Research and Public Health*, *16*(2), 286. https://doi.org/10.3390/ijerph16020286
13. Chersich, M. F., Pham, M. D., Areal, A., Haghighi, M. M., Manyuchi, A., Swift, C. P., ... & Hajat, S. (2020). Associations between high temperatures in pregnancy and risk of preterm birth, low birth weight, and stillbirths: systematic review and meta-analysis. *bmj*, *371*. https://doi.org/10.1136/bmj.m3811
14. Desai, B. H., & Mandal, M. (2021). Role of climate change in exacerbating sexual and gender-based violence against women: A new challenge for international law. *Environmental Policy and Law*, *51*(3), 137-157. https://doi.org/10.3233/EPL-210055
15. Ebi, K. L., Capon, A., Berry, P., Broderick, C., de Dear, R., Havenith, G., ... & Jay, O. (2021). Hot weather and heat extremes: health risks. *The lancet*, *398*(10301), 698-708. https://doi.org/10.1016/s0140-6736(21)01208-3
16. Ellena, M., Ballester, J., Mercogliano, P., Ferracin, E., Barbato, G., Costa, G., & Ingole, V. (2020). Social inequalities in heat-attributable mortality in the city of Turin, northwest of Italy: a time series analysis from 1982 to 2018. *Environmental Health*, *19*, 1-14. https://doi.org/10.1186/s12940-020-00667-x
17. Escarcega, M. (2024). *The impact of rising temperatures on women workers living in Bapalaal Kadiyani Chaali – an urban slum in Ahmedabad, India*. https://www.mahilahousingtrust.org/wp-content/uploads/2024/04/Hot-Take-Cool-Roof-Research-Study-Report-2024.pdf
18. Han, J., Yang, D., Liu, Z., Tian, L., Yan, J., Li, K., ... & Liu, X. (2021). The damage effect of heat stress and psychological stress combined exposure on uterus in female rats. *Life Sciences*, *286*, 120053. https://doi.org/10.1016/j.lfs.2021.120053

19. HeatWatch. (2024, May 3). *Struck by heat: A news analysis of heatstroke deaths in India in 2024.* https://www.heatwatch.in/blogs/press-release-new-report-struck-by-heat-a-news-analysis-of-heatstroke-deaths
20. Hess, J. J., Lm, S., Knowlton, K., Saha, S., Dutta, P., Ganguly, P., ... & Mavalankar, D. (2018). Building Resilience to Climate Change: Pilot Evaluation of the Impact of India's First Heat Action Plan on All-Cause Mortality. *Journal of environmental and public health*, *2018*(1), 7973519. https://doi.org/10.1155/2018/7973519
21. Hu, M., Zhang, K., Nguyen, Q. C., Tasdizen, T., & Krusche, K. U. (2022). A multistate study on housing factors influential to heat-related illness in the United States. *International Journal of Environmental Research and Public Health*, *19*(23), 15762. https://doi.org/10.3390/ijerph192315762
22. International Labour Organization. (2019). Working on a WARMER planet. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_711919.pdf
23. Kim, Y., Kim, H., & Kim, D. S. (2011). Association between daily environmental temperature and suicide mortality in Korea (2001–2005). *Psychiatry research*, *186*(2-3), 390-396. https://doi.org/10.1016/j.psychres.2010.08.006
24. Lambrou, Y., & Nelson, S. (2010). Farmers in a changing climate: Does gender matter?. http://www.fao.org/docrep/013/i1721e/i1721e00.pdf
25. Romanello, M., Di Napoli, C., Green, C., Kennard, H., Lampard, P., Scamman, D., ... & Costello, A. (2023). The 2023 report of the Lancet Countdown on health and climate change: the imperative for a health-centred response in a world facing irreversible harms. *The Lancet*, *402*(10419), 2346-2394. https://doi.org/10.1016/S0140-6736(23)01859-7
26. Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P., ... & Zommers, Z. (2023). *Climate change 2023: synthesis report. Contribution of working groups I, II and III to the sixth assessment report of the intergovernmental panel on climate change*. The Australian National University. https://doi.org/10.59327/IPCC/AR6-9789291691647
27. Liu, J., Varghese, B. M., Hansen, A., Xiang, J., Zhang, Y., Dear, K., ... & Bi, P. (2021). Is there an association between hot weather and poor mental health outcomes? A systematic review and meta-analysis. *Environment international*, *153*, 106533. https://doi.org/10.1016/j.envint.2021.106533

28. Liu, J., Varghese, B. M., Hansen, A., Zhang, Y., Driscoll, T., Morgan, G., ... & Bi, P. (2022). Heat exposure and cardiovascular health outcomes: a systematic review and meta-analysis. *The Lancet Planetary Health*, *6*(6), e484-e495. https://doi.org/10.1016/S2542-5196(22)00117-6
29. Min, J. Y., Lee, H. S., Choi, Y. S., & Min, K. B. (2021). Association between income levels and prevalence of heat-and cold-related illnesses in Korean adults. *BMC Public Health*, *21*, 1-10. https://doi.org/10.1186/s12889-021-11227-4
30. Mitra, A., & Rao, N. (2019). Gender, water and nutrition in India: An intersectional perspective. *Water Alternatives*, *12*(3), 930. https://www.water-alternatives.org/index.php/alldoc/articles/vol12/v12issue1/485-a12-1-11/file
31. MSSRF., (2024). How does climate change impact women and children across agro-ecological zones in India: A scoping study. M S Swaminathan Research Foundation.
32. Muralidharan, A., Broekhuijsen, M., Lisondra, L., Guru, A., Haver, J., & Irfan, S. (2025). The ripple effect: impacts of climate change on menstrual health and paths to resilience. *Frontiers in Global Women's Health*, *6*, 1569046. https://doi.org/10.3389/fgwh.2025.1569046
33. National Centre for Disease Control. (2024). *Guidelines on emergency cooling for management of se2vere heat-related illnesses*. National Programme on Climate Change and Human Health, Ministry of Health and Family Welfare, Government of India. https://ncdc.mohfw.gov.in/wp-content/uploads/2024/03/Emergency-Cooling-for-Severe-Heat-Related-Illnesses_March2024_NPCCHH.pdf
34. National Disaster Management Authority. (2019). *Guidelines for preparation of action plan – Prevention and management of heat wave*. Government of India. https://ndma.gov.in/sites/default/files/PDF/Guidelines/heatwaveguidelines.pdf
35. National Disaster Management Authority. (2022). *Annual report 2021-22*. Government of India. https://ndma.gov.in/sites/default/files/PDF/Reports/NDMA_Annual_Report_2021-22.pdf
36. Nitschke, M., Tucker, G. R., Hansen, A. L., Williams, S., Zhang, Y., & Bi, P. (2011). Impact of two recent extreme heat episodes on morbidity and mortality in Adelaide, South Australia: a case-series analysis. *Environmental Health*, *10*, 1-9. https://doi.org/10.1186/1476-069X-10-42

37. One Billion Resilient. (2023, February 6). *Extreme heat microinsurance launched in India to protect women*. One Billion Resilient. https://onebillionresilient.org/2023/02/06/extreme-heat-microinsurance-launched-in-india-to-protect-women/
38. Osberghaus, D., & Abeling, T. (2022). Heat vulnerability and adaptation of low-income households in Germany. *Global Environmental Change*, *72*, 102446. https://doi.org/10.1016/j.gloenvcha.2021.102446
39. Pandey, K. (2023). Heatwaves arrive early in 2023; hit 11 states from March 3 to April 18. Down to Earth. https://www.downtoearth.org.in/climate-change/heatwaves-arrive-early-in-2023-hit-11-states-from-march-3-to-april-18-88871. (Accessed on 19th April, 2025).
40. Parsons, L. A., Masuda, Y. J., Kroeger, T., Shindell, D., Wolff, N. H., & Spector, J. T. (2022). Global labor loss due to humid heat exposure underestimated for outdoor workers. *Environmental research letters*, *17*(1), 014050. https://doi.org/10.1088/1748-9326/ac3dae
41. PIB. (2023). India at COP-28: Highlights of 28th Conference of Parties. Research Unit Press Information Bureau. https://static.pib.gov.in/WriteReadData/specificdocs/documents/2023/dec/doc20231212285701.pdf (Accessed on 18th April, 2025).
42. Pillai, A., & Dalal, T. (2023). How is India adapting to heatwaves?: An assessment of heat action plans with insights for transformative climate action. https://cprindia.org/briefsreports/how-is-india-adapting-to-heatwaves-an-assessment-of-heat-action-plans-with-insights-for-transformative-climate-action/
43. Prabhu, Shravan, Keerthana Anthikat Sukesh, Srishti Mandal, Divyanshu Sharma, and Vishwas Chitale. 2025. How Extreme Heat is Impacting India: Assessing District-level Heat Risk. New Delhi: Council on Energy, Environment and Water. https://www.ceew.in/publications/mapping-climate-risks-and-impacts-of-extreme-heatwave-disaster-in-indian-districts
44. Samuelson, H., Baniassadi, A., Lin, A., González, P. I., Brawley, T., & Narula, T. (2020). Housing as a critical determinant of heat vulnerability and health. *Science of the total environment*, *720*, 137296. https://doi.org/10.1016/j.scitotenv.2020.137296
45. Schneider, A., Hampel, R., Ladwig, K. H., Baumert, J., Lukaschek, K., Peters, A., & Breitner, S. (2020). Impact of meteorological parameters on suicide mortality rates:

a case-crossover analysis in Southern Germany (1990–2006). *Science of the total environment*, *707*, 136053. https://doi.org/10.1016/j.scitotenv.2019.136053

46. Shankar, K., Hwang, K., Westcott, J. L., Saleem, S., Ali, S. A., Jessani, S., ... & Krebs, N. F. (2023). Associations between ambient temperature and pregnancy outcomes from three south Asian sites of the Global Network Maternal Newborn Health Registry: a retrospective cohort study. *BJOG: An International Journal of Obstetrics & Gynaecology*, *130*, 124-133. https://doi.org/10.1111/1471-0528.17616
47. Shoib, S., Hussaini, S. S., Armiya'u, A. Y. U., Saeed, F., Őri, D., Roza, T. H., ... & Chandradasa, M. (2023). Prevention of suicides associated with global warming: perspectives from early career psychiatrists. *Frontiers in psychiatry*, *14*, 1251630. https://doi.org/10.3389/fpsyt.2023.1251630
48. Shrikhande, S. S., Pedder, H., Röösli, M., Dalvie, M. A., Lakshmanasamy, R., Gasparrini, A., ... & Cissé, G. (2023). Non-optimal apparent temperature and cardiovascular mortality: the association in Puducherry, India between 2011 and 2020. *BMC Public Health*, *23*(1), 291. https://doi.org/10.1186/s12889-023-15128-6
49. Singh, C., Iyer, S., New, M. G., Few, R., Kuchimanchi, B., Segnon, A. C., & Morchain, D. (2022). Interrogating 'effectiveness' in climate change adaptation: 11 guiding principles for adaptation research and practice. *Climate and Development*, *14*(7), 650-664. https://doi.org/10.1080/17565529.2021.1964937
50. SPRF. (2022). *Heat waves in India: Policy gaps in preparedness and response*. Strategic and Policy Research Foundation. https://sprf.in/wp-content/uploads/2022/08/SPRF-2022_DP_Heat-Waves.pdf
51. Srinivasan, K., Maruthy, K. N., Venugopal, V., & Ramaswamy, P. (2016). Research in occupational heat stress in India: Challenges and opportunities. *Indian journal of occupational and environmental medicine*, *20*(2), 73-78. https://doi.org/10.4103/0019-5278.197522
52. UNFCCC. (2022). Dimensions and examples of the gender-differentiated impacts of climate change, the role of women as agents of change and opportunities for women. In United Nations Framework Convention on Climate Change (UNFCCC). New York: United Nations. https://unfccc.int/sites/default/files/resource/sbi2022_07.pdf
53. UN-Habitat, & Ministry of Housing and Urban Affairs (MoHUA), Government of India. (2023). *Smart Cities Mission, India: Localizing Sustainable Development Goals*.

United Nations Human Settlements Programme (UN-Habitat). https://smartcities.gov.in/sites/default/files/2023-09/SCM_UN_Report%20.pdf

54. United Nations Women. (2022). Explainer: How gender inequality and climate change are interconnected. https://www.unwomen.org/en/articles/explainer/how-gender-inequality-and-climate-change-are-interconnected (Accessed on 18th April,2025).
55. Venugopal, V., Chinnadurai, J., Lucas, R., Vishwanathan, V., Rajiva, A., & Kjellstrom, T. (2016). The social implications of occupational heat stress on migrant workers engaged in public construction: a case study from southern India. *The International Journal of the Constructed Environment*, *7*(2), 25. https://doi.org/10.18848/2154-8587/CGP/v07i02/25-36
56. World Health Organization. (2024). *Climate change, heat and health*. https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health
57. Zhao, Q., Guo, Y., Ye, T., Gasparrini, A., Tong, S., Overcenco, A., ... & Li, S. (2021). Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: a three-stage modelling study. *The Lancet Planetary Health*, *5*(7), e415-e425. https://doi.org/10.1016/S2542-5196(21)00081-4

# Annexures

## Annexure I

Components of each Index constructed using primary data:

| Index | Variables |
|---|---|
| Wealth | House ownership, electricity, assets, income, toilet facility |
| House Quality Index[17] | Type of house (Kutcha/pucca), main material for floor, roof and wall; Number of rooms, doors; cross-ventilation and wall paint colour |
| Exposure Index | Heat Index by IMD, exposure for homemakers (in mins) and other occupation (in hours) |
| Sensitivity Index | Pre-existing conditions, Habits |
| Adaptive Capacity Index | Amenities, mode of transport, access to healthcare, cope strategy, know how to manage heat stress, wealth index, education, house quality index |
| Heat Vulnerability Index | Exposure Index, Sensitivity index and Adaptive Capacity Index |

### Weights Assigned to components for each Index

(Each variable is standardized before its application in the index construction)

Exposure index= 0.8*Heat Index by IMD + 0.2* Total exposure of women (Both homemakers and others)

Composite Sensitivity Index= 0.7*CEEW sensitivity index + 0.3*sensitivity index from primary data

Composite Adaptive capacity Index = 0.40* Wealth Index+ 0.20 * house quality index + 0.10* adaptive capacity index constructed from primary data + 0.3*education

$$Heat\ Vulnerability\ Index = \frac{Exposure * Sensitivity}{Adaptive\ Capacity}$$

The theoretical possible range of the HVI is from 0 to 1. A higher value of the index emphasises higher vulnerability, while a lower value of the index shows low heat vulnerability in the region. It is to be noted that the HVI is not an absolute measure of the climate vulnerability profile; the index is only a relative measure among the districts.

| Component | Variable | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Exposure | Exposure Index | 0.30 | 0.29 | 0.02 | 0.95 |
| Sensitivity | Composite Sensitivity Index | 0.46 | 0.20 | 0.06 | 1 |
| Adaptive capacity | Composite Adaptive Capacity Index | 0.31 | 0.17 | 0.02 | 0.86 |
| Vulnerability | Heat Vulnerability Index | 0.02 | 0.04 | 0 | 1 |

[17] Materials such as cement, cooling tiles, burnt bricks, and marble/granite were classified as higher-quality construction materials across floors, roofs, and walls to maintain the unidirectional nature of the index.

### Developing the exposure and vulnerability indices

To generate comprehensive information on heat exposure and vulnerability, a multi-faceted approach was employed, integrating data from a primary quantitative survey with secondary datasets from the Indian Meteorological Department (IMD) and the Council on Energy, Environment and Water (CEEW).

Specifically, heat index data for exposure assessment were obtained from IMD, while CEEW provided the sensitivity index. Key indicators, including the duration of women's sun exposure and educational attainment, were directly derived from the primary survey. Furthermore, the Heat Vulnerability Index's construction encompassed the development of a wealth index and a house quality index, sourced from the primary data, to serve as integral components of the adaptive capacity index. This methodology ensured local specificity and provided granular insight into contextual realities.

Table 1, 2 and 3 provide information on the sources, rationale and nature of relationship of all selected indicators in the construction of heat vulnerability index

**Table 1: Indicators used to map Exposure**

| Indicator | Calculation and source | Rationale | Weightage (%) | Relation |
|---|---|---|---|---|
| Heat index | Indian Meteorological Department (IMD) | IMD's Heat Index for the exposure component provides a physiologically relevant, scientifically robust, locally accurate, and policy-aligned measure of heat exposure | 80 | Direct |
| Duration of time exposed to sun | Primary survey data conducted; Includes both homemakers and women with different occupations. | it measures the direct, cumulative, and behaviourally relevant radiant heat burden experienced by women, which is a critical determinant of heat stress and heat-related health outcomes, | 20 | Direct |

**Table 2 : Indicators used to map Sensitivity**

| Indicator | Calculation and source | rationale | Weightage (%) | Relation |
|---|---|---|---|---|
| Sensitivity Index (primary data) | Pre-existing non-communicable health conditions and habits (drinking, smoking) of women as reported in primary survey | Individuals with pre-existing non communicable illnesses and are particularly vulnerable to heat stress, as they directly compromise the body's ability to cope with heat stress, making it less resilient. Also, individuals' lifestyle patterns | 30 | direct |

| | | | | |
|---|---|---|---|---|
| | | affect their physiological response to heat stress. | | |
| CEEW Sensitivity Index | Land use and land cover, Elevation, Slope, Ground water, and Soil moisture | Leveraging CEEW's generated sensitivity index component streamlines the development of a robust, credible, and efficient composite sensitivity index. This approach integrates established expertise, comprehensive data, and validated methodologies, thereby optimizing resource allocation and upholding analytical rigor. | 70 | Direct |

**Table 3: Indicators used to map Adaptive Capacity**

| Indicator | Calculation and source | Rationale | Weightage (%) | Relation |
|---|---|---|---|---|
| Adaptive Index | Information on the type of amenities at workplace, access to healthcare facility, prior knowledge of heat stress management, coping strategies adopted to manage heat stress, mode of transport collected from the primary survey. | This index enables local specificity and ground-truth validity, reflecting the actual lived experiences, resources, and behaviours of the surveyed population. | 10 | Inverse |
| Wealth Index | Information on income, ownership of the house, assets owned by the household, Toilet facility, electricity availability from primary survey conducted | It directly informs household adaptive capacity by quantifying the economic resources available for acquiring and utilizing crucial adaptive strategies to mitigate the adverse health impacts of heat exposure. | 40 | Inverse |
| House Quality index | Materials used for roof, wall and floor of the house, | Quality of house highly influences women's physiological | 20 | Inverse |

| | | | | |
|---|---|---|---|---|
| | cross-ventilation, number of rooms and doors, wall paint colour | response to extreme heat stress. | | |
| Education | Percentage of women with more than 10 years of education | Education highly determines individual's capability to identify and understand the effect of heat stress | 30 | Inverse |

### Application of weights for the primary data

The primary survey employed a stratified multistage sampling design. In the first stage, villages and urban wards were selected using probability proportional to size (PPS). In the second stage, we deviated slightly from PPS by using purposive selection, allocating 60% of the sample to rural areas and 40% to urban areas. Although statistical weights are typically applied to correct for unequal selection probabilities and ensure representativeness, this study found them unnecessary. An assessment of key demographic characteristics revealed that the sample's caste distribution closely aligned with that of the National Family Health Survey-5 (2019–21). This consistency indicates that the sample adequately represents the target population, rendering additional weighting redundant.

# Annexure II

## HVI: Computational Methodology

The concept of vulnerability has evolved over time. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. In this study, we measured heat vulnerability as a function of exposure, sensitivity and adaptive capacity, *i.e.*, HVI=*f (Exposure, Sensitivity, Adaptive capacity)*, which is mathematically measured as below:

$$Heat\ Vulnerability\ Index = \frac{Exposure * Sensitivity}{Adaptive\ Capacity}$$

In this function, exposure and sensitivity are positively related to vulnerability and adaptive capacity is inversely associated with vulnerability. Where,

*Exposure* is "the presence of people, livelihoods, species or ecosystems, environmental functions, services, resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected" (IPCC, 2014).

*Sensitivity* is "the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise)" (Houghton & IPCC, 2001).

*Adaptive capacity* is "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (Houghton & IPCC, 2001).

## HVI: Computational Steps

The district-level Heat Vulnerability Index (HVI) is constructed using the indicators as mentioned above, obtained from different data sources. The computational steps are as follows:

$$\text{Each indicator is made unit free using linear scaling method} = \frac{X_{it} - \text{Min}(X_{it})}{\text{Max}(X_{it}) - \text{Min}(X_{it})}$$

**Step 1:**

Where, $X_i$ be the value of the selected indicator at district *i*. Normalised values of an indicator range between 0 to 1.

**Step 2: Computation of each dimension:**

Exposure is directly taken from the Climate Hazards and Vulnerability of India, published by the Indian Meteorological Department. The exposure index is prepared by the Indian Meteorological Department based on long-term heatwave statistics by district from 1969 to 2021.

$$Composite\ Sensitivity\ Index = (0.35 * CEEW\ Sensitivity\ Index) + (0.35 * DST\ CVI) + (0.2 * Irrigated\ agriculture\ land) + (0.1 * Maternal\ Height)$$

$$Composite\ Adaptive\ Capacity\ Index = (0.33 * Mean\ years\ of\ schooling) + (0.33 * Percentage\ of\ rich\ as\ per\ Wealth\ quantile) + (0.33 * Percentage\ of\ Instiuttional\ delivery)$$

Step 3:

$$Heat\ Vulnerability\ Index = \frac{(Exposure\ Index) * (Composite\ Sensitivity\ Index)}{(Adaptive\ Capacity\ Index)}$$

The theoretical possible range of the HVI is from 0 to 1. A higher value of the index indicates a higher vulnerability, while a lower value indicates low heat vulnerability in the region. It is worth noting that the HVI is not an absolute measure of climate vulnerability; rather, it is a relative measure among districts.

| Component | Variable | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Exposure | Heat Wave Index | 0.11 | 0.17 | 0 | 1 |
| Sensitivity | Sensitivity Index | 0.47 | 0.15 | 0.03 | 0.79 |
| Adaptive capacity | Adaptive Capacity Index | 0.54 | 0.16 | 0.09 | 0.97 |
| Vulnerability | Heat Vulnerability Index | 0.10 | 0.17 | 0 | 1 |

# Annexure III

## Women's Health and Socio-Economic Outcomes by Level of Heat Vulnerability

| | Heat Vulnerability Levels | | | | |
|---|---|---|---|---|---|
| **Variables** | **Very Low** | **Low** | **Medium** | **High** | **Very High** |
| *Women's Health Outcomes* | | | | | |
| High Blood pressure (%) | 6.14 | 5.89 | 6.83 | 6.38 | 7.5 |
| Underweight women (%) | 11.4 | 15.64 | 17.87 | 18.26 | 19.02 |
| Anemia (%) | 48.33 | 54.89 | 56.42 | 61.23 | 58.9 |
| At least 4 times ANC visits (%) | 66.25 | 80.38 | 62.6 | 55.1 | 49.4 |
| Use of sanitary napkin during menstruation (%) | 78.48 | 73.1 | 61.85 | 59.7 | 59.7 |
| Menstrual Hygiene [1] | 79.95 | 88.4 | 81.7 | 72.32 | 72.3 |
| Hysterectomy performed (%) | 22.35 | 21.55 | 26.3 | 26.73 | 34.02 |
| Pregnancy ended in miscarriage/stillbirth | 2.38 | 2.77 | 3.35 | 3.44 | 3.45 |
| Mean age at first cohabitation | 20.2 | 19.3 | 18.6 | 18.2 | 18.1 |
| Physical or Sexual violence (last 12 months) | 18.34 | 24.49 | 23 | 24.87 | 25.54 |
| Mass media exposure [2] | 78.42 | 70.08 | 54.4 | 51.43 | 53.04 |
| *Household characteristics* | | | | | |
| Clean fuel[3] | 70.24 | 75.88 | 70.04 | 48.7 | 48.03 |
| Food cooked outdoors | 4.50 | 5.14 | 5.80 | 7.45 | 11.74 |
| Pucca house | 69.50 | 76.96 | 68.45 | 49.0 | 52.78 |
| Mean room for sleeping | 2.04 | 2.09 | 1.98 | 1.91 | 1.87 |
| *Child nutrition and health status* | | | | | |
| Stunting | 30.58 | 32.43 | 36.31 | 37.54 | 36.79 |
| Wasting | 17.12 | 19.1 | 19.26 | 20.72 | 18.92 |
| Underweight | 26.04 | 29.42 | 32.8 | 34.52 | 33.58 |
| Anemia | 59.91 | 66.9 | 69.2 | 71.15 | 69.0 |
| Infectious disease | 19.17 | 21.76 | 19.01 | 20.21 | 26.42 |

[1] Locally prepared napkins, sanitary napkins, tampons, and menstrual cups are considered to be hygienic methods of protection

[2] Women with at least weekly frequency of reading a newspaper or magazine, listening to the radio, watching television, or going to the cinema are considered to have Mass Media Exposure.

[3] Electricity, LPG/natural gas, and biogas are considered to be clean fuels.

# Annexure IV

## Adverse Health Outcomes by Socio-Economic Characteristics and Heat Vulnerability Level

| Adverse Health Outcome | Heat Vulnerability | Place of residence | | Social Group | | | | Wealth Status | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Urban | Rural | SC | ST | OBC | Others | Poorest | Poorer | Middle | Richer | Richest |
| Anemia | Very Low | 45.1 | 50.7 | 53.3 | 52.0 | 46.22 | 45.0 | 59.9 | 54.9 | 50.0 | 46.7 | 41.8 |
| | Low | 51.6 | 57.2 | 57.2 | 60.5 | 54 | 51.1 | 64.6 | 59.2 | 55 | 52 | 49.9 |
| | Medium | 55.5 | 56.9 | 57.2 | 68.4 | 53.6 | 54.8 | 57.4 | 57.4 | 55.8 | 55.3 | 53.2 |
| | High | 58.2 | 62.4 | 62.9 | 68.9 | 57.7 | 60.6 | 62.5 | 62.5 | 61.1 | 58.9 | 54.3 |
| | Very High | 56.7 | 59.6 | 60.7 | 67.0 | 57.0 | 57.0 | 59.9 | 59.9 | 58.6 | 56.7 | 52.9 |
| Under-Weight | Very Low | 9.3 | 13.1 | 13.0 | 13.7 | 11.1 | 9.0 | 18.5 | 16.3 | 13.1 | 10.1 | 6.9 |
| | Low | 11.5 | 18.8 | 16.9 | 21.3 | 16.0 | 12.7 | 24.7 | 21 | 16.9 | 13.6 | 9.2 |
| | Medium | 13.1 | 20.3 | 18.9 | 27.1 | 17.8 | 13.7 | 26.3 | 21.7 | 18.2 | 14.8 | 9.9 |
| | High | 12.1 | 20.7 | 19.2 | 25.2 | 19.4 | 14.0 | 24.8 | 20.9 | 17.7 | 14.2 | 9.8 |
| | Very High | 13.3 | 20.8 | 21.0 | 25.6 | 18.6 | 14.4 | 27.4 | 22.2 | 17.2 | 13.8 | 9.7 |
| Pregnancy loss[18] | Very Low | 2.2 | 2.6 | 2.4 | 2.5 | 2.4 | 2.3 | 2.5 | 2.4 | 2.6 | 2.4 | 2.1 |
| | Low | 2.8 | 2.7 | 2.7 | 2.7 | 2.6 | 3.2 | 2.3 | 2.7 | 2.8 | 2.9 | 2.8 |
| | Medium | 3.2 | 3.4 | 3.8 | 2.3 | 3.5 | 3.2 | 3.5 | 3.3 | 3.3 | 3.2 | 3.2 |
| | High | 3.4 | 3.4 | 3.7 | 2.5 | 3.6 | 3.4 | 3.3 | 3.6 | 3.6 | 3.4 | 3.4 |
| | Very High | 3.4 | 3.5 | 3.6 | 3.0 | 3.5 | 3.4 | 3.7 | 3.6 | 3.6 | 3.2 | 3.1 |
| Hysterectomy | Very Low | 25.2 | 20.7 | 22.5 | 11.3 | 23.7 | 28.2 | 11.9 | 19.7 | 20.9 | 24.8 | 27.2 |
| | Low | 21.9 | 21.4 | 20.0 | 14.7 | 23.9 | 24.7 | 11.5 | 20.0 | 23.4 | 24.9 | 24.2 |
| | Medium | 26.1 | 26.4 | 24.3 | 17.1 | 28.2 | 29.1 | 18.0 | 24.8 | 27.6 | 30.5 | 32.6 |
| | High | 25.5 | 27.1 | 24.5 | 20.8 | 30.0 | 27.5 | 21.1 | 25.3 | 29.8 | 30.3 | 32.0 |
| | Very High | 32.9 | 34.3 | 30.8 | 18.9 | 37.2 | 38.4 | 25.0 | 33.7 | 38.2 | 40.1 | 38.4 |

[18] Pregnancy loss is measured in terms of miscarriage or stillbirth.

# Annexure V

## District Profile by Background Characteristics

| Background Characteristics | Andhra Pradesh | | Karnataka | | Kerala | | Maharashtra | | Rajasthan | | Tamil Nadu | | | Uttar Pradesh | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vizianagaram | Anantapur | Bangalore Rural | Udupi | Idukki | Kottayam | Nagpur | Nanded | Churu | Sawai Madhopur | Chennai | Ariyalur | Tiruvallur | Bhanda | Saharanpur |
| Sample | 241 | 246 | 240 | 241 | 241 | 240 | 244 | 241 | 246 | 242 | 90 | 242 | 152 | 240 | 241 |
| Age group | | | | | | | | | | | | | | | |
| 20-45 years | 83.0 | 85.8 | 70.0 | 41.1 | 54.4 | 36.7 | 62.7 | 74.7 | 72.4 | 70.7 | 67.8 | 63.2 | 63.2 | 92.9 | 81.3 |
| 46-60 years | 15.8 | 14.2 | 21.7 | 27.4 | 27.4 | 44.2 | 22.5 | 17.4 | 18.3 | 24.8 | 26.7 | 28.1 | 34.9 | 7.1 | 18.7 |
| Above 60 years | 1.2 | - | 8.3 | 31.5 | 18.3 | 19.2 | 14.8 | 7.9 | 9.4 | 4.6 | 5.6 | 8.7 | 2.0 | - | - |
| Education Level | | | | | | | | | | | | | | | |
| No formal education | 22.0 | 22.4 | 23.8 | 5.0 | 1.2 | 0.8 | 4.5 | 26.1 | 13.8 | 35.5 | 7.8 | 19.4 | 14.5 | 35.0 | 42.3 |
| Primary | 8.7 | 20.3 | 10.4 | 32.0 | 5.4 | 9.6 | 10.3 | 27.8 | 16.7 | 18.2 | 11.1 | 11.6 | 16.5 | 32.5 | 25.3 |
| Secondary | 27.8 | 33.3 | 43.3 | 35.7 | 28.2 | 30.4 | 23.0 | 17.4 | 22.4 | 16.9 | 44.4 | 36.8 | 36.2 | 24.2 | 17.8 |
| Higher education | 41.5 | 24.0 | 22.5 | 27.4 | 65.2 | 59.2 | 62.3 | 28.6 | 47.1 | 29.3 | 36.7 | 32.2 | 32.9 | 8.3 | 14.5 |
| Caste | | | | | | | | | | | | | | | |
| SC | 20.2 | 16.3 | 20.4 | 7.5 | 5.3 | - | 5.9 | 23.3 | 35.4 | 25.6 | 42.3 | 30.0 | 62.8 | 36.8 | 66.1 |
| ST | - | 1.6 | 13.8 | 4.6 | 4.8 | - | 2.9 | 5.4 | 2.8 | 1.7 | - | 0.8 | - | 0.4 | - |
| OBC | 68.9 | 50.8 | 64.2 | 61.8 | 34.3 | 37.5 | 21.6 | 49.2 | 40.0 | 48.8 | 37.2 | 30.4 | 28.1 | 55.2 | 32.6 |
| Others/ General | 10.9 | 31.3 | 1.7 | 26.1 | 55.6 | 62.5 | 18.7 | 22.1 | 21.9 | 24.0 | 20.5 | 38.8 | 9.1 | 7.5 | 1.3 |
| Wealth Index | | | | | | | | | | | | | | | |
| Poor | 13.8 | 19.9 | 49.6 | 5.8 | 5.8 | 0.7 | 24.0 | 27.9 | 49.8 | 72.3 | 16.3 | 36.3 | 14.0 | 84.5 | 37.2 |
| Middle | 35.2 | 45.5 | 34.6 | 57.7 | 18.0 | 9.2 | 40.1 | 46.3 | 21.1 | 21.4 | 25.0 | 45.8 | 16.0 | 13.0 | 42.3 |
| Rich | 51.1 | 34.6 | 15.8 | 36.5 | 76.3 | 90.1 | 36.0 | 25.8 | 29.1 | 6.3 | 58.8 | 17.9 | 70.0 | 2.5 | 20.5 |
| Religion | | | | | | | | | | | | | | | |
| Hindu | 89.1 | 79.7 | 90.0 | 90.5 | 60.0 | 42.9 | 31.2 | 78.7 | 95.8 | 93.0 | 71.8 | 99.6 | 66.9 | 90.4 | 88.4 |
| Muslim | 0.4 | 13.4 | 10.0 | 5.0 | 7.1 | 7.5 | 0.8 | 15.5 | 3.7 | 4.6 | 12.8 | | 2.5 | 9.6 | 11.2 |
| Others | 10.5 | 6.9 | - | 4.6 | 32.9 | 49.6 | 68.0 | 5.9 | 0.5 | 2.5 | 15.4 | 0.4 | 30.6 | | 0.5 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Occupation | | | | | | | | | | | | | | | |
| Homemaker | 62.6 | 52.0 | 68.3 | 88.0 | 57.7 | 77.5 | 70.9 | 78.8 | 42.7 | 44.6 | 77.8 | 76.0 | 77.0 | 70.8 | 60.6 |
| Own business | 8.4 | 7.3 | 6.7 | 0.8 | 2.5 | 7.1 | 5.3 | 8.3 | 9.4 | 7.4 | 2.2 | 1.2 | 4.0 | 2.9 | 2.1 |
| Labourer | 18.1 | 24.0 | 14.6 | 3.3 | 9.5 | 2.1 | 7.4 | 5.0 | 23.6 | 28.9 | 4.4 | 15.3 | 13.8 | 22.1 | 28.2 |
| Tertiary service provider | 10.9 | 13.8 | 9.6 | 7.1 | 2365.0 | 9.2 | 10.7 | 2.1 | 6.5 | 6.2 | 13.3 | 4.1 | 4.0 | 2.5 | 8.3 |
| Others | 1.2 | 2.9 | 0.8 | 0.8 | 6.6 | 4.2 | 5.7 | 5.8 | 17.9 | 12.8 | 2.2 | 3.3 | 1.3 | 1.7 | 0.8 |
| Marital status | | | | | | | | | | | | | | | |
| Never married | 6.7 | 4.1 | 7.5 | 7.9 | 20.6 | 6.3 | 18.1 | 12.1 | 4.9 | 11.2 | 12.2 | 2.9 | 8.6 | 2.5 | 0.4 |
| Married | 86.1 | 88.2 | 82.1 | 78.4 | 72.3 | 79.2 | 67.9 | 72.9 | 86.6 | 76.9 | 77.8 | 81.0 | 77.5 | 92.5 | 94.2 |
| Widow | 5.9 | 7.3 | 10.0 | 13.7 | 6.7 | 14.6 | 12.4 | 12.1 | 8.1 | 9.5 | 6.7 | 15.7 | 13.3 | 3.3 | 5.4 |
| Divorced/Separated | 1.3 | 0.4 | 0.4 | | 0.4 | - | 1.7 | 2.9 | 0.4 | 2.5 | 3.3 | 0.4 | 0.7 | 1.7 | - |
| Household size | | | | | | | | | | | | | | | |
| Up to 4 members | 51.0 | 59.8 | 59.6 | 49.0 | 54.4 | 76.3 | 54.1 | 59.3 | 32.1 | 58.7 | 68.9 | 71.1 | 62.5 | 33.8 | 18.3 |
| 5-7 members | 44.4 | 36.7 | 35.0 | 48.6 | 41.1 | 22.5 | 41.8 | 36.1 | 54.9 | 40.1 | 30.0 | 27.7 | 32.9 | 63.8 | 59.3 |
| 8 or more members | 4.6 | 3.3 | 5.4 | 2.5 | 4.6 | 1.3 | 4.1 | 4.6 | 13.0 | 1.2 | 1.1 | 1.2 | 4.6 | 2.5 | 22.4 |
| House Quality Index | | | | | | | | | | | | | | | |
| Poor | 55.7 | 8.5 | 61.8 | 44.8 | 35.4 | 10.4 | 7.1 | 26.5 | 14.4 | 6.0 | 45.0 | 89.7 | 70.6 | 91.4 | 22.2 |
| Better | 37.5 | 57.6 | 38.2 | 48.3 | 49.0 | 60.4 | 21.4 | 51.0 | 20.9 | 11.3 | 30.0 | 6.9 | 17.7 | 7.1 | 53.3 |
| Good | 6.8 | 33.9 | - | 6.9 | 15.6 | 29.2 | 71.4 | 22.5 | 64.8 | 82.7 | 25.0 | 3.5 | 11.8 | 1.4 | 24.4 |
| Place of residence | | | | | | | | | | | | | | | |
| Urban | 37.3 | 35.4 | 37.1 | 37.8 | 37.8 | 37.5 | 39.8 | 37.9 | 36.0 | 21.2 | 100.0 | 37.2 | | 35.4 | 37.3 |
| Rural | 62.7 | 64.6 | 62.9 | 62.2 | 62.2 | 62.5 | 60.3 | 62.1 | 64.0 | 78.8 | | 62.8 | 100.0 | 64.6 | 62.7 |

*Note: All values are in percentages (%)*

# Annexure VI

## Women's Health-Related Outcomes Across Background Characteristics

| Background Characteristics | Health Outcomes | | | |
|---|---|---|---|---|
| | Impact on General Physical Health | Impact on Reproductive Health | Impact on Menstrual Health | Impact on Mental Health |
| Sample | 3361 | 3360 | 2835 | 3314 |
| **Heat Vulnerability Index** | **($\chi^2$=330.9, p<0.001)** | **($\chi^2$=602.8, p<0.001)** | **($\chi^2$=365.10, p<0.001)** | **($\chi^2$=268.30, p<0.001)** |
| Low | 56.1 | 24.5 | 16.0 | 52.4 |
| Medium | 64.3 | 50.7 | 33.8 | 61.8 |
| High | 89.8 | 76.4 | 57.2 | 84.4 |
| **Age group** | **($\chi^2$=2.57, p=0.276)**** | **($\chi^2$=115.6, p<0.001)** | **($\chi^2$=151.4, p<0.001)** | **($\chi^2$=12.11, p=0.002)**** |
| 20-45 years | 70.2 | 56.3 | 41.0 | 68.0 |
| 46-60 years | 68.4 | 42.5 | 17.7 | 61.1 |
| Above 60 years | 73.3 | 27.4 | 5.0 | 65.2 |
| **Education Levels** | **($\chi^2$=68.34, p<0.001)** | **($\chi^2$=112.9, p<0.001)** | **($\chi^2$=18.93, p<0.001)** | **($\chi^2$=124.92, p<0.001)** |
| No formal education | 79.5 | 65.2 | 38.1 | 78.8 |
| Primary | 77.6 | 59.4 | 42.0 | 76.1 |
| Secondary | 63.8 | 43.4 | 35.6 | 64.6 |
| Higher education | 66.3 | 44.0 | 31.2 | 56.0 |
| **Caste** | **($\chi^2$=33.35, p<0.001)** | **($\chi^2$=55.08, p<0.001)** | **($\chi^2$=62.17, p<0.001)** | **($\chi^2$=62.48, p<0.001)** |
| SC | 72.5 | 58.0 | 43.8 | 76.1 |
| ST | 45.1 | 27.8 | 19.0 | 60.2 |
| OBC | 71.2 | 49.3 | 33.3 | 65.4 |
| Others/General | 67.3 | 43.3 | 25.2 | 58.3 |
| **Wealth Index** | **($\chi^2$=18.2, p<0.001)** | **($\chi^2$=175.5, p<0.001)** | **($\chi^2$=37.76, p<0.001)** | **($\chi^2$=129.19, p<0.001)** |
| Poor | 74.7 | 65.2 | 43.0 | 76.4 |
| Middle | 68.4 | 48.5 | 31.7 | 68.2 |
| Rich | 67.0 | 37.6 | 31.1 | 53.9 |
| **Religion** | **($\chi^2$=0.17, p=0.917)**** | **($\chi^2$=85.48, p<0.001)** | **($\chi^2$=47.95, p<0.001)** | **($\chi^2$=90.51, p<0.001)** |
| Hindu | 70.2 | 53.0 | 36.3 | 69.5 |
| Muslim | 71.2 | 58.7 | 45.1 | 66.4 |
| Others | 69.6 | 31.1 | 19.6 | 47.1 |
| **Work sector** | **($\chi^2$=77.33, p<0.001)** | **($\chi^2$=153.9, p<0.001)** | **($\chi^2$=20.80, p<0.001)** | **($\chi^2$=83.98, p<0.001)** |
| Homemaker | 65.8 | 44.9 | 33.83 | 63.2 |
| Formal sector | 72.3 | 45.5 | 30.14 | 56.9 |
| Informal sector | 83 | 71.2 | 42.95 | 80.3 |
| **Marital status** | **($\chi^2$=14.9, p=0.005)** | **($\chi^2$=12.19, p=0.016)**** | **($\chi^2$=26.83, p<0.001)** | **($\chi^2$=45.34, p<0.001)** |
| Never married | 60.9 | 42.5 | 30.1 | 47.9 |
| Married | 70.6 | 51.4 | 37.2 | 67.8 |

| | | | | |
|---|---|---|---|---|
| Widow | 71.7 | 48.6 | 19.3 | 68.2 |
| Divorced/Separated | 83.9 | 65.6 | 40.7 | 71.0 |
| **Household size** | **($\chi^2$=44.05, p<0.001)** | **($\chi^2$=68.24, p<0.001)** | **($\chi^2$=27.13, p<0.001)** | **($\chi^2$=66.58, p<0.001)** |
| Up to 4 members | 65.3 | 44.3 | 31.2 | 60.0 |
| 5-7 members | 74.9 | 56.2 | 38.6 | 72.6 |
| 8 and more | 80.5 | 68.8 | 47.6 | 78.0 |
| **House Quality Index** | **($\chi^2$=5.86, p=0.053)**** | **($\chi^2$=72.77, p<0.001)** | **($\chi^2$=12.75, p=0.002)**** | **($\chi^2$=76.87, p<0.001)** |
| Poor | 70.8 | 60.3 | 39.7 | 70.9 |
| Better | 67.4 | 45.1 | 32.8 | 71.2 |
| Good | 72.1 | 44.9 | 33.2 | 55.4 |
| **Place of residence** | **($\chi^2$=0.66, p=0.416)**** | **($\chi^2$=10.91, p<0.001)** | **($\chi^2$=1.43, p=0.231)**** | **($\chi^2$=1.02, p=0.312)**** |
| Urban | 70.9 | 46.8 | 33.9 | 67.3 |
| Rural | 69.6 | 52.7 | 36.2 | 65.6 |

*Note: "-"indicates not enough sample.; p-value < 0.001 indicates a statistically significant association at the 1% level of significance. All values are in percentages (%).*

***indicates the non-significant association with p-value >0.001, The test of significance used is the Chi-square test.*

# Annexure VII

## Heat-Related Impact on Women's Interpersonal Relationships at Work and Home by Background Characteristics

| Background Characteristics | Interpersonal Conflict at Work | Interpersonal Conflict at Home |
|---|---|---|
| Sample | 1134 | 3363 |
| Heat Vulnerability Index | ($\chi^2$=177.03, p<0.001) | ($\chi^2$=255.87, p<0.001) |
| Low | 16.1 | 42.4 |
| Medium | 25.7 | 38.2 |
| High | 59.4 | 69.3 |
| Age group | ($\chi^2$=5.79, p=0.055)** | ($\chi^2$=56.45, p<0.001) |
| 20-45 years | 39.7 | 54.4 |
| 46-60 years | 37.4 | 40.2 |
| Above 60 years | 21.4 | 41.3 |
| Education Level | ($\chi^2$=40.38, p<0.001) | ($\chi^2$=85.96, p<0.001) |
| No formal education | 50.6 | 56.7 |
| Primary | 42.6 | 62.9 |
| Secondary | 42.7 | 48.2 |
| Higher education | 27.7 | 41.5 |
| Caste | ($\chi^2$=19.80, p<0.001) | ($\chi^2$=28.45, p<0.001) |
| SC | 45.9 | 49.4 |
| ST | 35.7 | 52.8 |
| OBC | 37.7 | 53.6 |
| Others/General | 28.6 | 41.8 |
| Wealth Index | ($\chi^2$=28.02, p<0.001) | ($\chi^2$=91.12, p<0.001) |
| Poor | 47.0 | 56.2 |
| Middle | 36.0 | 55.4 |
| Rich | 29.0 | 38.3 |
| Religion | ($\chi^2$=54.38, p<0.001) | ($\chi^2$=227.23, p<0.001) |
| Hindu | 42.4 | 54.0 |
| Muslim | 35.9 | 60.5 |
| Others | 12.1 | 17.7 |
| Work sector | ($\chi^2$=39.93, p<0.001) | ($\chi^2$=90.34, p<0.001) |
| Homemaker | NA | 46.1 |
| Formal sector | 24.4 | 43.3 |
| Informal sector | 45.0 | 65.8 |
| Marital status | ($\chi^2$=49.77, p<0.001) | ($\chi^2$=40.13, p<0.001) |
| Never married | 16.0 | 36.9 |
| Married | 44.1 | 52.6 |
| Widow | 35.7 | 40.0 |
| Divorced/Separated | 35.0 | 46.9 |
| Household size | ($\chi^2$=33.18, p<0.001) | ($\chi^2$=71.34, p<0.001) |
| Up to 4 members | 30.8 | 43.5 |
| 5-7 members | 44.3 | 56.1 |
| 8 and more | 58.6 | 67.1 |
| House Quality Index | ($\chi^2$=16.39, p<0.001) | ($\chi^2$=204.87, p<0.001) |

| | | |
|---|---|---|
| **Poor** | 45.3 | 65.1 |
| **Better** | 32.8 | 47.1 |
| **Good** | 34.1 | 35.3 |
| **Place of residence** | **($\chi^2$=6.93, p=0.008)**** | **($\chi^2$=23.38, p<0.001)** |
| **Urban** | 32.5 | 44.4 |
| **Rural** | 40.9 | 53.1 |

*Note: "-" indicates not enough sample; p- value <0.001 indicates significant association at 1% level of significance. All values are in percentages (%).*

***indicates the non-significant association with p-value >0.001, The test of significance used is the Chi-square test.*

# Annexure VIII

## Reported Prevalence of Health-Related Adverse Heat Impacts Across Levels of Heat Vulnerability for Different Socio-Economic Background Characteristics

| Background Characteristics | Impact on General Physical Health | | | | Impact on Reproductive Health | | | | Impact on Menstrual Health | | | | Impact on Mental Health | | | | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Heat Vulnerability Index | | | | Heat Vulnerability Index | | | | Heat Vulnerability Index | | | | Heat Vulnerability Index | | | | |
| | Low | Medium | High | p-value ($\chi^2$) | Low | Medium | High | p-value ($\chi^2$) | Low | Medium | High | p-value ($\chi^2$) | Low | Medium | High | p-value ($\chi^2$) | |
| **Age group** | | | | | | | | | | | | | | | | | |
| **20-45 years** | 23.7 | 27.9 | 48.5 | <0.001 | 16.7 | 30.4 | 53.0 | <0.001 | 15.8 | 29.0 | 55.3 | <0.001 | 24.4 | 28.1 | 47.5 | <0.001 | 2307 |
| **46-60 years** | 30.3 | 36.0 | 33.7 | <0.001 | 14.1 | 42.2 | 43.7 | <0.001 | 20.5 | 34.9 | 44.6 | <0.001 | 25.2 | 40.1 | 34.7 | <0.001 | 772 |
| **Above 60 years** | 40.1 | 36.9 | 23.0 | 0.005** | 15.7 | 47.0 | 37.4 | <0.001 | - | 14.3 | 85.7 | <0.001 | 47.7 | 27.9 | 24.4 | <0.001 | 307 |
| **Education level** | | | | | | | | | | | | | | | | | |
| **No formal education** | 10.9 | 32.5 | 56.6 | <0.001 | 6.3 | 36.1 | 57.7 | <0.001 | 8.8 | 30.2 | 61.0 | <0.001 | 14.6 | 32.2 | 53.3 | 0.003** | 638 |
| **Primary** | 20.3 | 29.1 | 50.6 | <0.001 | 8.9 | 33.3 | 57.8 | <0.001 | 11.5 | 23.0 | 65.5 | <0.001 | 25.5 | 24.8 | 49.8 | <0.001 | 588 |
| **Secondary** | 22.5 | 30.5 | 47.0 | <0.001 | 11.4 | 32.4 | 56.3 | <0.001 | 11.7 | 27.8 | 60.5 | <0.001 | 28.9 | 27.6 | 43.5 | <0.001 | 959 |
| **Higher education** | 43.8 | 30.1 | 26.1 | <0.001 | 32.7 | 32.3 | 35.0 | <0.001 | 26.1 | 34.0 | 39.9 | <0.001 | 34.2 | 36.2 | 29.6 | <0.001 | 1201 |
| **Caste** | | | | | | | | | | | | | | | | | |
| **SC** | 16.5 | 39.9 | 43.6 | <0.001 | 15.5 | 38.1 | 46.4 | <0.001 | 19.0 | 32.3 | 48.7 | <0.001 | 19.0 | 39.6 | 41.5 | <0.001 | 914 |
| **ST** | 41.5 | 26.8 | 31.7 | 0.001** | 20.0 | 36.0 | 44.0 | <0.001 | 26.7 | 33.3 | 40.0 | 0.004** | 52.8 | 22.6 | 24.5 | 0.068** | 91 |
| **OBC** | 28.3 | 23.6 | 48.2 | <0.001 | 14.1 | 28.4 | 57.5 | <0.001 | 12.2 | 25.1 | 62.8 | <0.001 | 32.1 | 21.3 | 46.6 | <0.001 | 1469 |
| **Others /General** | 34.0 | 34.0 | 31.9 | <0.001 | 16.5 | 38.4 | 45.1 | <0.001 | 9.5 | 33.8 | 56.8 | <0.001 | 26.6 | 36.9 | 36.5 | <0.001 | 777 |
| **Wealth Index** | | | | | | | | | | | | | | | | | |
| **Poor** | 7.3 | 31.0 | 61.7 | <0.001 | 5.4 | 31.6 | 63.0 | <0.001 | 7.8 | 25.0 | 67.2 | <0.001 | 11.8 | 29.6 | 58.6 | <0.001 | 1160 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Middle** | 29.9 | 35.5 | 34.7 | <0.001 | 20.1 | 39.4 | 40.5 | <0.001 | 20.5 | 34.0 | 45.5 | <0.001 | 33.7 | 33.2 | 33.1 | <0.001 | 1101 |
| **Rich** | 45.7 | 25.1 | 29.2 | <0.001 | 30.2 | 29.2 | 40.6 | <0.001 | 23.8 | 31.1 | 45.1 | <0.001 | 39.2 | 28.9 | 31.9 | <0.001 | 1125 |
| **Religion** | | | | | | | | | | | | | | | | | |
| **Hindu** | 26.7 | 27.1 | 46.2 | <0.001 | 16.1 | 31.1 | 52.8 | <0.001 | 16.4 | 26.3 | 57.3 | <0.001 | 29.5 | 26.6 | 43.9 | <0.001 | 2577 |
| **Muslim** | 22.2 | 36.2 | 41.1 | <0.001 | 10.7 | 42.8 | 46.6 | <0.001 | 11.4 | 38.6 | 50.0 | <0.001 | 28.2 | 28.9 | 43.0 | <0.001 | 224 |
| **Others** | 32.1 | 46.6 | 21.4 | 0.046** | 24.7 | 47.3 | 28.0 | <0.001 | 21.4 | 45.7 | 32.9 | <0.001 | 9.7 | 61.7 | 28.6 | <0.001 | 489 |
| **Work sector** | | | | | | | | | | | | | | | | | |
| **Homemaker** | 32.1 | 31.3 | 36.6 | <0.001 | 20.6 | 36.6 | 42.8 | <0.001 | 18.7 | 32.9 | 48.4 | <0.001 | 32.9 | 31.0 | 36.1 | <0.001 | 2339 |
| **Formal sector** | 39.1 | 28.7 | 32.2 | <0.001 | 22.6 | 32.9 | 44.5 | <0.001 | 26.1 | 22.7 | 51.1 | <0.001 | 31.5 | 31 | 37.6 | <0.001 | 321 |
| **Informal sector** | 7.8 | 29.2 | 63.1 | <0.001 | 4.9 | 27.2 | 67.9 | <0.001 | 5.7 | 22.9 | 71.4 | <0.001 | 9.0 | 29.5 | 61.5 | <0.001 | 715 |
| **Workplace** | | | | | | | | | | | | | | | | | |
| **Indoor** | 11.7 | 31.2 | 57.1 | <0.001 | 9.2 | `27.9 | 62.9 | <0.001 | 12.9 | 16.5 | 70.6 | <0.001 | 13.2 | 31.5 | 55.4 | <0.001 | 485 |
| **Outdoor** | 37.8 | 31.8 | 30.5 | <0.001 | 22 | 36.2 | 41.8 | <0.001 | 24.0 | 33.3 | 42.7 | <0.001 | 31.5 | 34.3 | 34.3 | <0.001 | 363 |
| **Both** | 5.6 | 21.8 | 72.6 | <0.001 | 2.0 | 24.1 | 73.9 | <0.001 | 2.9 | 23.9 | 73.2 | 0.007** | 2.8 | 22.1 | 75.1 | <0.001 | 281 |
| **Marital status** | | | | | | | | | | | | | | | | | |
| **Never married** | 38.2 | 40.6 | 21.2 | 0.003** | 18.6 | 56.6 | 24.8 | <0.001 | 19.8 | 48.2 | 32.1 | <0.001 | 23.6 | 52.8 | 23.6 | <0.001 | 275 |
| **Married** | 27.0 | 28.5 | 44.4 | <0.001 | 17.2 | 30.4 | 52.4 | <0.001 | 16.4 | 27.5 | 56.1 | <0.001 | 28.0 | 28.4 | 46.6 | <0.001 | 2742 |
| **Widow** | 18.5 | 36.9 | 44.6 | <0.001 | 7.0 | 41.8 | 51.3 | <0.001 | 3.0 | 30.3 | 66.7 | <0.001 | 16.6 | 34.3 | 46.1 | <0.001 | 327 |
| **Divorced/ Separated** | 3.9 | 53.9 | 42.3 | 0.020** | - | 52.4 | 47.6 | 0.025** | - | 36.4 | 63.6 | 0.178** | 4.6 | 50.0 | 45.5 | 0.224** | 32 |
| **Household size** | | | | | | | | | | | | | | | | | |
| **Up to 4 members** | 27.7 | 33.6 | 38.7 | <0.001 | 16.3 | 37.6 | 46.1 | <0.001 | 14.3 | 33.5 | 52.2 | <0.001 | 26.0 | 34.0 | 40.0 | <0.001 | 1793 |
| **5-7 members** | 26.2 | 26.6 | 47.2 | <0.001 | 15.4 | 28.8 | 55.8 | <0.001 | 16.7 | 24.3 | 59.0 | <0.001 | 27.7 | 26.8 | 45.6 | <0.001 | 1414 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **8 or more members** | 22.1 | 34.3 | 43.6 | <0.001 | 20.2 | 37.0 | 42.9 | <0.001 | 21.8 | 37.2 | 41.0 | 0.045** | 23.7 | 33.3 | 43.0 | <0.001 | 179 |
| **House Quality Index** | | | | | | | | | | | | | | | | | |
| **Poor** | 13.4 | 32.6 | 54.0 | <0.001 | 9.4 | 32.2 | 58.5 | <0.001 | 9.6 | 27.8 | 62.7 | <0.001 | 15.9 | 30.8 | 53.4 | <0.001 | 1235 |
| **Better** | 27.6 | 35.9 | 36.5 | <0.001 | 19.0 | 39.9 | 41.1 | <0.001 | 20.1 | 38.2 | 41.7 | <0.001 | 32.6 | 35.1 | 32.4 | <0.001 | 1105 |
| **Good** | 41.2 | 22.9 | 35.9 | <0.001 | 23.8 | 28.7 | 47.5 | <0.001 | 20.9 | 21.9 | 57.2 | <0.001 | 34.6 | 24.3 | 41.1 | <0.001 | 1046 |
| **Place of residence** | | | | | | | | | | | | | | | | | |
| **Urban** | 31.7 | 32.9 | 35.4 | <0.001 | 20.1 | 38.4 | 41.6 | <0.001 | 20.7 | 25.3 | 54.0 | <0.001 | 32.3 | 34.0 | 33.8 | <0.001 | 1221 |
| **Rural** | 23.8 | 29.2 | 47.0 | <0.001 | 14.2 | 31.0 | 54.9 | <0.001 | 13.8 | 31.4 | 54.9 | <0.001 | 23.3 | 28.7 | 48.0 | <0.001 | 2165 |

*Note: "-" indicates not enough sample: Chi-square value <0.001 indicates significant association at 1% level of significance. All values are in percentages (%).*

*** indicates non-significant association with p-value >0.001,the test of significance used is Chi-square test*

# Annexure IX

## Heat-Related Impacts on Women's Daily Routines and Experiences of Violence by Background Characteristics

| Background Characteristics | Impact on daily Routine | Ever Experienced Violence | Increase in Violence |
|---|---|---|---|
| Sample | 2924 | 3373 | 293 |
| Heat Vulnerability Index | ($\chi^2$=39.74, p<0.001) | ($\chi^2$=467.45, p<0.001) | ($\chi^2$=29.81, p<0.001) |
| Low | 84.9 | 4.2 | 38.1 |
| Medium | 85.8 | 12.5 | 40.8 |
| High | 92.9 | 38.0 | 71.6 |
| Age group | ($\chi^2$=3.71, p=0.157)** | ($\chi^2$=38.04 p<0.001) | ($\chi^2$=0.44, p=0.803)** |
| 20-45 years | 87.1 | 20.8 | 56.9 |
| 46-60 years | 89.7 | 14.6 | 52.4 |
| Above 60 years | 88.7 | 8.2 | 60.0 |
| Education Level | ($\chi^2$=58.46, p<0.001) | ($\chi^2$=52.06, p<0.001) | ($\chi^2$=3.55, p=0.315)** |
| No formal education | 90.7 | 24.2 | 32.0 |
| Primary | 93.5 | 24.9 | 52.1 |
| Secondary | 89.3 | 15.6 | 49.3 |
| Higher education | 82.2 | 13.9 | 60.6 |
| Caste | ($\chi^2$=86.53, p<0.001) | ($\chi^2$=21.01, p<0.001) | ($\chi^2$=17.46, p=0.001) |
| SC | 91.3 | 22.0 | 58.5 |
| ST | 87.5 | 14.4 | 50.0 |
| OBC | 90.6 | 17.6 | 43.5 |
| Others/General | 78.2 | 13.6 | 78.0 |
| Wealth Index | ($\chi^2$=62.91, p<0.001) | ($\chi^2$=125.22, p<0.001) | ($\chi^2$=5.55, p=0.062)** |
| Poor | 92.5 | 28.2 | 48.4 |
| Middle | 89.2 | 15.7 | 59.6 |
| Rich | 81.8 | 10.6 | 64.7 |
| Religion | ($\chi^2$=55.15, p<0.001) | ($\chi^2$=78.07, p<0.001) | ($\chi^2$=4.86, p=0.088)** |
| Hindu | 90.1 | 20.2 | 57.9 |
| Muslim | 80.5 | 21.2 | 37.5 |
| Others | 79.4 | 3.7 | 50.0 |
| Work sector | ($\chi^2$=32.41, p<0.001) | ($\chi^2$=173.04, p<0.001) | ($\chi^2$=8.94, p=0.011) |
| Homemaker | 87.6 | 13.6 | 48.1 |
| Formal sector | 79.5 | 14.6 | 72.7 |
| Informal sector | 92.3 | 35.1 | 63.3 |
| Marital status | ($\chi^2$=124.64 p<0.001) | ($\chi^2$=24.60, p<0.001) | ($\chi^2$=5.78, p=0.123)** |
| Never married | 65.6 | 7.7 | 50.0 |
| Married | 89.8 | 19.5 | 55.0 |
| Widow | 87.4 | 16.3 | 73.9 |
| Divorced/Separated | 93.8 | 21.9 | |

| | | | |
|---|---|---|---|
| **Household size** | **($\chi^2$=4.53, p=0.104)**** | **($\chi^2$=56.99, p<0.001)** | **($\chi^2$=1.08, p=0.582)** |
| **Up to 4 members** | 86.9 | 14.0 | 53.1 |
| **5-7 members** | 88.6 | 21.9 | 57.3 |
| **8 and more** | 91.8 | 32.4 | 62.5 |
| **House Quality Index** | **($\chi^2$=31.144, p<0.001)** | **($\chi^2$=85.36, p<0.001)** | **($\chi^2$=11.72, p=0.003)** |
| **Poor** | 89.5 | 26.3 | 50.0 |
| **Better** | 90.5 | 14.8 | 53.7 |
| **Good** | 83.2 | 12.4 | 76.4 |
| **Place of residence** | **($\chi^2$=0.463, p=0.496)**** | **($\chi^2$=3.19, p=0.074)**** | **($\chi^2$=0.72, p=0.396)**** |
| **Urban** | 88.4 | 16.7 | 52.5 |
| **Rural** | 87.6 | 19.1 | 57.7 |

*Note: "-" indicates not enough sample; Affect Daily Routine translates to difficulty in performing daily households chores like cleaning, cooking, exhaustion, etc. All values are in percentages (%)*

***indicates the non-significant association with p-value >0.001, The test of significance used is the Chi-square test.*

# Annexure X

## Case Studies

### 1. Examining the Impacts of Heat on Women's Work and Health in Singareni Colony, an Informal Settlement in Hyderabad, India.

*Contributed by: Chidananda Arpita and Swastik Harish*

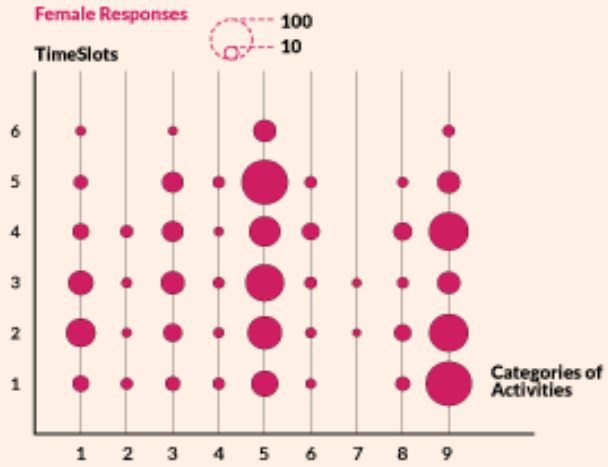
**Attributions:**

1. Data collection, analysis and presentation in this blog is a joint effort of the Indian Institute of Technology, Hyderabad, the Hyderabad Urban Lab, the Dalit Women's Collective, Singareni Colony, Hyderabad and Swastik Harish and Associates, Bengaluru. Research supporting this post was supported by funding from the Economic and Social Research Council's (ESRC), UK Global Challenges Research Fund (GCRF) for the project, Cool Infrastructures: Life with Heat in the Off-Grid City (Award No: ES/T008091/1).
2. Principal Investigator: Prof. Aalok Khandekar, Associate Professor of Anthropology/ Sociology, Department of Liberal Arts | Department of Climate Change, Indian Institute of Technology, Hyderabad

**Background:** Gender norms are visible in the very way labour itself is distributed among men and women in Singareni Colony. In addition to engaging in a wide range of employment activities such as street vending, housekeeping, domestic work, waste segregation and home-based work such as ginger-garlic peeling, bangle making, garland making, copper-wire extraction, etc., women were responsible for a starkly high share of unpaid domestic and care-giving work. On the contrary, no men from our study could be classified as homemakers; while only a few reported to be engaging in any unpaid domestic (13%) or care-giving work (21%). Such an uneven distribution of labour is clearly reflected in the disparate experiences of heat among men and women during extreme heat events in Singareni colony. The inadequate kutcha and semi-pakka houses of the Basti showed almost equal or even higher peak indoor

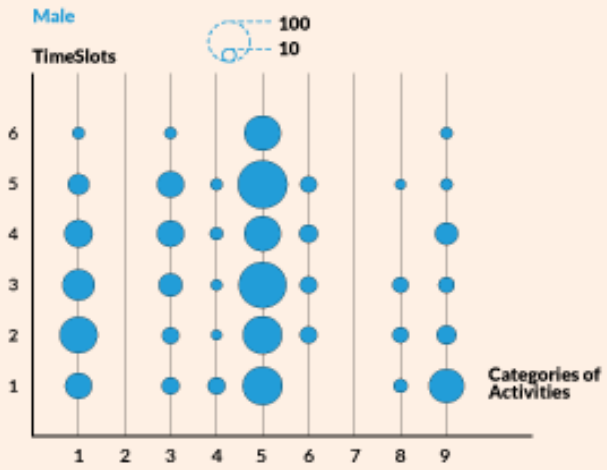
# What do they do throughout the day?

## Distribution of female responses across various categories of activities and timeslots.




*Graph 2: Distribution of female responses across various categories of activities and timeslots*

## Distribution of male responses across various categories of activities and timeslots




*Graph 3: Distribution of male responses across various categories of activities and timeslots.*

| Graph | Categories of Activities (X-axis) | Time Slots (Y-axis) |
|---|---|---|
| Graphs 2&3 | 1. Employment and related activities<br>2. Learning<br>3. Leisure, Mass media, and Sports<br>4. Religious and cultural practices<br>5. Self-care/Maintenance<br>6. Socialization<br>7. Travelling<br>8. Unpaid caregiving services<br>9. Unpaid domestic activities | 1. Early morning (4am-8am)<br>2. Morning (8am-12pm)<br>3. Afternoon (12pm-4pm)<br>4. Evening (4pm-8pm)<br>5. Night (8pm-12am)<br>6. Midnight (12am-4am) |

*Figure 2: Distribution of everyday activities across gender*[1]

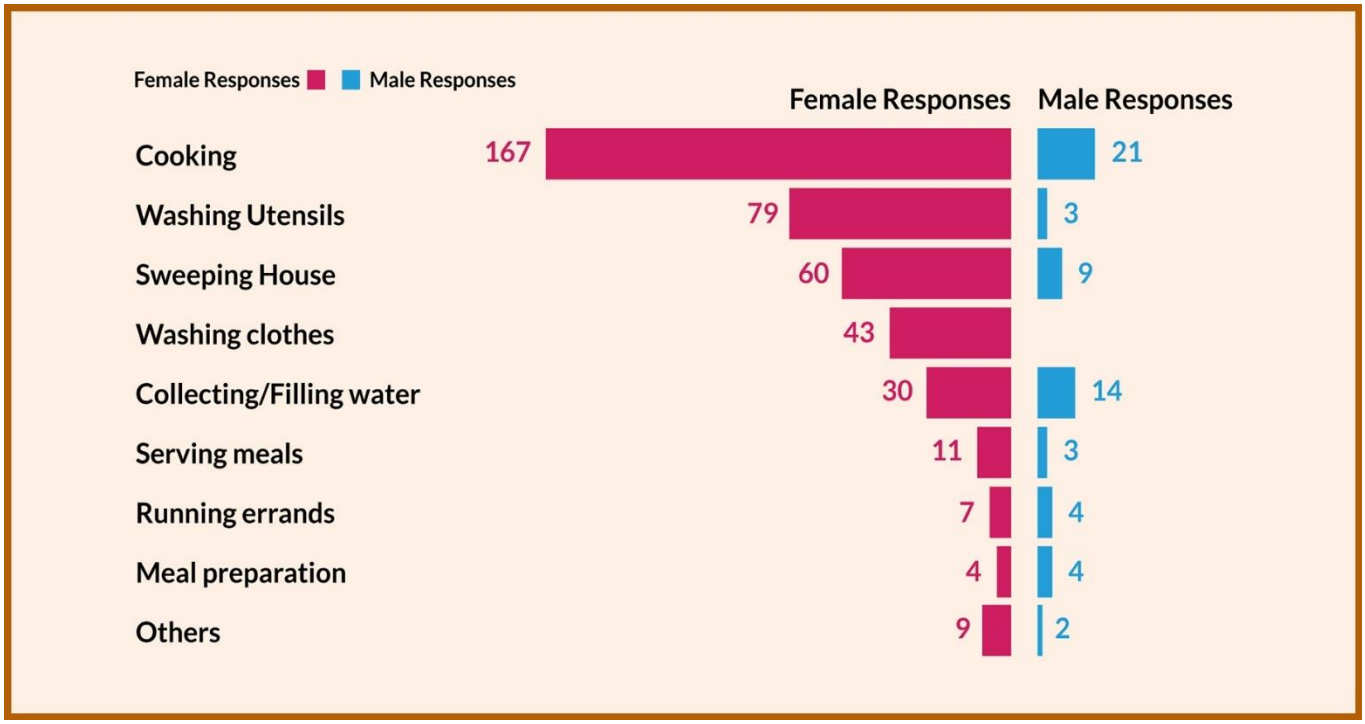



*Figure 2:Distribution of unpaid domestic activities across gender*

temperatures than peak outdoor temperatures in the 2023 summer, and crossed a shocking 46°C in May and 47°C in June *(source: temperature sensor data)*. The nature of labour along with cultural barriers restrict the mobility of women within a limited radius around their houses in Singareni Colony, where they spend much longer indoor hours in a day in comparison to men. Exposure to such high temperatures along with intense workload subject women to various kinds of heat led health risks. The kitchen turns into an 'oven' during summers as rightly described by one of our respondents.

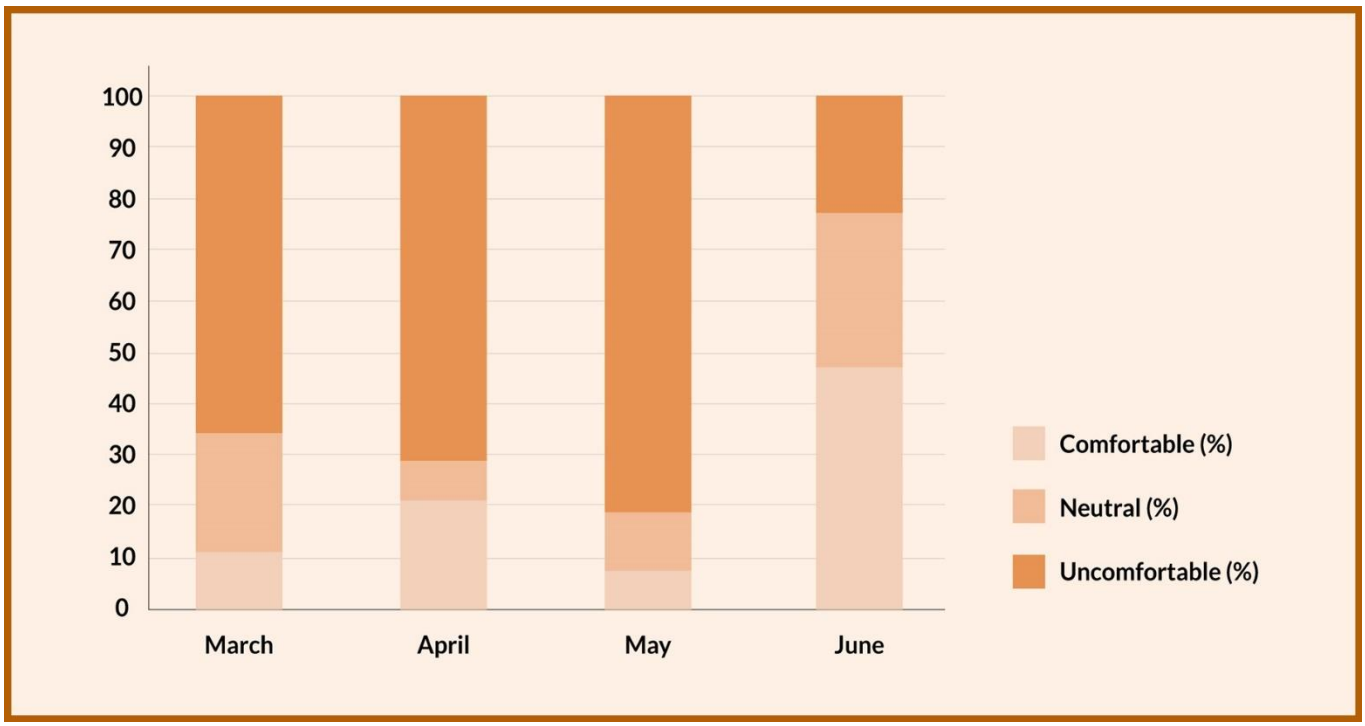



*Figure 1 Comfort levels while cooking over March to June*

Several women in the neighborhood complain of excessive sweating and suffocation along with feeling irritable while cooking during the peak summer periods describing their feeling as 'Thakaan' (translates to fatigue) (link). A woman who makes bangles using chemicals to decorate the bangle frames with glitters in a very congested space in her house, says she feels the hottest while cooking and while making bangles.

| Feeling uncomfortable while conducting various activities | Female % | Male % |
|---|---|---|
| Indoor | 84% | 67% |
| Outdoor | 13% | 32% |
| Threshold Space<br>(Veranda, Staircase, Corridors, Alleyways) | 3% | 1% |

*Table 1. Perception across place of activity and gender*
*Source: Time Activity Perception Data, Working Paper (Arpita, Khandekar)*

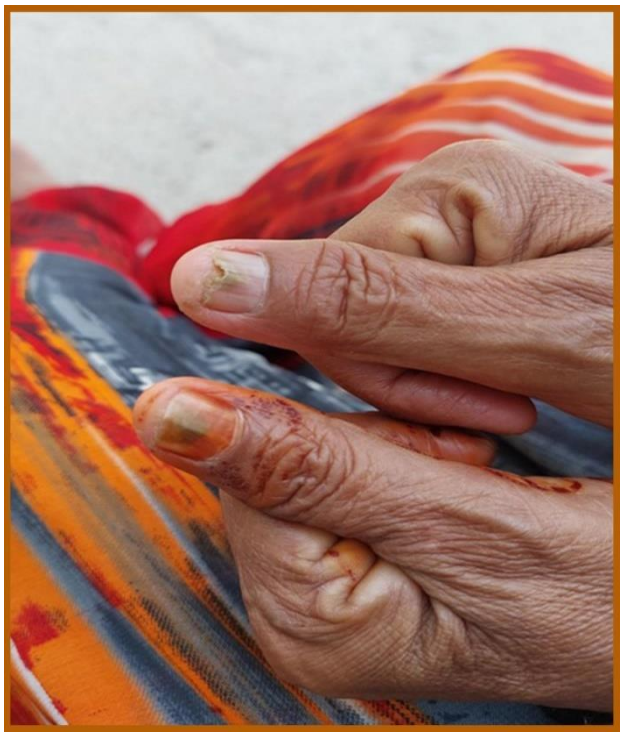


*Figure 4: Physical signs of impact from ginger-garlic peeling done regularly by our respondent*

Out of the total number of times our respondents took measures regarding the health of their own or their family members throughout the year, 80% (204 responses) were related to heat, out of which 25% (64 responses) were serious measures such as 'consulting a doctor for heat related problems', or 'taking medication for heat-related problems'. Out of 49 responses where our respondents mentioned having suffered from various health problems throughout the year, 43 % (21 responses) were directly related to heat. *(Source: TAPS)*.

While measuring the effect of heat on the residents of Singareni Colony, understanding the nature of their livelihood and the materiality of their jobs became crucial. Heat impacted the livelihood of women in Singareni colony in specific ways. Each job involving a direct contact with a certain kind of material had a particular effect on their experience of work in summers. This relationality could be well understood from home-based work which is predominantly done by women in the Basti. When women handle kilos of ginger and garlic everyday from within their homes or at the depot, their hands feel the heat from the material itself. They describe it by saying “ungli/haath tadakda hai”, which literally translates to ‘fingers and hands burn’. While the peeling part is handled by women, men are usually associated with either arranging the stock at the depot or selling the stock on their carts. Damaged fingertips, cracks on fingers and palms, heat rashes are some of the physical signs you find on the hands of these women who peel and sort ginger and garlic regularly. A bangle maker who uses chemicals to decorate the bangle frames with glitters in a very congested space in

*Figure 5: Shaded outdoor and threshold spaces in Singareni*

her house says she feels the hottest while cooking and while making bangles. Additionally, she is constantly worried for her toddler while working who approaches her amidst work and is at the risk of coming in contact with the chemicals. Despite this, she prefers summers because the chemicals do not stiffen up and remain fluidy which helps her make more bangles in less time. Do we think of such everyday household level risks, while imagining heat?

What emerged from our research as spatial pockets of comfort and solace amidst the everyday bodily discomfort in the summer, were the ‘shaded outdoor and threshold spaces’ which included verandahs, shaded alleyways, shaded spaces under the trees etc. Unlike socialising and relaxing at a tea stall, which is predominantly done by men (link), such spaces provide maximum comfort to both men and women through a day, but especially to women who otherwise have limited choices for adaptation.

Such spaces allowed women to socialise, and release heat led stress even during the hottest days of April and May (link). Such granular understanding of heat and its impact hardly make it to the wider discourses around carbon neutrality or even city level heat action plans. Socio-economic considerations at household levels and risks of indoor spaces are overlooked in the government heat warning manuals which encourage people to remain indoors during heatwaves. Potential of shaded threshold and outdoor spaces in low income settlements are often overlooked in city planning practices and especially in slum resettlement and rehabilitation projects.

**Research design**

Designing a methodological framework that allows us to understand the impact of heat in low-income settlements (i) at a household level and (ii) at the scale of 'daily' or 'everyday' risks of heat, was the core objective of our study. The study was conducted over 1.5 years approximately. We combined multiple methods that can capture all of the various facets and dimensions of the 'social life of heat' in the best way possible. Broadly, there were a few things that the team tried to capture: physical heat data, people's daily perception of heat, adaptation and mitigation strategies to respond to heat, the broader cultural and social understanding of life with heat.

In order to capture these various dimensions of heat, the team used 4 major kinds of tools or methods :

(i) **Temperature and humidity sensors and data loggers** which capture readings at regular intervals in the living areas, sleeping areas, kitchens and external spaces of our respondents' houses. The sensors were positioned in kutcha, semi-pukka and pukka buildings with various orientations across cardinal directions and across houses that had roofs exposed to the sun or not.

(ii) **Perception and Activity Survey** which is a longitudinal study that captures peoples' perception of heat and comfort not just across any given day, but also how it changes across seasons, and the measures taken to respond to the discomforts.

(iii) **Interviews and Qualitative fieldwork** that included baseline interviews, which assess respondents' demographic, educational, and financial status with a focus on thematics such as access to infrastructure like water and electricity, ownership of assets, both generally and specifically related to cooling (fans, coolers, ACs). Qualitative interviews were conducted with respondents as well as with key Informants like local leaders, construction workers, masons, etc. to gather a more nuanced understanding of the context.

**A set of small building level suggestions**: Based on the long-term relationship between the researchers and the respondents (and the community in general), the team decided to make some small suggestions to alleviate/mitigate heat impacts - at least in terms of building practices. A small booklet of good practices was developed and propagated within the community and its masons. The booklet was produced in Telugu and English, and contained very simple interventions in very simple language, with an objective to build the knowledge of the community and its masons regarding heat mitigation practices, and to fit within the context of material markets and land dynamics of the area. A sample page of the booklet is shown here.

## 2. Heat Stress Effect among Pregnant Women

*Contributed by: Dr Bollineni Keertthi, President-Vasavya Mahil Mandali*

**Problem Statement:**
In the coastal districts of Andhra Pradesh where fishing is a prime livelihood source, women are disadvantaged both in poverty and climate stress. Teddu Kavya, 22 years old and a member of a fishing community, had the impact of early marriage, poor education, and poor access to health care. Kavya met the love of her life, Praveen, at age 17 and got married. Lacking financial means to pursue further studies, she was pregnant at 18 without adequate knowledge or resources to take care of her body during pregnancy.

Owing to anaemia and absence of medical check-ups, Kavya's health during pregnancy was weak. Heat conditions exacerbated her fatigue, and ignorance about the need for hydration and nutrition weakened her further. Most women in Jalaripeta area, similar to Kavya, are subjected to heat stress while helping with associated activities of fishing or taking care of household chores at the time of peak temperatures. These women are particularly at risk while pregnant, as poor diet and limited access to health care worsen the condition.

There is also very limited community-level information on how heat stress influences the health of women, particularly maternal and reproductive outcomes. It is low-level awareness, with very little preventive care. Kavya's story is emblematic of a problem that afflicts many women in coastal rural district where gender, poverty, and climate hazards interact with impunity.

**Intervention**
The turning point was when the community coordinators of Vasavya Mahila Mandali (VMM), through the local Anganwadi center, recognized Kavya during a home visit. They offered her counselling on prenatal care, nutrition, and the need for regular medical check-ups. Kavya was referred to the Urban Primary Health Centre (UPHC), where her haemoglobin level was checked, and she was administered tetanus toxoid (TT) doses and advised on dietary intake.
The coordinator highlighted changes in lifestyle like:

- Consuming fibre-rich, protein-balanced meals.
- Consuming fluids before and after exercise.
- Dressing in comfortable clothing during summer.
- Regular use of iron and folic acid supplements.

VMM promoted peer-to-peer encouragement, encouraging women like Kavya to spread their learning among other young mothers within the community.

**Outcomes:**
As a result of the timely intervention, Kavya started going for regular health check-ups and adhered to the diet and medication regimen. Her haemoglobin levels increased immensely, and she gave birth to a healthy child in the Goshal Hospital. She turned into an informal peer motivator among her community members, motivating other pregnant women to adopt healthier behaviors and receive medical care.
Her story shows that localized engagement on addressing climate effects among pregnant women is helpful for peer led specific education and knowledge, can yield measurable outcomes for maternal and child well-being—even among risk-prone, heat-affected populations.

**Recommendations:**

- Build Stronger Community Health Outreach:
- Increase the reach of Anganwadi and VMM-initiated intensive and frequent quality home visits to all pregnant women.

**Synthesize Climate Awareness with Maternal Care:**

- Empower women to learn the risks of exposure to heat in pregnancy and strategize to maintain coolness and hydration.

**Institutionalize Cooling Infrastructure**

- Set up shaded resting places or community cooling centres, particularly in high-external labour contribution among women areas.
- Improve Nutrition Support as suitable to heat conditions
- Provide subsidized nutrition kits to poor families from Anganwadis and health facilities.

**Enhance Local Data Collection:**

- Facilitate local surveys and heat-related illnesses data tracking among women to inform area-based policy interventions.
- Engage Men in Maternal Health Education
- Promote male partner involvement in maternal health programs to raise support from the family for the expecting woman.

## 3. Draught Induced Migration- Effecting the health of Girls in Rural Andhra Pradesh.

*Contributed by: Dr Bollineni Keertthi, President-Vasavya Mahil Mandali*

**Problem Statement**

Anantapur district in Andhra Pradesh is one of the most drought-prone regions in India, facing chronic rainfall scarcity that has severely impacted agricultural productivity. The livelihoods of small and marginal farmers are at constant risk, forcing many to migrate in search of work. In Damekethepalli village of Chilamattur Mandal, Sri Satya Sai district (erst while Anantapur) the livelihood based migration issues are compounded by poverty, limited educational access, and gendered vulnerabilities. Dhana (name changed), a 9th-grade student at the Zilla Parishad Government High School (ZPHS), represents the plight of many adolescent girls affected by such migration-induced challenges.

Dhana's parents, small-scale farmers, struggled with repeated crop failures due to insufficient rainfall. With no stable income, they migrated to Bangalore in search of work. While both parents needed to work to afford city expenses, they feared for Dhana's safety and her ability to continue her education. They decided to discontinue her schooling and take her with them, but found it equally challenging to ensure her protection in the urban environment. Consequently, they arranged her marriage with a 21-year-old man, Murali, on March 20, 2024. Within two months, Dhana became pregnant but suffered a miscarriage in October 2024 due to complications including foetal heart issues and excessive blood loss.

This case highlights the urgent intersectional issues of climate-induced migration, school dropouts, early marriage, and teenage pregnancy. Dhana's story underscores the vulnerabilities adolescent girls face in disaster-prone and economically fragile communities, and the need for targeted interventions to safeguard their education and health rights.

**Research design**

The case of Dhana sheds light on the need for multi-pronged interventions in drought-affected regions like Anantapur. Climate-induced migration is increasingly triggering a chain reaction of negative outcomes, particularly for adolescent girls. These include school dropout, child marriage, and health risks arising from early pregnancies. To address these issues, Vasavya Mahila Mandali (VMM) implemented an intervention strategy in collaboration with local schools, community leaders, and health departments in Chilamattur Mandal.

**Needs Assessment:**
A rapid needs assessment was conducted in Damekethepalli and neighboring villages, identifying a growing number of adolescent girls facing forced school drop outs due to migration. Parents cited concerns about safety and lack of facilities in destination locations. Teachers expressed distress over the sudden withdrawal of students like Dhana. Health workers reported increasing cases of early pregnancies and maternal health issues among adolescent girls.

**Community Mobilization and Awareness Campaigns:**
VMM conducted targeted campaigns through school meetings, Gram Sabha sessions, and door-to-door awareness drives to educate families about the dangers of early marriage and the importance of continued education for girls. Real-life case stories like Dhana's were anonymously shared (with consent) to build empathy and awareness.

**School and Health System Strengthening:**
Coordination with ZPHS authorities led to the formation of a "Girls' Retention Task Force" at school level, including teachers, peer leaders, and community volunteers. Health departments facilitated sessions on adolescent health, menstrual hygiene, reproductive rights, and consequences of early pregnancies. Health screenings and counseling services were introduced quarterly.

**Bridge Education and Residential Support:**
For students vulnerable to migration, VMM proposed temporary residential schooling models like TRANSIT HOMES WITH EDUCATION and bridge education in partnership with local hostels and child protection units. This allowed girls like Dhana, if earlier intervened, to continue education safely even if parents migrated.

**Livelihood Support for Parents:**
To address the root cause—livelihood insecurity—VMM connected parents to MGNREGS schemes, and in some cases facilitated skill-based training (e.g., tailoring, carpentry, and mobile

servicing) to ensure income generation locally. Small kitchen gardens, supported by water-conserving drip irrigation methods, were piloted in five villages.

**Legal Literacy and Protection Mechanisms:**
Training sessions on the Prohibition of Child Marriage Act (2006) and Protection of Children from Sexual Offences (POCSO) Act were conducted with parents and village elders. VMM established a youth reporting mechanism via WhatsApp and in-person adolescent groups to identify and intervene in potential child marriage cases.

**Case Management and Health Intervention for Dhana:**
Post-miscarriage, VMM arranged health counseling and care for Dhana at a government hospital, along with psychological support through local NGOs. A caseworker from the Child Welfare Committee (CWC) helped explore options to legally annul the marriage and restore her right to education.

**Future Areas for Intervention and Recommendations**

- Dhana's case emphasizes the urgent need for systemic interventions that link climate resilience, education retention, and adolescent protection. Future efforts should focus on:
- Early Warning Systems for Migration: Deploy village-level monitors to identify families likely to migrate and assess children at risk of school dropout or early marriage.
- Strengthening Social Protection: Expand government schemes like Kasturba Gandhi Balika Vidyalaya (KGBV) and residential bridge schools to accommodate girls from migratory families.
- Psycho-social Support: Institutionalize counselling services in schools, PHCs, and community centers to address trauma among adolescent girls.
- Monitoring and Accountability: Establish local Child Protection Committees with real-time data sharing and grievance redressal mechanisms.
- Climate-Adaptive Livelihoods: Promote sustainable agriculture and rural employment through climate-resilient farming, water harvesting, and skill-building initiatives.
- Ultimately, interventions must be gender-sensitive, community-driven, and integrated with education, health, and climate adaptation frameworks to ensure that no girl like Dhana is left behind.

**Note:** % of Migration: 11% over District population 4.98 Lakhs people estimated. Due to factors like drought, lack of irrigation and limited employment opportunities in the agriculture.

## 4. Impact of Heat on Mental Health of Women – A SCARF perspective

*Contributed by: Shreenila Venkatesh, Padmavati Ramachandran Schizophrenia Research Foundation, Chennai India*

The impact of climate change on human health is vast and multifaceted. One area that has not received sufficient attention is the relationship between heat and mental health, particularly in women. This case study seeks to explore this dynamic through the lived experiences of female clients who visit the Schizophrenia Research Foundation (SCARF), a not-for-profit organization providing mental health care in Chennai, an urban metropolitan city in southern India known for its relentless and unforgiving heat.

Chennai's residents are no strangers to extreme ambient temperatures, especially during the peak summer months of April to June. The heat index in the city has nearly tripled from 2011 to 2019, indicating a dramatic rise in heat exposure. For women, this environmental stressor is compounded by socioeconomic and occupational vulnerabilities. A study conducted in Chennai revealed that approximately 71% of women were exposed to high levels of occupational heat stress. Most of these women were employed in outdoor sectors such as construction and agriculture, where over 95% reported adverse health impacts due to heat exposure.

Beyond the physical strain, there is growing evidence that heat contributes significantly to neuropsychiatric challenges. Women from historically marginalized communities and lower socioeconomic backgrounds appear to bear a disproportionate share of this burden. High temperatures have been associated with increased reports of negative emotions and a spike in visits to emergency departments for mental health conditions, especially among women. At SCARF, we undertook a pilot exercise to get an understanding of how women attending the OPD at SCARF Clinical Services experienced Heat. A set of questions were asked to women clients or women caregivers, during routine review visits, that included handling the heat, heat as a barrier your everyday life, effect on mental health and ways of coping.

Several women attending the outpatient department have reported heightened irritability during hotter days, to the extent that it disrupts their daily functioning. One woman, in her late fifties, shared her distressing experience of being the primary caregiver for her brother who lives with severe mental illness. She described the unbearable effort to complete even basic tasks like buying groceries. The added responsibility of managing household needs, including cooking in an already sweltering environment, was overwhelming. She noted that even wearing a saree, a culturally significant and traditional attire adds to her discomfort, causing excessive sweating. Her sleep cycle was disturbed, with increasing difficulty to wake up early, often feeling more fatigued than usual. Her lower-income household, prevented the use an air conditioner due to the cost of electricity, She often resorted to prayer as a means of coping with her mental and physical exhaustion. Her narrative highlights how heat on top pre-existing stressors, can precipitate and perpetuate depressive symptoms, feelings of helplessness, and overall psychological distress.

Furthermore, individuals with mental illnesses are particularly vulnerable to heat. Studies have shown that they are nearly three times more likely to die during heatwaves compared to the general population. Moreover, many classes of psychotropic medications, including antidepressants and antipsychotics, which are commonly prescribed in our clinical setting can impair the body's ability to regulate temperature, further elevating risk.

A woman, recently discharged from our residential facility, shared how her daily bathing time has increased significantly as a way to find relief from the raging heat. Since leaving the residential facility, where temperatures were better managed, her exposure to outdoor heat has increased. She reported becoming easily irritable and noted spending more time with her plants and shared her worries about how the plants will also require frequent watering due to heat. She expressed concern about how the widespread use of air conditioners among middle-class families might be contributing to the urban heat island effect, worsening the very problem people are trying to escape. This comment reflected a deeper existential anxiety: if the solution to managing heat is also contributing to its escalation, what options are left in an urban city like Chennai?

Conversations revealed another consistent pattern: the tendency to stay indoors to avoid the draining effects of the heat. While this may appear to be a practical solution, it inadvertently leads to increased social isolation. One client shared that she has developed a fear of crowds and experiences restlessness when in large gatherings, a symptom that seems to be exacerbated by heat exposure. She now requires someone to accompany her in public spaces, indicating heightened anxiety and a need for emotional support.

These accounts underscore how rising temperatures are not merely a discomfort but a serious aggravator of psychological distress. Among women, especially those with caregiving responsibilities or limited socioeconomic means, heat becomes a chronic and invisible stressor that seeps into all aspects of daily life. The psychological impacts range from mood disturbances and irritability to more severe manifestations such as anxiety and depressive symptoms.

The experiences gathered from these women demonstrate how climate-related heat is not just an environmental issue but a deeply personal and gendered mental health crisis. They reflect a glaring gap in research and clinical practice concerning the intersection of climate change, heat, and mental health, especially in low- and middle-income countries like India. There is an urgent need to explore this area with more rigorous methodologies that incorporate local narratives. By doing so, we can begin to inform culturally relevant and climate-sensitive clinical approaches to diagnosis, treatment, and psychosocial support, particularly for women who may be disproportionately impacted by these environmental changes.

**References:**


1. Rothschild, J., & Haase, E. (2023). The mental health of women and climate change: direct neuropsychiatric impacts and associated psychological concerns. *International Journal of Gynecology & Obstetrics*, *160*(2), 405-413.
2. Venugopal, V., Rekha, S., Manikandan, K., Latha, P. K., Vennila, V., Ganesan, N., ... & Chinnadurai, S. J. (2016). Heat stress and inadequate sanitary facilities at workplaces–an occupational health concern for women?. *Global health action*, *9*(1), 31945.
3. Debnath, K. B., Jenkins, D., Patidar, S., Peacock, A. D., & Bridgens, B. (2023). Climate change, extreme heat, and South Asian megacities: Impact of heat stress on inhabitants and their productivity. *ASME Journal of Engineering for Sustainable Buildings and Cities*, *4*(4).

## 5. Heat-stress among women health workers: A case from Kalaburagi

Contributed by: Swati Surampally, Indian Institute for Human Settlements (IIHS)

This case study presents the lived experience of Urban Accredited Social Health Activists (ASHAs) in Kalaburagi, Karnataka, and the occupational challenges they face due to rising temperatures. During fieldwork for the research project 'If Cities Could Speak: Vulnerability, Climate and Health in the City', funded by the Wellcome Trust, IIHS visited Bapu Nagar, a low-income settlement in Kalaburagi, to explore the impacts of heat in the settlement. What emerged was an urgent and often overlooked reality: those responsible for delivering health services at the community level are themselves facing the brunt of climate-related health risks.

Kalaburagi, situated in the North Interior Karnataka (NIK) region, experiences prolonged periods of extreme heat, with annual maximum temperatures averaging 44.9°C over the past seven years (KSDMA, 2024). The district ranks among the most vulnerable in Karnataka according to the Heatwave Health Risk Index (HHRI) (Thakkar et al., 2025), driven by factors such as high diurnal temperature range, poor green cover, a large proportion of the population working outdoors, frequent heatwave occurrences, a high number of people with disabilities, and a significant proportion of individuals commuting to work on foot.

ASHAs, employed by the Ministry of Health and Family Welfare under the National Health Mission (NHM, n.d.), play a critical role in India's public health infrastructure. In Karnataka, one ASHA is assigned per 2,500 urban residents. Their responsibilities are multifaceted, ranging from facilitating access to healthcare services, conducting household surveys, and providing community-level care, to raising awareness about health rights and entitlements. This work involves extensive walking within their assigned areas, frequent visits to Urban Primary Health Centres (UPHCs), assisting with childbirths, organising community meetings, and maintaining detailed health records.

While trying to locate Lakshmi (name changed for privacy), ASHA assigned for Bapu Nagar, she remarked over the phone, *"You won't be able to identify me as I am not wearing the pink saree."* When we met in person, she explained, *"I am not wearing the uniform saree because I feel too hot in it, hence I am wearing a cotton saree."* This remark, seemingly casual, pointed to a deeper issue—one that reveals how frontline health workers are navigating extreme heat while fulfilling essential public health responsibilities.

For ASHAs like Lakshmi, heat exposure is an occupational hazard. When asked about her personal experiences with heat stress, Lakshmi recounted, *"Due to walking around in the heat, my blood pressure dropped. I was given iron supplements at the UPHC, and only then did my blood pressure improve... I try to finish work by 3-4 pm, so I often skip lunch."* Although this was her first major incident, she noted that colleagues frequently experience symptoms such as dizziness, fatigue, low hemoglobin levels, and body pain after prolonged exposure to the sun. An overlooked factor contributing to their discomfort is the mandated uniform. In Karnataka, ASHAs are required to wear government-issued pink polyester sarees while on duty. Polyester, lacks moisture absorption

properties and traps sweat (Islam et al., 2023), exacerbating heat stress. Lakshmi described it vividly: *"The saree material is like 'chhattri batti' (umbrella cloth). It feels like plastic. It causes discomfort, especially during the summers."*

Despite repeated pleas to improve the quality of their uniforms, there has been little response from the authorities. As per NHM's budgetary allocations for 2024-25 and 2025-26, ASHAs in Karnataka are provided two sarees annually, each costing INR 400. Lakshmi shared, *"We asked them to change the quality of the saree, but they did not respond. Even if we wear a cotton saree, we have to wear the same colour. I tried to find a cotton saree in the same shade, but couldn't."* While the material of the saree causes discomfort, the uniform holds significance for ASHAs, providing them with a visible identity in the community. Lakshmi noted, *"Only if I wear this saree, people identify me as an ASHA. Without it, they might not take me seriously."*

*Figure 1: Image: An ASHA worker wearing the pink uniform in Kalaburagi. Credits: Swati Surampally, IIHS*

ASHAs have no fixed work hours. They are often summoned at odd hours to accompany women to hospitals for childbirth. *"Sometimes we don't even get a chair to sit on in the hospitals. It gets very tiring,"* Lakshmi said. Long hours on foot, exposure to high temperatures, and lack of rest all add up to significant strain. Yet, there is little institutional recognition of their occupational risks or provisions for heat adaptation—such as shaded rest areas, hydration breaks, or climate-sensitive clothing.

In January 2024, ASHAs across Karnataka, including Lakshmi, participated in a state-wide protest demanding better wages, timely payments, and improved working conditions. Among their demands was a request to replace sarees with more practical attire, such as cotton aprons, similar to those provided to ASHAs in Delhi. Lakshmi noted that multiple letters were written to the state and central governments, but no response has been received to date. In the absence of structural support, ASHAs rely on personal coping mechanisms. *"I sometimes use a scarf," Lakshmi said. "I cannot carry an umbrella with me. It's difficult to hold an umbrella and write at the same time."* These practices, while reflective of individual coping efforts, are inadequate in addressing the physical and mental strain caused by prolonged heat exposure.

**Gaps and Urgency**

The experiences of Lakshmi and her colleagues underscore critical gaps in occupational health policies for the frontline health workers. Despite being vital to public health outreach, ASHAs are often overlooked in discussions on heat-stress. Strengthening the response requires:

- Gender-disaggregated research on the health impacts of extreme heat, particularly on women engaged in outdoor informal or semi-formal labour.
- Data-driven interventions to improve occupational safety, including the design and provision of climate-appropriate uniforms and adjustments in work schedules during peak heat periods.
- Increased awareness at the policy level to prioritise climate-responsive strategies in occupational health.

Drawing attention to these lived experiences is essential. As temperatures rise and cities like Kalaburagi continue to grapple with prolonged heat events, the well-being of those who form the first line of public health response must not be compromised. Protecting ASHAs is not only a matter of occupational justice—it is a prerequisite for building equitable and climate-resilient health systems.

References:


1. Islam, M. R., Golovin, K., & Dolez, P. I. (2023). Clothing Thermophysiological Comfort: A Textile Science Perspective. *Textiles*, 3(4), 353-407. https://doi.org/10.3390/textiles3040024
2. National Health Mission. (n.d). Induction Training Module for ASHAs in Urban Areas. *Ministry of Health and Family Welfare*. https://www.nhm.gov.in/images/pdf/NUHM/Training-Module/Induction_Training_Module_for_ASHAs.pdf
3. Thakkar, V., Srinivas, V., Marula Siddhappanavara, P., Madappa, T., Jeganathan, A., & Murthy, I. K. (2025). Heatwave health risk index for Karnataka, India. *The Journal of Climate Change and Health*, *22*, 100428. https://doi.org/10.1016/j.joclim.2025.100428

# Annexure XI

**List of participants for the National Stakeholder consultation on Heat, Gender and Climate Resilience, Chennai**

Location: MSSRF, Chennai

Date: 03.03.2025

| Sl. No | Participants' Name | Organisation |
|---|---|---|
| 1 | Ms. Apekshita varshney | HeatWatch |
| 2 | Dr. Ritu Parchure | Prayas Health Group |
| 3 | Mr. Swastik Harish | Swastik Harish and Associates |
| 4 | Ms. Swati Surampally | Indian Institute of Human Settlements (IIHS) |
| 5 | Dr. Prabhdeep Kaur | Indian Institute of Science |
| 6 | Dr. Manan Bhan | Ashoka Trust For Research in Ecology and The Environment (ATREE) |
| 7 | Dr. Aditi Khandekar | United Way of Hyderabad |
| 8 | Ms. Meghana Myadam | Hyderabad Urban labs |
| 9 | Dr. Vidhya Venugopal | Sri Ramachandra University |
| 10 | Dr. Parama Roy | Okapi Research and Advisory Pvt Ltd |
| 11 | Mr. Krishna Mohan Ramachandran | Chennai Resilience Centre |
| 12 | Dr. Rajalakshmi | Indepent consultant |
| 13 | Dr. Padmavati | Schizophrenia Research Foundation (SCARF) |
| 14 | Dr. Ganeshkumar | ICMR-National Institute of Epidemiology (ICMR-NIE) |
| 15 | Dr. Keerthi Bollineni | Vasavya Mahila Mandali |
| 16 | Dr. Pillarisetty Deeksha | Vasavya Mahila Mandali |
| 17 | Dr. Rajib Chattopadhyay | Indian Institute of Tropical Meteorology |
| 18 | Ms. Sona Priyanka | Pondicherry Institute of Medical Sciences |
| 19 | Ms. Roopa Sri | Pondicherry Institute of Medical Sciences |
| 20 | Dr. Vybhav | Art Park |
| 21 | Mr. Elijah John Mathew | The New LEED |
| 22 | Ms. Siraj | The New LEED |
| 23 | Ms. Jenny | Poovulagin Nanbargal |
| 24 | Mr. Chandrakant Komaragiri | United Way of Hyderabad |
| 25 | Dr. Shobha Govindan | OHCC HUB-TN |
| 26 | Dr. Vijayakumar | TNUHP |
| 27 | Dr. Ashika | TNUHP |
| 28 | Ms. Sunaina | TNUHP |

**List of participants for the National Stakeholder consultation on Heat, Gender and Climate Resilience, Ahmedabad**

Location: Novotel, Ahmedabad

Date: 28.04.2025

| Sl. No | Participants' Name | Organisation |
|---|---|---|
| 1 | Dr. Saru Gupta | Council on Energy, Environment and Water (CEEW) |
| 2 | Dr. Shreya Banerjee | Indian Institute of Technology, Jodhpur |
| 3 | Dr. Dileep Mavalankar | Indian Institute of Public Health Gandhinagar |
| 4 | Ms. Bijal Brahmbhatt | Mahila Housing Trust |
| 5 | Mr. Joel Shelton Terrance | Habitat Forum INHAF |
| 6 | Mr. Bharath Natraj | Migrants Resilience Collaborative, Bangalore |
| 7 | Dr. Poornima Prabhakaran | Ashoka University |
| 8 | Dr. Sreevatsan Raghavan | Translational Health Science and Technology Institute (THSTI) |
| 9 | Mr. Nimish Gupta | Centre for Science and Environment (CSE) |
| 10 | Ms. Kalyani Raj | All India Women's Conference |
| 11 | Mr. Alok Vajpeyi | Population Foundation of India |
| 12 | Mr. Nakul Sharma | Climate Action Network South Asia (CANSA) |
| 13 | Dr. Swapnil Jain | Voluntary Health Association of India (VHAI) |
| 14 | Mr. Sri Sukanta Bhattacharya | Gram Vikas |
| 15 | Mr. Ishan Kukreti | Sustainable Futures Collaborative |
| 16 | Ms. Sweta Srivastava | Heat project study co-ordinator |
| 17 | Ms. Neha Abraham | Self Employed Women's Association (SEWA) |
| 18 | Ms. Ruchi Agarwal | Self Employed Women's Association (SEWA) |
| 19 | Ms. Zulekha Khalil | Self Employed Women's Association (SEWA) |
| 20 | Dr. Rajvi Joshipura | Self Employed Women's Association (SEWA) |
| 21 | Ms. Naimisha Joshi | Self Employed Women's Association (SEWA) |
| 22 | Mr. Vishal Pathak | All India Disaster Mitigation Institute (AIDMI) |
| 23 | Ms. Ananya Datta | Public Health Resource Society (PHRS) |
| 24 | Dr. Yasobant | Indian Institute of Public Health Gandhinagar |
| 25 | Dr. Priya | Indian Institute of Public Health Gandhinagar |

karmaanya

CII CENTRE FOR WOMEN LEADERSHIP

mssrf
M S Swaminathan Research Foundation
SCIENCE FOR SUSTAINABLE DEVELOPMENT

WOMEN'S COLLECTIVE FORUM

ALLIANCE FOR GLOBAL GOOD
GENDER EQUITY AND EQUALITY

Supported by

Towards a new dawn
Ministry of Women and Child Development
Government of India

Gates Foundation