Too hot to work, too poor to rest

Health and economic impacts of heat stress on informal workers in urban India

Ritu Bharadwaj, N Karthikeyan, Raashee Abhilashi, Archana Shukla Mukherjee, Vandana Khurana, Harita Yadav Saha and Rijo George

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Cover image: migrant construction workers in northern India. Photo: Achin Phulre/Quirky Tokri

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Contents

Figures

Tables

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Abbreviations

AKI	Acute kidney injury
BOCW	Building and Other Construction Workers
C-CIQ	Comprehensive Climate Impact Quantification
CKD	Chronic kidney disease
DBT	Direct Benefit Transfer
FGD	Focus group discussion
GDP	Gross domestic product
ILO	International Labour Organization
IMD	India Meteorological Department
KIIs	Key informant interviews
NGO	Nongovernmental organisation
PDS	Public Distribution System
PLFS	Periodic Labour Force Survey
PM-JAY	Pradhan Mantri Jan Arogya Yojana
SEWA	Self Employed Women's Association

Summary

Extreme heat is imposing a large and rising burden on India's informal workers, who face continuous exposure both at work and at home, with little protection or opportunity to recover. Although most of these impacts are invisible and unaccounted for, heat is reducing productivity, widening living wage deficits, increasing heat-related illness and chronic kidney disease risks, and generating losses close to 2% of gross domestic product (GDP). But anticipatory social protection, stronger workplace protections and improved access to health and food entitlements can reduce many of these losses, using systems that are already in place and at a small fraction of current costs.

Extreme heat has become one of the world's most widespread occupational hazards. In India, the burden falls most heavily on the informal workforce, who make up close to 90% of workers in occupations such as construction, brick making, road building and small-scale manufacturing, where the body is the main productive asset. For these informal workers, rising temperatures are reducing productivity, eroding incomes, worsening health and deepening poverty. Yet most of this burden goes uncounted for, because conventional assessments rarely capture it.

This report measures that burden and sets out what it would take to reduce it. Using the Comprehensive Climate Impact Quantification (C-CIQ) toolkit and a survey of 538 informal worker households across three heat-exposed cities — Agra, Ajmer and Delhi — we examine how heat affects workers both at work and at home, quantify the resulting economic and non-economic loss and damage, and assess the policy responses needed to protect those most exposed.

Heat exposure does not end at work

Vulnerability is shaped by how workers live as much as by rising temperatures. Most of the people we surveyed were migrants in highly heat-exposed work, such as construction, brick kilns, road building, garment manufacturing and food processing. Migration was particularly common among outdoor workers, with 90.5% of households having moved to the city, against 77.2% of indoor worker households.

After work, many workers return to homes that provide no relief from heat. Among outdoor workers, 55.6% live under tin or asbestos roofs and another 13.9% under tarpaulin or temporary roofing. Only 28.1% live under reinforced concrete. More than 85% of outdoor and around 80% of indoor worker households live below minimum living space standards. Cooling is minimal: almost one-third of outdoor worker households (29.3%) have no fan, 67.6% have a single fan, and only 3.1% have two or more. Workers rate indoor heat near the top of a five-point scale (4.3 for outdoor workers, 4.2 for indoor workers) and the housing heat exposure index scores 6.6 and 4.4 for outdoor and indoor workers, respectively, showing that many homes increase, rather than reduce, heat exposure.

Living and working conditions leave workers highly exposed

Workers receive little respite during work. Access to drinking water, shade, rest areas, sanitation and medical support is poor, and the workplace facilities index scores just 2.1 out of 10 for outdoor workers and 3 for indoor workers. Water scarcity compounds this: only about one-third of households have adequate water year-round, and around two-thirds of outdoor and more than 60% of indoor worker households face moderate to severe shortages in the summer months (March to May in India). Sanitation is worst among outdoor workers, with 34.3% reporting no access to a toilet.

Workers rely heavily on their own coping strategies, yet the most effective strategies lie beyond their control. Nearly half (46.1%) of outdoor workers and 39.4% of indoor workers never rest in shade during work, and most cannot shift their hours to cooler parts of the day due to work demands. The coping action index is below the midpoint for both groups, at 4.32 out of 10 for outdoor workers and 4.20 for indoor workers.

A central finding is that indoor workers are no better protected. Although they avoid direct sun, many work in enclosed, poorly ventilated workshops where heat builds through the day; and across several measures, they report heat stress that is comparable to being outdoors.

Heat is reducing productivity and incomes

Heat is already imposing measurable economic losses. Outdoor workers lose an average of 24.29 workdays a year and indoor workers, 14.78. For outdoor workers, this includes 13.48 days lost to heat-related illness, 8.69 to reduced productivity while still at work and 2.12 to workplace closures. Indoor workers lose 6.36 days to illness, 7.38 to reduced productivity and 1.05 to closures.

These losses translate into annual wage losses of US$151.20 per outdoor worker and US$89.23 per indoor worker. These are significant sums for households on very low incomes and are often absorbed through borrowing, reduced food consumption and delayed healthcare. A large part of the loss occurs even when workers stay at work, so assessments that count only absence understate the true impact of heat.

Heat is creating serious health risks

The health burden is substantial and reaches well beyond short-term discomfort. Workers reported widespread heat cramps, heat exhaustion and heatstroke. The heat-related illness prevalence index reaches 9 out of 10 for cramps, 8.9 for exhaustion and 5.4 for stroke among outdoor workers, and 8.7, 7.7 and 5.1, respectively, among indoor workers.

Repeated dehydration is a particular concern. The study found that 18.7% of workers show symptoms that are consistent with acute kidney injury, and around 4.8%, or 1 in 20, may eventually develop chronic kidney disease (CKD) from repeated heat exposure. Scaled nationally, that is roughly 26.35 million informal workers in physically demanding work, an estimated loss of 4.51 billion workdays a year.

Heat also affects mental wellbeing. The psychological stress index more than doubles in the summer months, rising from around 2 out of 10 in cooler months to over 4 for both groups. Workers linked this to income insecurity, declining health, poor sleep and the inability to escape heat at work or at home.

Heat is deepening poverty and widening the living wage deficit

Surveyed households earn well below a living wage, without considering heat losses. Against the Anker living wage benchmark for the Delhi National Capital Region of US$3,125 a year, outdoor worker households earn an average of US$1,709 and indoor worker households, US$1,946, leaving them 45.3% and 37.7% below a living wage, respectively.

Heat widens these deficits. After considering heat-related wage losses, annual household income falls to US$1,558 for outdoor workers and US$1,857 for indoor workers, and the living wage deficit rises to 50.2% and 40.6%, respectively. Heat therefore acts as a poverty multiplier, pushing already vulnerable households further from a decent standard of living.

Heat generates both economic and non-economic loss and damage

Using the C-CIQ framework, the study assesses both economic (lost workdays, forgone wages, healthcare costs and reduced earning capacity) and non-economic losses (physical pain, psychological stress, disrupted sleep, strain on family life and loss of dignity). Many of these do not appear in conventional economic accounts, so the true burden of heat extends far beyond what is visible in labour or economic statistics.

The economic case for acting early

The costs are substantial at both household and national scales. Across the 13 states with the highest heat exposure, around 350.67 million workers undertake heat-exposed physical labour and together lose an estimated US$36.36 billion in wages each year. CKD linked to prolonged exposure adds US$22.73 billion a year (around 0.58% of GDP) and combined seasonal and long-term losses approach 2% of GDP.

Acting before losses occur is far more cost-effective than responding afterwards. Analysis across eight countries finds that every US$1 invested in anticipatory action generates US$2.06–5.17 in avoided losses and development gains.

Strengthening social protection for heat-exposed workers

India already has many of the systems it needs to protect heat-exposed workers. A heat-triggered cash transfer, delivered through Direct Benefit Transfer (DBT) and targeted through the e-Shram register, could provide income support when extreme heat prevents work, costing US$0.66 billion to US$1.99 billion a year. Improving access to existing entitlements would cost even less: US$77.09 million for migrant access to Ayushman Bharat health cover and US$42.81 million for the Public Distribution System (PDS). These are a small fraction of the losses workers currently bear.

Strengthening workplace protection and enforcement

Workplace protections are not keeping pace with rising heat. Rules rely largely on guidance rather than enforceable standards, and many of the most exposed workers fall outside formal protection altogether. The study recommends an enforceable heat threshold, with mandatory drinking water, shade and rest breaks once it is crossed, recognition of heat-related illness within occupational protection frameworks and protection for every worker exposed to hazardous heat regardless of the size of the establishment.

Financing protection against heat-related income losses

Evidence from India's Self Employed Women's Association's heat insurance programme suggests that insurance alone cannot cover routine heat losses. Its 2024 payout of around US$8 per worker replaced only 5–9% of the income workers lost. Parametric insurance has a role in exceptionally severe years, but direct cash transfers through social protection systems give more reliable and timely support for heat exposure. This study therefore recommends a layered approach, using direct transfers as the foundation and insurance to manage extreme risk.

Moving from evidence to action

Most of these losses remain invisible and uncompensated. Yet India already has the systems it needs to respond — from the e-Shram register and DBT architecture to Pradhan Mantri Jan Arogya Yojana, the PDS and heatwave forecasting. The challenge is mainly in coordination. Connecting these systems to heat risk and activating them before losses occur would protect livelihoods and health at a fraction of the current cost to workers and the economy. As temperatures continue to rise, protecting informal workers from heat will become central to India's labour, social protection and climate adaptation agenda.

1

The hidden cost of heat

1.1 Heat stress: a threat to workers, productivity and economic growth

With its frequency, intensity and duration increasing due to climate change, extreme heat has become one of the world's most widespread occupational hazards. The International Labour Organization (ILO) estimates that 2.41 billion workers — 71% of the global workforce — are exposed to excessive heat at some point during their work, a share that has risen steadily since 2000 (ILO, 2024a). Heat stress is the leading cause of weather-related deaths, and studies covering 2000–2019 attribute around 489,000 deaths a year to heat, 45% of them in Asia (WHO, 2024). Behind these mortality figures sits a much larger burden of illness, injury and lost earning capacity that rarely appears in any official assessment.

India sits at the higher end of this crisis. The India Meteorological Department (IMD) recorded 2024 as the country's warmest year since records began in 1901 (IMD, 2025), with 37 cities crossing 45°C between March and June (Das and Varshney, 2024). The ILO projects that heat stress will reduce India's working hours by 5.8% in 2030, a productivity loss equivalent to 34 million full-time jobs (ILO, 2019). These losses fall overwhelmingly on informal workers. Periodic Labour Force Survey (PLFS) data for 2023–2024 show that 58.4% of Indian workers are self-employed and a further 19.8% are casual labourers (NSO, 2024). It is this informal workforce that labours in the occupations where the body is the main productive asset, such as construction, brick making, road building, rickshaw pulling, loading and small-scale manufacturing.

For informal workers, heat exposure translates directly into lost earnings, illness and reduced productivity. A daily wage labourer who misses work because of heat-related illness, a brick moulder whose output falls during the hottest months or a garment worker who slows down in an overheated factory all experience immediate income losses. And it is largely these workers and their households who bear these losses, absorbing them through borrowing, reduced consumption or delayed healthcare, with little compensation or protection.

Heat exposure is not confined to outdoor work. Workers in garment units, glass factories and small workshops often labour for long hours in poorly ventilated, heat-trapping spaces where temperatures can be as severe as those outdoors. And exposure does not end when their shift finishes. Many workers return to overcrowded homes with tin or tarpaulin roofs that retain heat late into the night, leaving little opportunity for recovery before the next working day. Understanding heat exposure therefore requires looking beyond the workplace to the wider conditions in which workers live.

The policy response so far has not matched the nature of the problem. Insurance-based income protection schemes — including parametric products that trigger payments when temperatures exceed a threshold — represent an important innovation. But payouts are often small relative to earnings lost and are typically not received until after the heat event has passed (WEF, 2025; Down to Earth, 2026). More fundamentally, such schemes compensate a fraction of the losses and do not address the conditions that force people to continue working through dangerous heat or the longer-term impacts on health and productivity.

The situation in India is no different from many other countries and regions. Across South and Southeast Asia, Africa and Latin America, developing and low-income countries with large informal workforces face the same combination of rising heat, physically demanding work and weak social protection. Evidence on what works in India can directly provide learnings for them. Many developed countries have also started to face the heat. Europe recorded an estimated 61,672 heat-related excess deaths in the summer of 2022, and occupational heat exposure is rising faster in Europe and Central Asia than any other region (WHO, 2024; ILO, 2024b). As outdoor and indoor work everywhere gets hotter, the question we are addressing through this report is how to protect workers' health and incomes in ways that can allow them to stop working when conditions become dangerous.

1.2 Why the economic and non-economic costs of heat go uncounted

Heat damage differs from other climate hazards, and as a result, its costs are often not measured. A rapid-onset event, such as a cyclone or flood, arrives on a specific date, in a certain location, and is usually accompanied by a damage assessment, in terms of houses destroyed and crops lost. After the event, the government announces compensation and enters the losses into national disaster statistics. But a heatwave produces no similar record. Rather, its losses take the form of millions of small, individual or household-level impacts: a day's wages forgone, an intravenous drip paid for out of pocket, a slower afternoon's work, food that spoils before it can be eaten, a night without sleep. Households quietly absorb such losses, often through borrowing, untracked by any institution.

Even the most basic indicator — such as heat-related deaths — is unreliable. In the summer of 2024, India's official count recorded 360 heatstroke deaths, while an independent analysis of the same season identified 733 deaths and more than 40,000 heatstroke cases across 17 states (Das and Varshney, 2024). Deaths among informal workers are particularly likely to go unattributed, because heat is rarely recorded as a cause. Labour departments monitor wage compliance but do not track heat-related illness or fatalities among the workers they register. And if deaths are undercounted by half, the undercounting of nonfatal illness, lost work and chronic harm is far greater.

Where economic estimates exist, they are constructed from the top down. The working hours and productivity figures cited in Section 1.1 are derived by applying physiological work capacity models to temperature data. These estimates, while important in establishing the scale of the problem, cannot show how or where people actually experience loss. For example, they do not show how many workdays a construction labourer in Delhi or a brick moulder in Ajmer loses in a year, what share of a household's income disappears, what share households spend on treatment or how the loss compares with what a household needs to live on.

The measurement gap is wider still for three categories of loss:

- **Exposure of indoor workers**, which has been studied far less than exposure of those working outdoors under direct sun.
- **Exposure beyond the workplace**, as studies that measure heat stress during working hours assume the body recovers afterwards; but this is not the case for workers whose housing offers no relief. Studies do not tend to measure the housing, water and food dimensions of exposure alongside occupational dimensions.
- **Noneconomic losses** — such as psychological distress, chronic fatigue, disturbed sleep, strained family relations and the indignity of working through illness for fear of dismissal — are real and recurring harms that are difficult to quantify; as a result, they are absent from both policy frameworks and assessments that determine where climate finance flows.

Some of the damage caused by heat exposure is also long lasting. Repeated dehydration and heat stress can injure the kidneys; and recurrent episodes of acute kidney injury (AKI) may progress to irreversible chronic kidney disease (CKD). The ILO estimates that 26.2 million people worldwide were living with CKD linked to workplace heat stress in 2020 (ILO, 2024a). Yet the costs associated with treatment, reduced earning capacity and declining health often emerge years after the original exposure and are rarely attributed to heat.

The result is a systematic underestimation of heat-related loss and damage. Economic losses, non-economic harms, workplace exposure, household exposure and long-term health impacts are often measured separately or not at all. Capturing the full burden requires an approach that can assess these dimensions together and traces how vulnerability, exposure and protection interact to shape outcomes for workers and their households.

1.3 Study locations, workers surveyed and the indoor–outdoor comparison

This study took place in three Indian cities — Agra in Uttar Pradesh, Ajmer in Rajasthan and the national capital Delhi — which are all in the country's heat-prone plains of the north and northwest, where summer temperatures regularly exceed 44°C and the summer season has been lengthening. We selected these cities for their high exposure to extreme heat, large concentrations of informal sector workers and the presence of established grassroots organisations and trade unions that could support fieldwork and reach workers who are otherwise hard to survey.

Within these cities, we surveyed informal workers in two broad settings: outdoor and indoor. Outdoor workers were drawn from brick kilns, building construction and road construction, and indoor workers, from food packaging, garment manufacturing, handloom, marble carving and granite cutting, shoe making and wooden block making.

We chose these sectors because they employ large numbers of informal workers in physically demanding tasks and expose those workers to heat in different ways. Outdoor workers are directly exposed to the sun, while indoor workers are in enclosed and poorly ventilated spaces where machinery, kilns and a lack of airflow can push temperatures as high as those outside. Setting the two groups side by side allowed us to see where their exposure and outcomes converge and where they differ, and to design protections that reach both groups.

We surveyed a total of 538 informal worker households, 358 from outdoor sectors and 180 from indoor sectors. We selected households so that each had an equal chance of inclusion, and grouped them by work setting to allow direct comparisons between the outdoor and indoor samples. The India sample forms part of a wider study, which surveyed over 700 workers across India and Bangladesh.

The household survey was the core instrument, capturing data on demographics, income, housing, food security, water and sanitation access, work patterns, physical and mental health symptoms linked to heat, healthcare spending, and access to employer or government support. We complemented the survey with five other methods: time-motion studies of work and rest cycles; self-reported health risk scoring; focus group discussions (FGDs) with men, women and young workers; key informant interviews (KIIs) with employers, doctors, union leaders and officials; and in-depth family case studies of how heat accumulates across a season. The full study design, sampling approach and instruments are set out in Appendix 1.

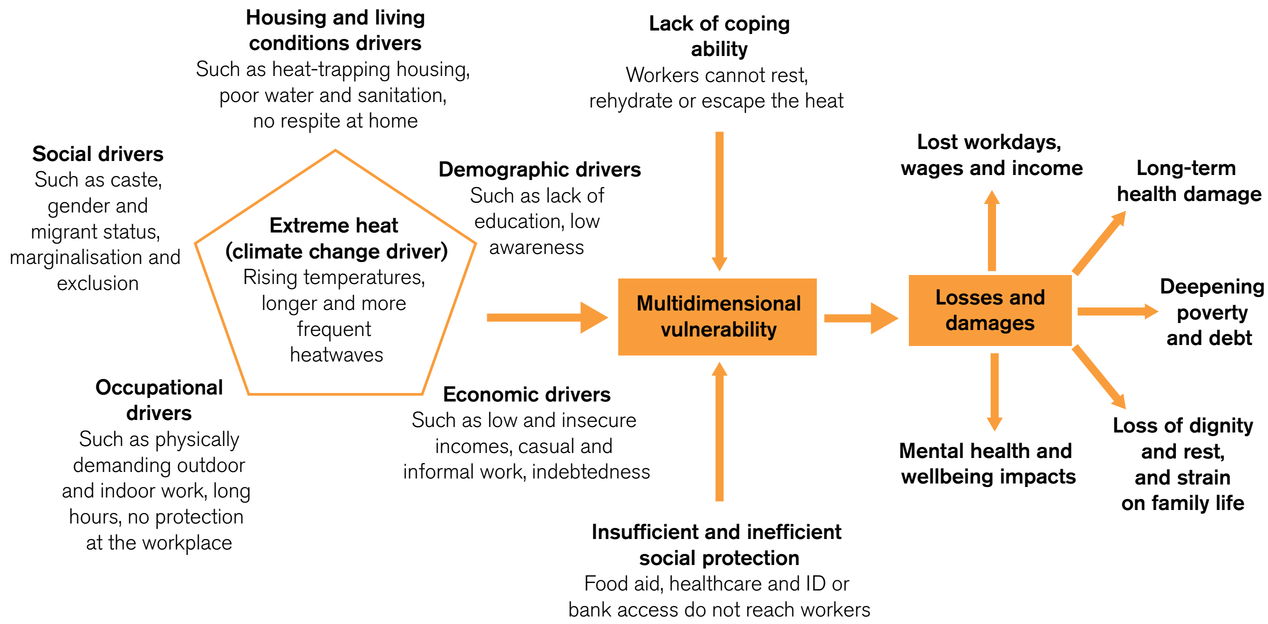
We undertook the fieldwork with grassroots organisations and unions in each city, and the trust they had already built meant people spoke openly about their working conditions, health and household circumstances. A panel of three doctors advised on the survey tools and reviewed the findings, and local health professionals in each city helped validate the symptoms workers reported, strengthening the health risk scoring.

To capture the full range of heat-related loss and damage, we used two complementary approaches. First, we examined the underlying vulnerabilities that shape workers' exposure and sensitivity to heat. Second, we quantified the resulting economic and non-economic losses using the C-CIQ toolkit (Bharadwaj et al., 2024).

The C-CIQ toolkit combines economic valuation, composite indices and qualitative methods to assess impacts that range from measurable economic losses to non-economic harms that are difficult to value. Within this framework, we developed a series of indices covering housing heat exposure, social protection, workplace facilities, coping actions, heat-related illness prevalence and psychological stress, allowing comparisons across worker groups and settings.

Summarised in Figure 1, the overall analytical framework for assessing vulnerability and heat-related loss and damage traces the pathway from the factors that shape vulnerability, through heat exposure to the resulting economic and non-economic losses and damages experienced by workers and their households. The framework also provides the basis for identifying where interventions and investments are most needed to reduce heat-related risks.

Figure 1. From drivers of vulnerability to loss and damage



Source: adapted from Bharadwaj et al., 2024.

The value of this approach for policymakers is that it quantifies and uncovers otherwise hidden losses, enabling them to be considered in policy and programmatic responses. By quantifying non-economic losses and damages alongside economic loss, and by tracing how losses in one domain trigger losses in another, it gives policymakers a basis for deciding where protection and finance are most needed and how they could deliver them.

2

Underlying vulnerabilities and their interaction with heat

Heat does not affect every worker in the same way. A secure, well-housed worker may be able to absorb a temperature that could push a poorly housed daily wage earner into lost work, illness and debt. The difference is not the heat, but the conditions in which workers live and work. To understand why some workers experience far greater losses and damages than others, we use the 3P framework (see Figure 2), which examines how vulnerability, heat exposure and protection interact to shape outcomes.

2.1 Examining underlying vulnerabilities and their interaction with heat

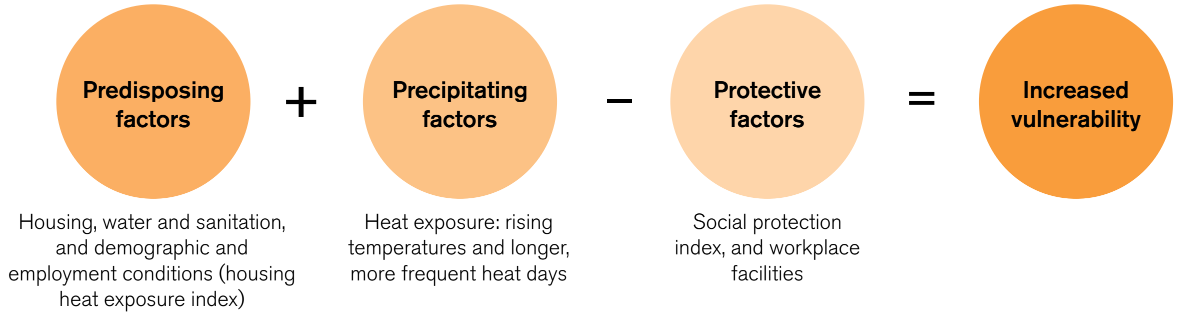
Figure 2 presents the 3P framework we use in this study, which is organised around three elements: predisposing, precipitating and protective factors.

Predisposing factors are the conditions that make workers and households more susceptible to heat-related loss and damage. They include demographic and social characteristics, employment conditions, income and indebtedness, and the quality of their housing, water and sanitation. A daily wage labourer living under a tin roof, sharing overcrowded accommodation, with limited access to water and cooling, is already vulnerable before temperatures rise.

Precipitating factors are the triggers that convert vulnerability into loss and damage. In this study, the principal precipitating factor is heat itself: rising average temperatures, more frequent and prolonged heatwaves, and increasingly extreme conditions during the working season. Understanding these trends, and how workers experience them, helps explain why heat-related losses are becoming more frequent and severe.

Protective factors are the measures and systems that can reduce vulnerability and harm when heat strikes. These include social protection programmes, food security schemes, healthcare access and workplace safeguards. Where these protections are absent or inaccessible — as is often the case for informal workers — households are left to absorb the resulting losses through reduced income, debt, food insecurity or by working through illness.

Figure 2. The 3P framework



Source: adapted from Bharadwaj et al., 2024.

2.2 Predisposing factors that shape vulnerability

2.2.1 Migration and household composition

Migration is common in both surveyed groups, particularly among outdoor workers, 90.5% of whom had migrated to the city, against 77.2% of indoor worker households. These are internal labour migrants who have moved within India from rural districts to cities in search of work.

Migration is itself a predisposing factor because India's social protection system remains closely tied to place of residence (Srivastava, 2020b). As a result, migrants often struggle to access food rations, healthcare and welfare support in the cities where they work. So, when heat exposure leads to lost work or illness, many households cannot access the support that could help them cope. This disadvantage is particularly pronounced among outdoor workers, where migrants are more prevalent.

Most workers migrate as families rather than alone (see Figure 3). Working-age adults make up around 69% of migrant household members among outdoor workers and 72% among indoor workers. Adults in outdoor worker households are split almost evenly between women and men, confirming that women migrate and work alongside men rather than remaining behind. Among indoor worker households, men account for a somewhat larger share. Children make up roughly 30% of outdoor worker households and 27% of indoor worker households, while the elderly are almost entirely absent, at around 1% or less. Parents live and often work alongside their children in the same heat-exposed environments, while older relatives remain at their place of origin. This leaves migrant families without the support of an extended household, exposing women and children to many of the same heat risks faced by working men.

Migration to the city is relatively recent and ongoing. Around 42% of households in both groups first migrated within the last five years, and close to two-thirds within the last ten years (see Figure 4). A smaller share had been settled for much longer; in some cases, for more than 30 years. The predominance of recent arrivals is important because they are typically the least established and least able to draw on local support when heat exposure leads to lost work or illness. They have had less time to build the documentation, networks and familiarity with local services that would help them access assistance. This pattern also points to a continuing flow of migrants rather than it being a one-off movement, suggesting that these vulnerabilities will continue to affect new arrivals.

Figure 3. Composition of migrant households at destination sites, by work setting

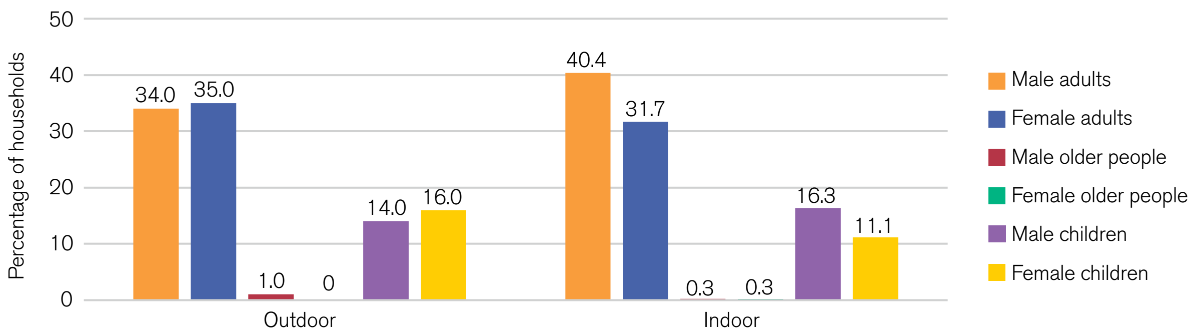
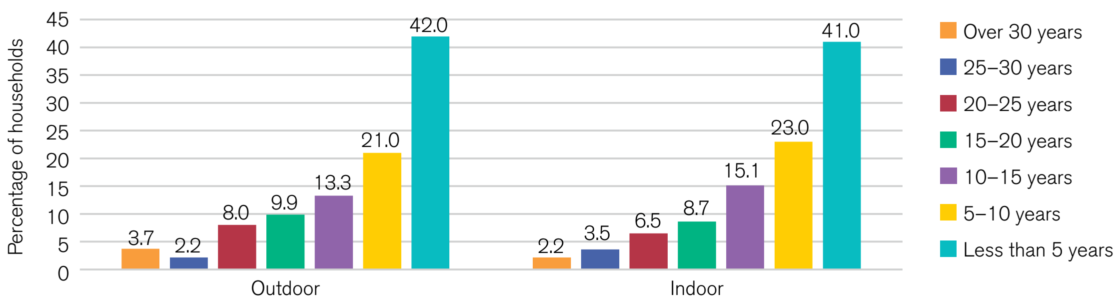


Figure 4. Years since the household first migrated, by work setting



2.2.2 Sex and education of the household head

Most households are headed by men (91.6% of outdoor workers and 86.1% of indoor workers) (see Figure 5). Female-headed households are somewhat more common among indoor workers, at 13.9% compared with 8.4% for outdoor workers. This is relevant to heat vulnerability because female-headed households are more likely to depend on a single earner, and women typically earn less than men for comparable informal work. When heat exposure causes illness or lost work, the impact therefore falls on an already smaller income base.

Levels of education among household heads are generally low, limiting both employment opportunities and the ability to navigate administrative systems (see Figure 6). Among outdoor worker households, 31.6% of household heads are illiterate, compared with 17.2% in indoor worker households. Only around 11% of heads of outdoor worker households and 20% of heads of indoor worker households have studied beyond the tenth standard. Low literacy makes it harder to move into less heat-exposed work, understand heat-related risks and access social protection schemes that require registration, documentation and administrative procedures. This compounds the disadvantages already faced by migrant households, who often lack local networks and familiarity with available services.

The picture improves when we look at the highest level of education reached by any household member rather than focusing on the head alone (see Figure 7). Household-level illiteracy falls to 15.9% among outdoor worker households and 4.4% among indoor worker households, while the share with a member educated beyond the tenth standard rises to 28% and 49%, respectively. This suggests that younger household members are generally better educated than their parents and may have greater opportunities to move into safer and better-paid work in the future. But for now, decisions about employment and coping with heat remain largely in the hands of household heads, so these educational gains have yet to translate into lower exposure or greater protection.

Figure 5. Male and female-headed households, by work setting

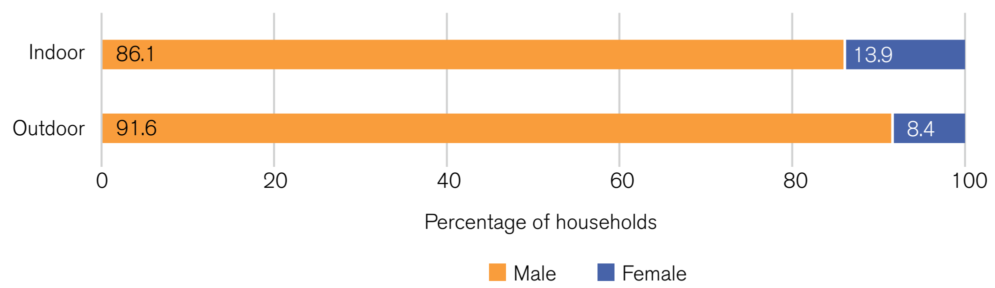


Figure 6. Level of education of the household head, by work setting

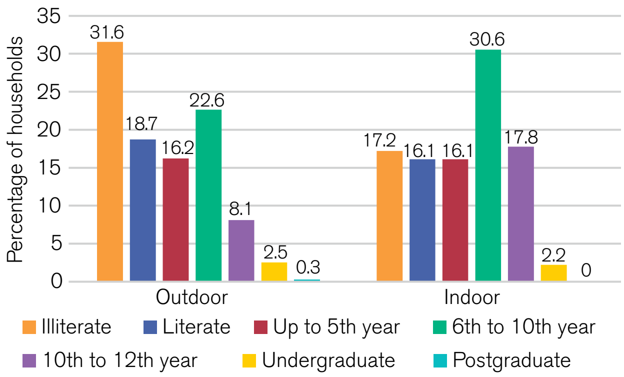
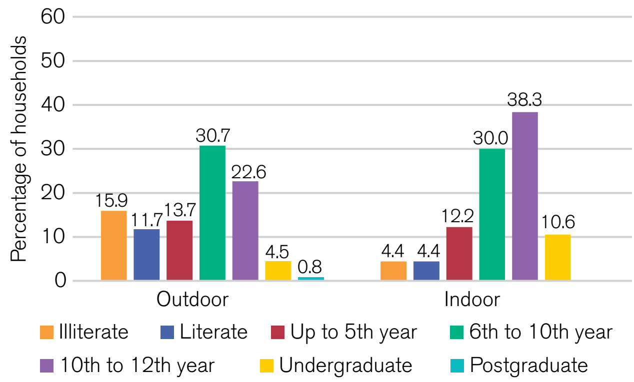


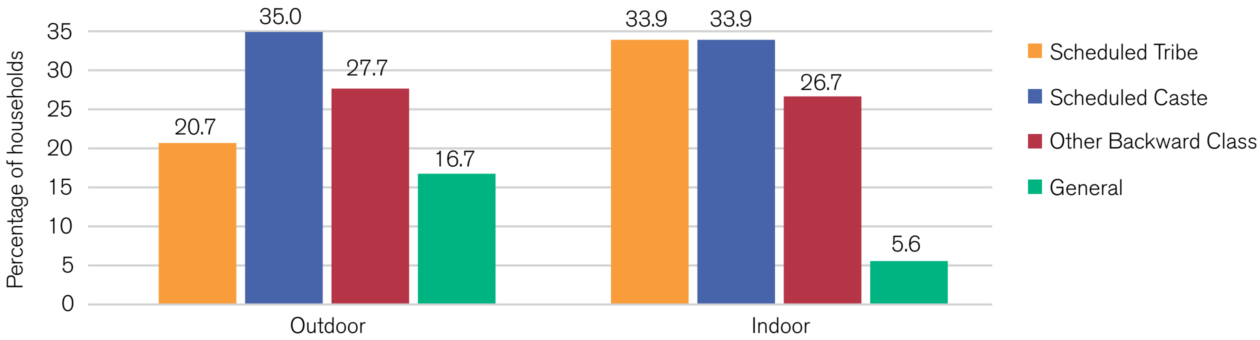
Figure 7. Maximum level of education in the household, by work setting



2.2.3 Social category

The informal workforce is primarily composed of the most marginalised social groups (see Figure 8). Among outdoor workers, 34.9% of participating households belong to 'Scheduled Castes' and 20.7% to 'Scheduled Tribes', so more than half fall within these two groups. A further 27.7% belong to 'Other Backward Classes', and only 16.8% are from the general category. The concentration is even greater among indoor workers, with Scheduled Castes and Scheduled Tribes accounting for 67.8% of households, and only 5.6% belonging to the general category.

Figure 8. Social category of households, by work setting



India formally recognises Scheduled Castes, Scheduled Tribes and Other Backward Classes as groups that have experienced historical social and economic disadvantage (Constitution of India, Articles 341 and 342). But despite such protections, land ownership, education and wealth are lower among these groups than the population as a whole, and these inequalities shape their access to employment and opportunities.

This historical marginalisation is reflected in the composition of the workforce surveyed. Scheduled Caste, Scheduled Tribe and Other Backward Class workers are concentrated in some of the lowest-paid, least secure and most physically demanding informal occupations, which are also most exposed to extreme heat. This pattern overlaps with other disadvantages identified in this study, including poorer housing conditions, weaker access to public services and lower levels of social protection. Heat exposure therefore compounds existing structural inequalities, falling disproportionately on groups that already have limited capacity to absorb loss and damage.

The particularly high concentration of Scheduled Caste and Scheduled Tribe households among indoor workers also highlights an important finding of this study. Although we often assume that indoor work provides some protection from extreme heat, the workers concentrated in these occupations remain among India's most socially and economically marginalised. The social disadvantages that shape vulnerability therefore extend across both outdoor and indoor work settings.

2.2.4 Income

The predisposing factors discussed so far converge on income. Daily wage earners' pay is low, irregular and dependent on physically demanding work; and migration status, limited education and social marginalisation are among the factors that shape their earnings. Income matters because it determines a household's capacity to absorb loss when heat strikes.

For workers with little or no savings, and often existing debt, stopping work during extreme heat is rarely an option. A lost workday or spell of illness translates quickly into lost earnings, deeper borrowing, reduced consumption or delayed treatment. Income therefore influences not only living standards, but also the ability of workers and their households to protect themselves from heat-related loss and damage.

We must also assess income against what a household needs to live on. The same earnings can provide very different levels of security, depending on the cost of maintaining a basic but decent standard of living. For that reason, we do not present income in isolation. In Section 4.7, we compare household earnings against a living wage benchmark and examine how heat exposure widens the gap between what households earn and what they need to live on.

Overall, the analysis of predisposing factors shows that the workforce enters each summer already disadvantaged. Both outdoor and indoor workers face multiple vulnerabilities, though these are concentrated in slightly different ways. Outdoor workers are more likely to be migrants and their household heads are less likely to be educated, while indoor workers are more concentrated among historically marginalised social groups and include a higher share of female-headed households. Neither group has the resources needed to absorb the losses that heat exposure brings.

2.2.5 Living conditions that offer no respite from heat

Heat exposure does not end at the workplace. After a shift in the sun or hot workshop, many workers return to homes that have absorbed the day's heat and release it through the evening and night, leaving little opportunity for recovery before the next working day. Most occupational studies overlook this dimension of heat exposure because they focus on workplace conditions alone. In this section, we examine the living conditions that shape exposure after work — including home ownership, roof type, wall material, ceiling height, living space per person, perceived indoor heat and the availability of cooling equipment — showing that home often offers little respite from heat and, in some cases, adds to it.

2.2.5.1 Housing and the built environment

The physical characteristics of a home determine how much heat it lets in, traps and retains. We examine five features: ownership, roof type, wall material, ceiling height and living space per person.

Very few workers (2.8% of outdoor and 3.6% of indoor worker households) own the homes they live in (see Figure 9). Among outdoor workers, 46.3% rent, 35.8% live in employer-provided shelter and 15.1% live in temporary accommodation, much of it on or beside the workplace. The vast majority (86.3%) of indoor workers rent. Insecure tenure matters because workers living in rented, employer-provided or temporary housing have little ability or incentive to invest in improvements to make their homes cooler.

The roof is where most heat enters a low-rise home, and this is where the two groups differ most (see Figure 10). More than half (55.6%) of outdoor workers live under asbestos or tin sheet roofs and 13.9% live under tarpaulin or gunny bag roofing, so close to 7 in 10 live beneath materials that absorb and radiate heat. Only 28.1% have a reinforced concrete roof. Indoor workers fare better on this measure: 59% live under reinforced concrete roofs, but more than a third (37.4%) live under tin or asbestos roofing. Metal and tarpaulin roofs can raise indoor temperatures well above ambient air temperature, particularly during prolonged periods of extreme heat (Vellingiri et al., 2020).

Walls are more commonly built from durable materials, with 72.5% of outdoor workers and 88.5% of indoor workers living in homes with brick walls. But 13.3% of outdoor worker households live in homes with temporary walls made from sacking or wooden slabs, and around one-tenth of both groups live in homes with tin walls (see Figure 11).

Ceilings are mostly low, which traps heat and limits air circulation. Using 10 feet or less as the threshold for a low ceiling (Farooq et al., 2020), 88.6% of outdoor worker households and 64.7% of indoor worker households fall into this category (see Figure 12). Combined with heat-absorbing roofs, low ceilings leave little space for hot air to rise and circulate to cool down the homes.

Their homes are also crowded. Against an adequate housing standard of approximately 97 square feet of living space per person (Behr et al., 2021), 85.2% of outdoor and 79.9% of indoor worker households fall below the threshold (see Figure 13). Crowding contributes directly to indoor heat, as more people share limited space and air, making rest and recovery difficult, particularly at night when entire families occupy the same room.

Figure 9. House ownership status, by work setting

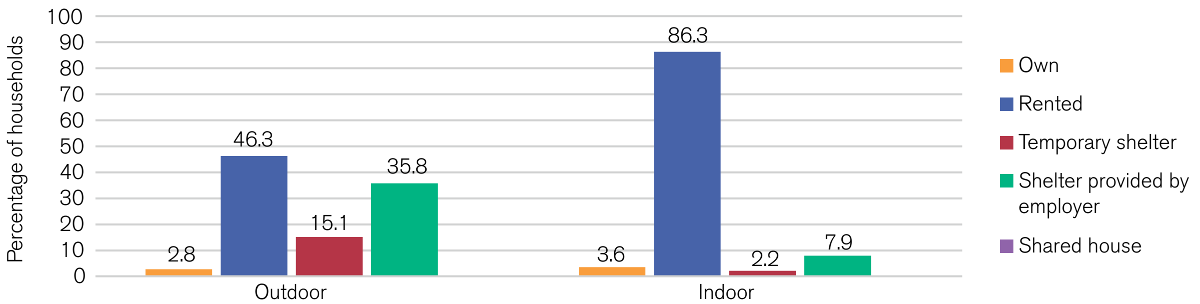


Figure 10. House roof type, by work setting

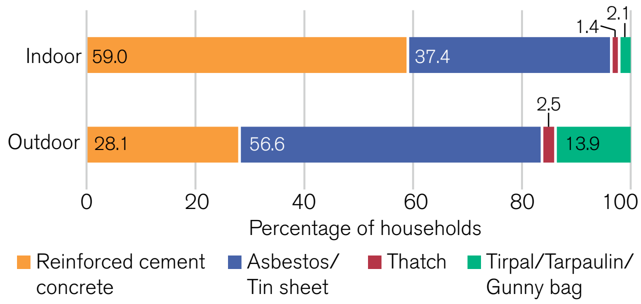


Figure 11. House wall type, by work setting

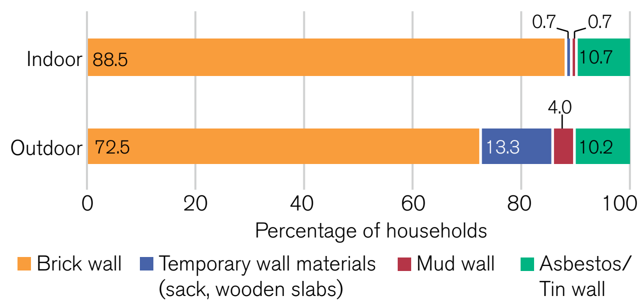


Figure 12. House roof height, by work setting

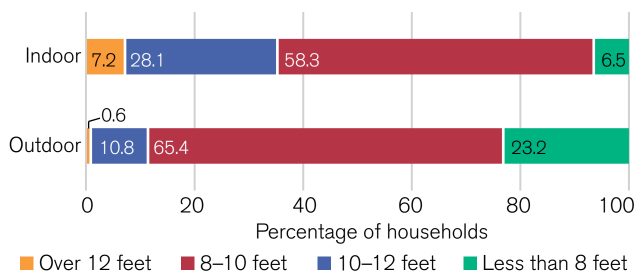
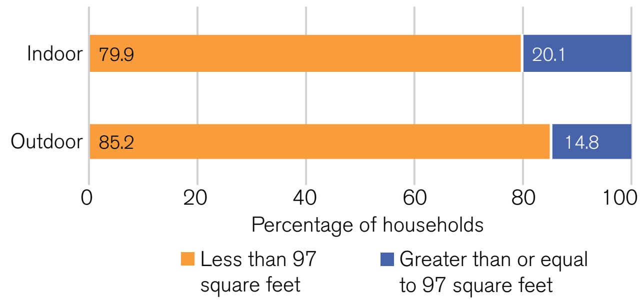


Figure 13. Per capita house area, by work setting



2.2.5.2 Indoor heat and cooling

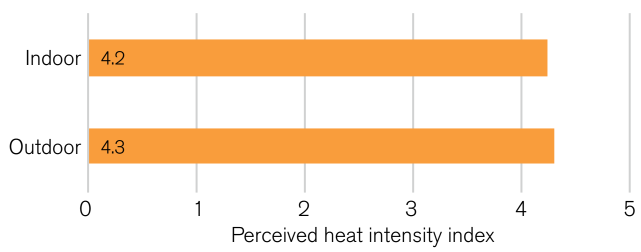
We asked workers how hot their homes become in summer and how they can cool them. The responses show their homes are very hot, and they have few means to reduce the temperature. On a five-point scale, outdoor workers perceive the heat inside their homes during peak summer at 4.30, and indoor workers, at 4.24 (see Figure 14) — both near the top of the scale. Although indoor workers have somewhat better roofs and higher ceilings, they perceive their homes to be almost as hot as outdoor workers' homes, suggesting that these housing advantages provide little relief from the heat.

Respondents have limited means available to cool their homes. Among outdoor worker households, 29.3% have no fan, 67.6% have a single fan, and only 3.1% have two or more fans (see Figure 15). Indoor households are better supplied: 91.4% have one fan and almost none have no fans; but a single fan in a crowded room under a low ceiling offers only limited relief. For nearly one-third of outdoor worker households, even this basic form of cooling is absent.

Beyond fans, active cooling is largely out of reach. The vast majority (89.2% of outdoor worker households and 64.8% of indoor worker households) have no access to low-cost water-based air coolers (see Figure 16), and very few (0.6% of outdoor worker households and 0.7% of indoor worker households) have air conditioning (see Figure 17). The high indoor heat reported by workers therefore goes largely unmanaged.

Refrigerators are also rare, found in only 2.5% of outdoor and 11.5% of indoor worker households (see Figure 18). This becomes important not only for comfort but also for health and food security. Without refrigeration, food spoils quickly in hot weather, and it is impossible to keep water, milk and medicines cool. The absence of refrigerators therefore limits households' ability to manage some of the secondary effects of extreme heat.

Figure 14. Perceived heat intensity index, by work setting



Note: Perceived heat intensity index is based on workers' ratings of the heat levels inside their homes. It ranges from 1 to 5; higher score indicates higher perceived heat intensity.

Figure 15. Availability of fans at home, by work setting

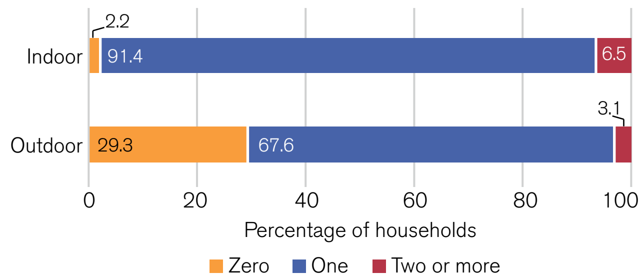


Figure 16. Availability of air coolers at home, by work setting

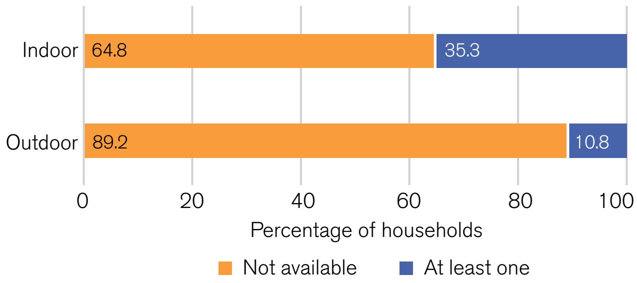


Figure 17. Availability of air conditioners at home, by work setting

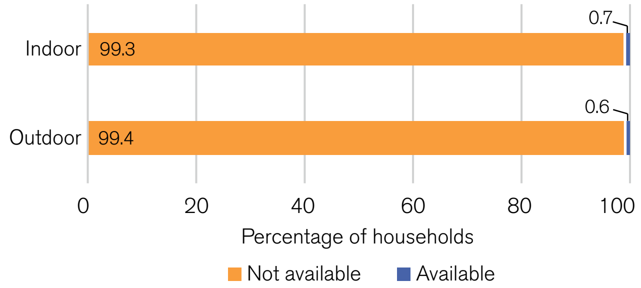
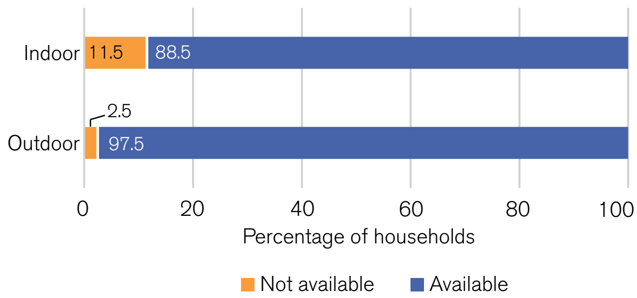


Figure 18. Availability of refrigerator at home, by work setting

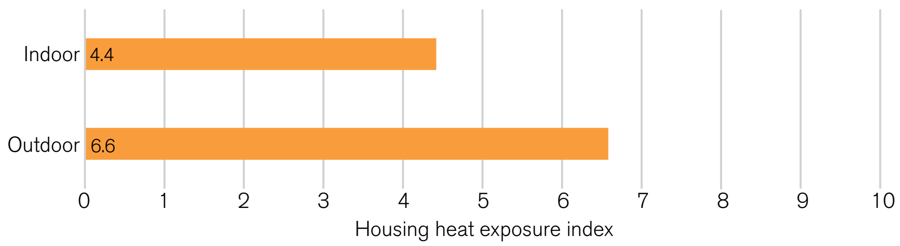


2.2.5.3 The housing heat exposure index

To bring the different features of the home together into a single comparable measure, we constructed a housing heat exposure index that combines the five housing variables examined here: roof type, ceiling height, living space per person, perceived indoor heat during summer and the availability of cooling equipment. Following the C-CIQ approach, it is scaled from 0 to 10, with higher scores indicating greater heat exposure at home.

Outdoor worker households scored 6.58 on the index, compared with 4.42 for indoor worker households (see Figure 19). This confirms that outdoor workers generally live in housing conditions that expose them to greater heat, reflecting the higher prevalence of heat-absorbing roofs and lower ceilings, greater crowding and more limited access to cooling. But the lower score among indoor workers does not mean that their homes provide much relief from heat. Indoor workers reported almost the same level of perceived indoor heat as outdoor workers (4.24 compared with 4.30 on a five-point scale), suggesting that both groups experience substantial heat exposure at home, and therefore have limited opportunity to recover after work.

Figure 19. Housing heat exposure index, by work setting



Note: The housing heat exposure index is a composite of variables, namely roof type, roof height, per capita housing area, heat intensity inside the house during summer months and fan availability. It ranges from 0 to 10, with higher scores meaning worse heat exposure.

2.2.6 Water and sanitation

Water and sanitation are basic factors for coping with heat. As well as needing water to drink, people need it for washing and bathing, which help regulate body temperature, while having access to a toilet is part of being able to stay hydrated and maintain hygiene during hot periods. On both counts, we found significant shortfalls, particularly among outdoor workers.

Only about one-third of households (33.6% of outdoor and 39.6% of indoor worker households) have adequate water available year-round (see Figure 20). The remainder face varying degrees of scarcity during the summer months, when demand is highest. Among outdoor workers, 51.5% report moderate and 14.8%, extremely scarce water availability in summer, meaning that around two-thirds experience shortages during the hottest part of the year. Indoor workers are only slightly better placed, with 46.8% reporting moderate and 13.7% extreme scarcity. Water becomes hardest to obtain when heat makes it most necessary, forcing households to ration supplies, spend time collecting water and trade off drinking water against water for washing and bathing.

The largest difference between the two groups is in access to sanitation at home (see Figure 21). More than one-third (34.3%) of outdoor workers have no toilet facility and rely on open defecation, 24.7% use a pit latrine and only 41.1% have access to a sanitary toilet. Indoor workers are better served: 73.4% have a sanitary toilet and only 2.9% have no facility. This reflects the housing conditions described in Section 2.2.5, as outdoor workers are more likely to live in temporary or employer-provided accommodation where sanitation facilities are often absent. The lack of a toilet compounds the effects of heat and water scarcity, increasing hygiene risks and placing a disproportionate burden on women in terms of privacy, safety and the need to restrict fluid intake.

Water and sanitation therefore represent another layer of vulnerability that households carry into the summer months.

Figure 20. Water availability at home, by work setting

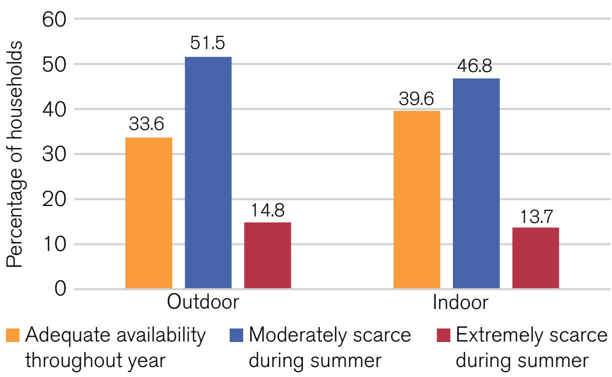
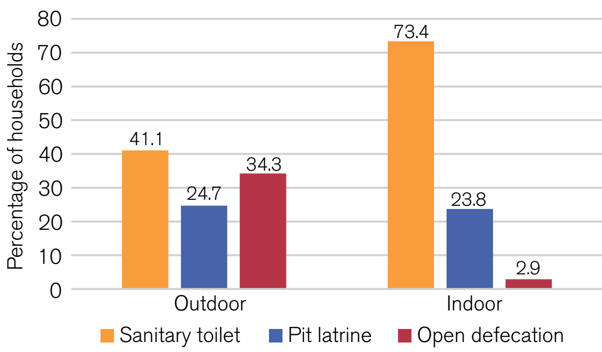


Figure 21. Toilet facilities at home, by work setting



2.2.7 Food security

Food security shapes how well the body withstands heat, since adequate nutrition supports the physical effort and recovery that hot work demands, while heat itself acts directly on food through spoilage (Misiou and Koutsoumanis, 2021). We examined meal frequency, food adequacy, seasonal shortages and food spoilage to understand how heat affects food security among worker households.

Most (63.7% of outdoor and 65% of indoor worker) households eat three meals a day, around one-third eat two meals and very few eat just one meal or skip meals altogether (see Figure 22). On this measure, outright hunger appears uncommon. Yet meal frequency alone does not indicate whether food is sufficient or consistently available throughout the year.

When asked whether their food had been adequate day to day during the previous month, 13.4% of outdoor and 10.6% of indoor worker households reported that it had not (see Figure 23). Yet on average, outdoor and indoor worker households experience 10.9 and 11.9 days, respectively, without adequate food per month (see Figure 24). This suggests that even households that generally consider their food to be adequate experience periods of shortfall.

Food shortages are strongly seasonal and concentrated in the hottest months of the year (see Figure 25). Only 11.2% of outdoor and 19.6% of indoor worker households reported facing no food shortages at any point during the year. For most households, shortages clustered in May, June and July, when temperatures are highest and the body most needs nourishment to cope with heat, reinforcing the interaction between food insecurity and heat stress.

Heat also affects the food households already have. Around 80% of both groups reported that food goes stale in summer at least sometimes, while 38.6% of outdoor and 46.1% of indoor worker households reported that this happens frequently or very frequently (see Figure 26). With refrigerators almost absent, people often cannot store food safely through the heat of the day, increasing both food waste and the risk of consuming spoiled food. Despite their somewhat better housing conditions, indoor workers reported frequent spoilage slightly more often than outdoor workers.

The findings show that heat undermines nutrition at the point the body most needs it. Food shortages peak during the hottest months, while spoilage reduces the value of the food households can obtain, reinforcing an already important source of vulnerability.

Figure 22. Number of meals per day, by work setting

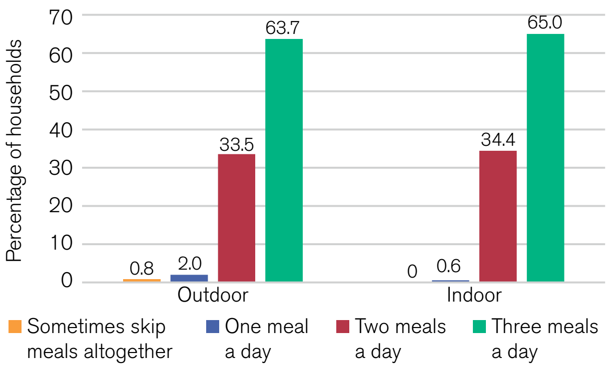


Figure 23. Share of households with adequate daily food in the last month, by work setting

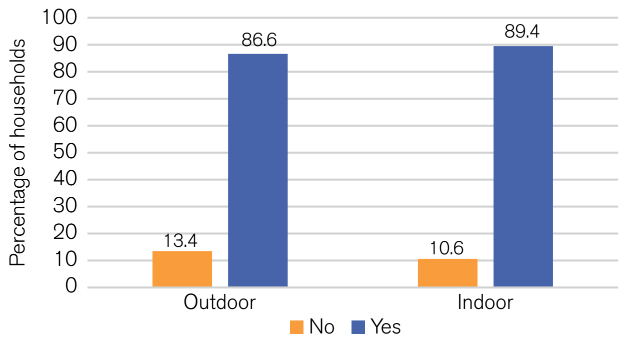


Figure 24. Average number of days without adequate food in the last month, by work setting

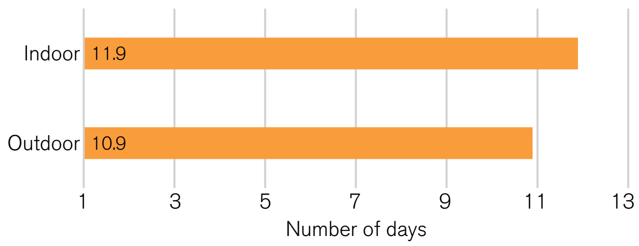


Figure 25. Months in which the family faces food shortages, by work setting

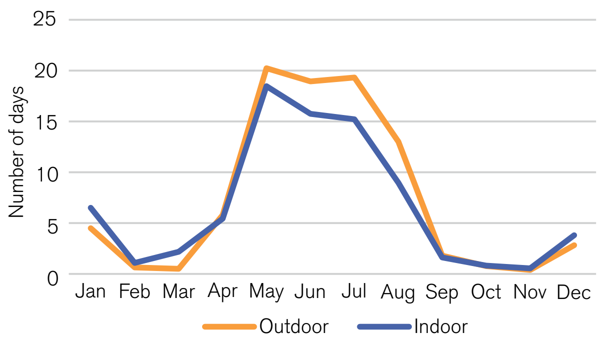
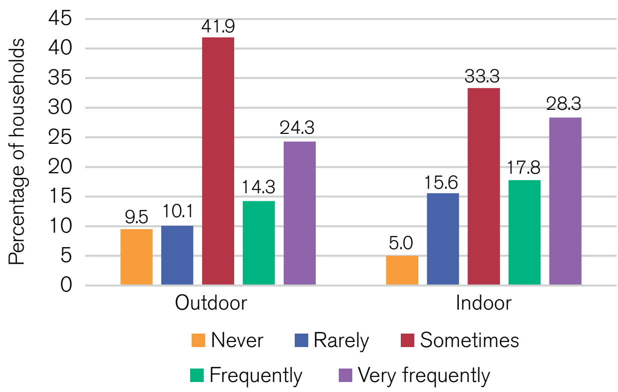


Figure 26. Frequency with which food goes stale in summer, by work setting



Case study 1. Anita: two shifts, no end

Anita, in her mid-thirties, lives in Rajokri, Delhi, in a single 8x6-foot room with no windows and just one door. She lives there with her partner, brother and three children under ten.

The family migrated from Badha village in Uttar Pradesh nearly 20 years ago. All three adults work in informal construction.

Anita's day begins before she reaches the site, as she cooks and gets the children ready for the day. Then she walks to work, usually taking her youngest child with her.

"I have no one to leave him with," she says. *"He sits where I work."*

On site, Anita carries headloads of brick, breaks stones and mixes cement. On multi-storey sites, she climbs up to five floors with 15–25 kilogrammes of materials balanced on her head.

In peak summer, when temperatures across northern India exceed 45°C, Anita often feels dizzy and weak. Climbing with bricks makes it worse. But she tries to be regular at work.

"If you don't come, you don't earn. It's that simple."

Drinking water, shade and toilets are not always available at her workplace. For women, the absence of toilets makes the heat worse.

"Sometimes we spend hours without going to the toilet. There is nowhere to go."

When Anita was pregnant, she skipped work for around 18 months.

"When I was pregnant, no contractor would take me. We borrowed just to eat."

Women on construction sites earn less than men for equivalent work.

"I can carry as much load as a man, but my work is paid less."

There is no medical care at work, and no wage protection if she falls sick.

"No one asks if you are unwell."

After work, Anita returns to the family's small room, where they cook indoors. Heat from the stove has nowhere to escape, and they have just one air cooler for six people. There is no part of her day, whether at work or at home, that is not defined by heat, labour and the absence of protection.

Anita faces heat exposure inside and outside her home while managing daily household responsibilities. Photo: Achin Phulre/Quirky Tokri

2.3 Precipitating factor: heat

Within the 3P framework, heat is the precipitating factor that turns underlying vulnerabilities into loss and damage. In this section, we examine how temperatures have changed over time, the seasonal pattern of heat exposure, how workers perceive these changes and the role that climate stress has played in driving migration.

2.3.1 Long-term temperature and anomaly trends

To establish how much hotter India has become, we drew on the IMD's all-India temperature series for 1901–2025 and measured each year against the long-term average for that period.

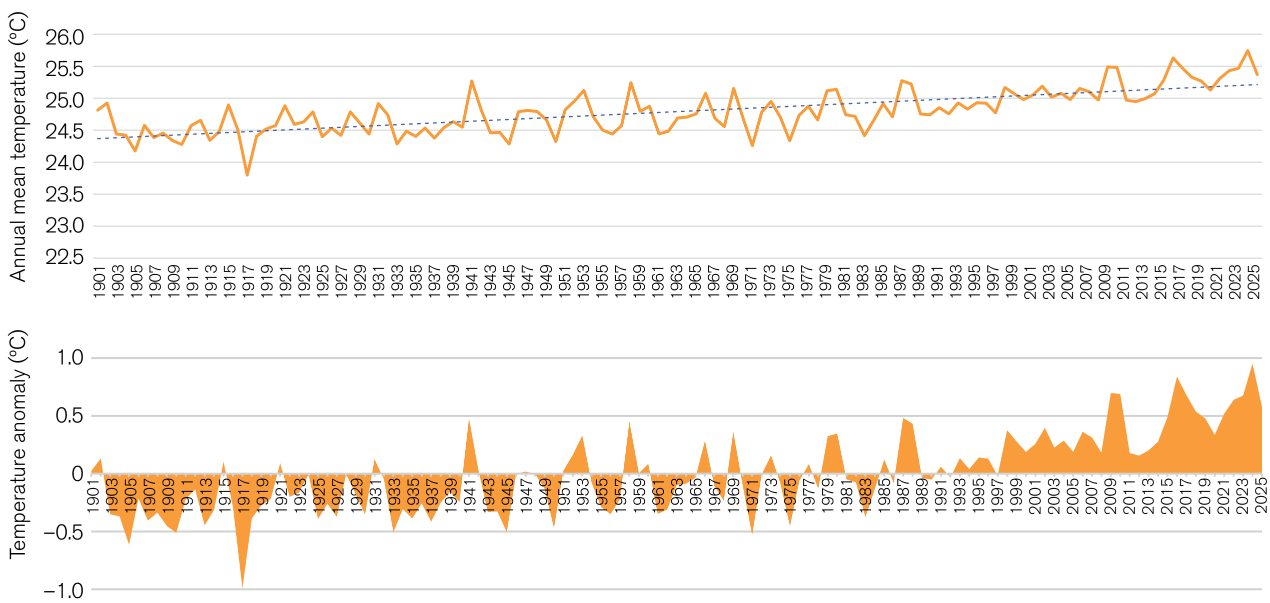
Mean temperatures have risen over the period, with the increase concentrated in recent decades. Against a long-term annual mean of 24.79°C, the earlier years were close to or below the average, while recent years are consistently above it. With an annual mean temperature of 25.74°C, 2024 is the warmest year on record, 0.95°C above the long-term average. Figure 27 shows the annual mean temperature and its deviation from the long-term average.

Maximum temperatures, which are particularly relevant to workers because they determine conditions during the working day, show a similar pattern. Against a long-term annual maximum of 30.46°C, 2024 was 0.79°C above average, while the highest maximum temperature anomaly on record was in 2016, at 1.06°C above average. Figure 28 presents the annual maximum temperature and its anomaly over the same period.

The concentration of the warmest years in recent decades highlights the pace of change. By mean temperature, the ten warmest years since 1901 are from 2009 onwards; eight of them since 2016 (see Table 1). The ranking by maximum temperature shows a similar pattern, with eight of the ten warmest years occurring after 2009 (see Table 2). These are not isolated extremes; rather, the most recent years dominate the temperature record.

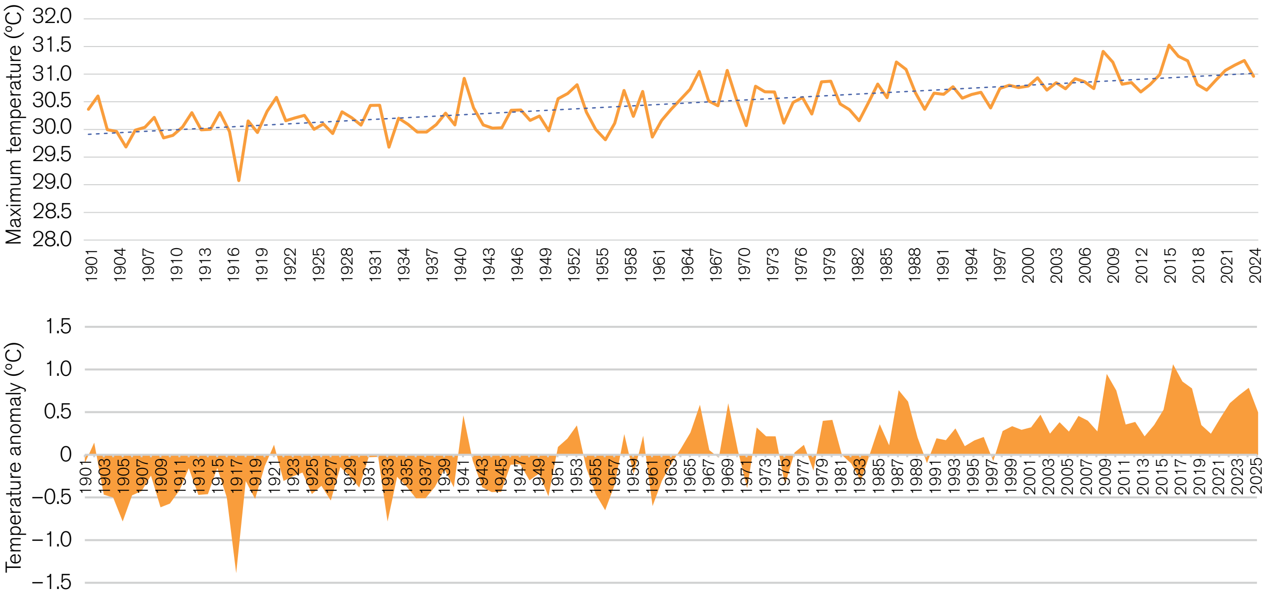
The evidence shows a clear and accelerating warming trend. Heat is not a future risk for Indian workers; it is a present and intensifying factor that acts on the vulnerabilities described in Section 2.2.

Figure 27. Annual mean temperature and anomaly, 1901–2025



Source: Authors' own calculations based on data from https://imdpune.gov.in/cmpg/Product/allindia_temp.html?utm_source=chatgpt.com. Long term average was calculated for 1901–2025 period.

Figure 28. Annual maximum temperature and anomaly, 1901–2025



Source: Authors' own calculations based on data from https://imdpune.gov.in/cmpg/Product/allindia_temp.html?utm_source=chatgpt.com. Long term average was calculated for 1901–2025 period.

Table 1. Ten warmest years in India by mean temperature, 1901–2025

Rank	Year	Anomaly above long-term average (°C)
1	2024	0.95
2	2016	0.84
3	2009	0.70
4	2010	0.69
5	2017	0.68
6	2023	0.68
7	2022	0.64
8	2025	0.58
9	2018	0.54
10	2021	0.52

Table 2. The ten warmest years in India by maximum temperature, 1901–2025

Rank	Year	Anomaly above long-term average (°C)
1	2016	1.06
2	2009	0.95
3	2017	0.86
4	2024	0.79
5	2018	0.78
6	1987	0.76
7	2010	0.75
8	2023	0.70
9	1988	0.62
10	2022	0.61

2.3.2 The seasonal profile of heat

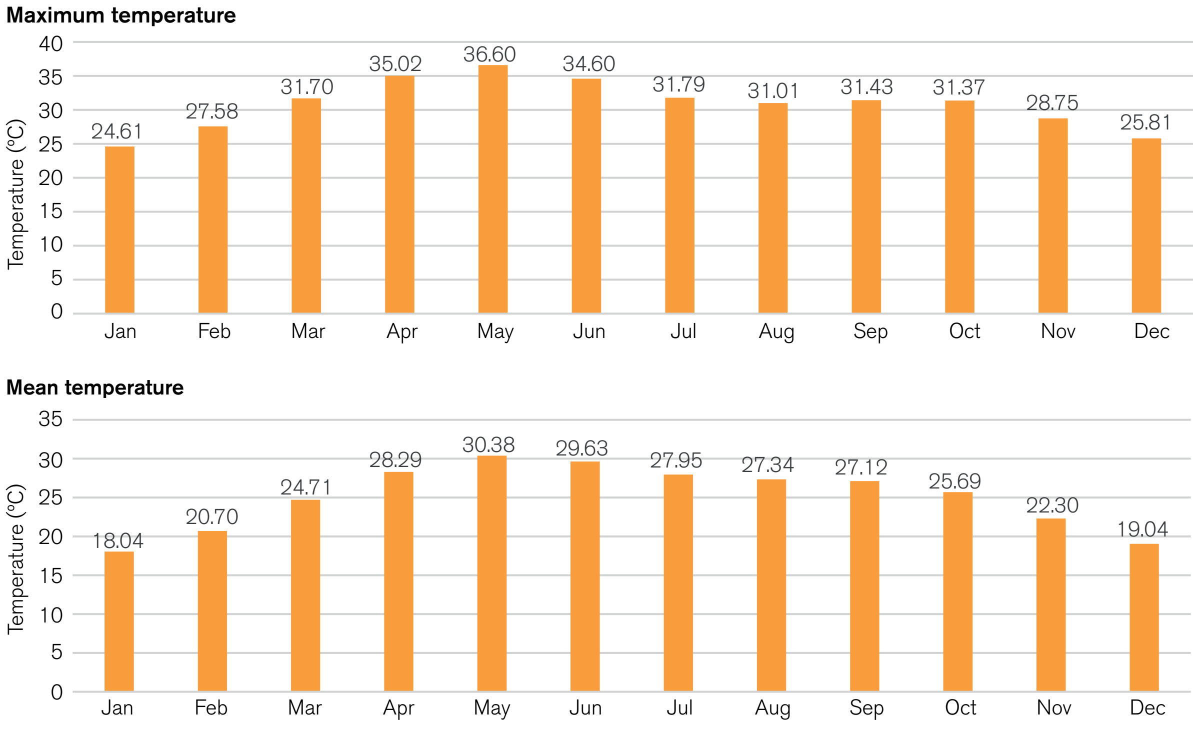
The annual averages conceal a strong seasonal pattern, and it is the distribution of heat across the year, rather than the annual mean, that workers experience. Drawing on the IMD's monthly climate normals for 1991–2020, Figure 29 presents the average monthly mean and maximum temperatures for India.

Daytime heat builds steadily from the start of the year and peaks before the monsoon onset in June. Average maximum temperatures rise from 24.61°C in January to 35.02°C in April and 36.60°C in May, the hottest month, before easing slightly to 34.60°C in June. These are long-term averages across the country, and the daily maximums experienced during heatwaves in the study cities are considerably higher, often exceeding 44°C. Average maximum temperatures remain above 31°C from March to October, indicating that heat exposure extends across much of the year and is not confined to a short hot season.

Mean monthly temperatures follow a similar pattern, reaching 30.38°C in May. Although the monsoon reduces daytime maximums, mean temperatures remain around 27–30°C from June to September. The monsoon therefore offers only limited relief, as warm nights and high humidity keep the felt heat elevated even when daytime temperatures decline.

This seasonal pattern is important for the rest of the analysis. April to June, when daytime heat is most intense, coincide with the period when respondents most commonly experience food shortages. More broadly, summer extends across several months, meaning that the heat exposure documented in this report reflects sustained, rather than episodic, exposure.

Figure 29. Average monthly maximum and monthly mean temperatures, 1991–2020



Source: Authors' own calculations, based on IMD data.

2.3.3 How workers perceive the change

The temperature record outlined in Section 2.3.2 describes the change from a meteorological perspective. We also asked workers how summer heat has changed over their working lives, both to compare their lived experience with the temperature record and because, in a participatory approach, the perceptions of those affected are evidence in their own right. Workers' responses closely matched the trends observed in the climate data.

Asked how summer temperatures had changed in recent years, around 9 in 10 workers said they had increased. Among outdoor workers, 56.7% rated the increase as very high and 33.2% as high, while among indoor workers, 56.1% rated it as very high and 36.7% as high, showing that 89.9% of outdoor workers and 92.8% of indoor workers have perceived a rise in temperatures (see Figure 30). Fewer than 1 in 10 workers in both groups reported no change. Workers described not only hotter days, but also the disappearance of the cooler evenings they once relied on for recovery:

"It used to cool down in the evening. Now, it stays hot, even at night."

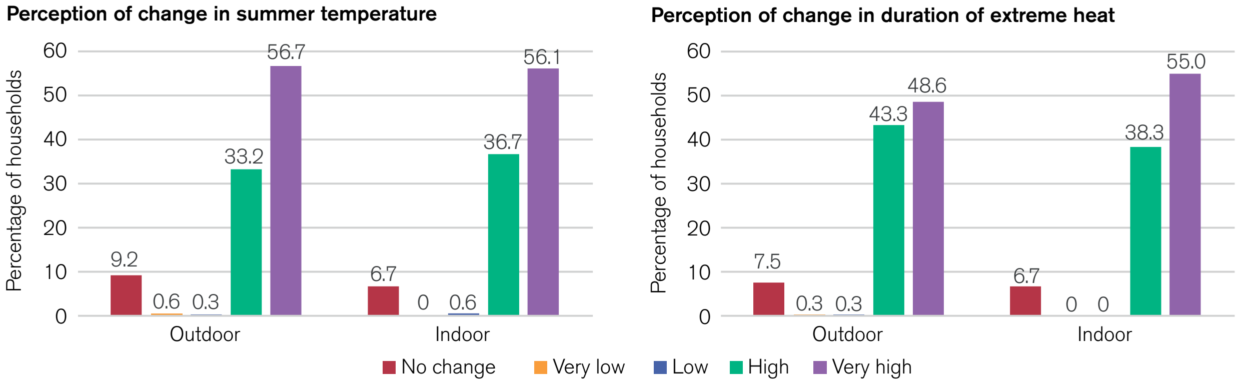
Participant in FGD with women construction workers, Delhi

Workers also perceived extreme heat as lasting longer than it used to. Asked whether the number of extremely hot days had changed, 91.9% of outdoor workers and 93.3% of indoor workers reported that periods of extreme heat had lengthened, with around half in both groups rating the increase as very high (see Figure 30). This perception mirrors the longer and more sustained hot season evident in the climate data. Brick kiln workers in Ajmer described the change in practical terms:

"We have noticed that heatwaves, which earlier lasted around five days, now last up to ten days or even more. The heat has become more intense. The temperature rises earlier in the day and stays high even at night. Earlier, we did not complain much about the heat, but now it is a constant concern." Participant in FGD with men and women brick kiln workers, Ajmer

Two findings stand out. First, workers' lived experiences closely align with the meteorological record. Second, indoor workers perceive the changes at least as strongly as outdoor workers.

Figure 30. Workers' perception of change in summer temperature and duration of extreme heat days compared to previous years, by work setting

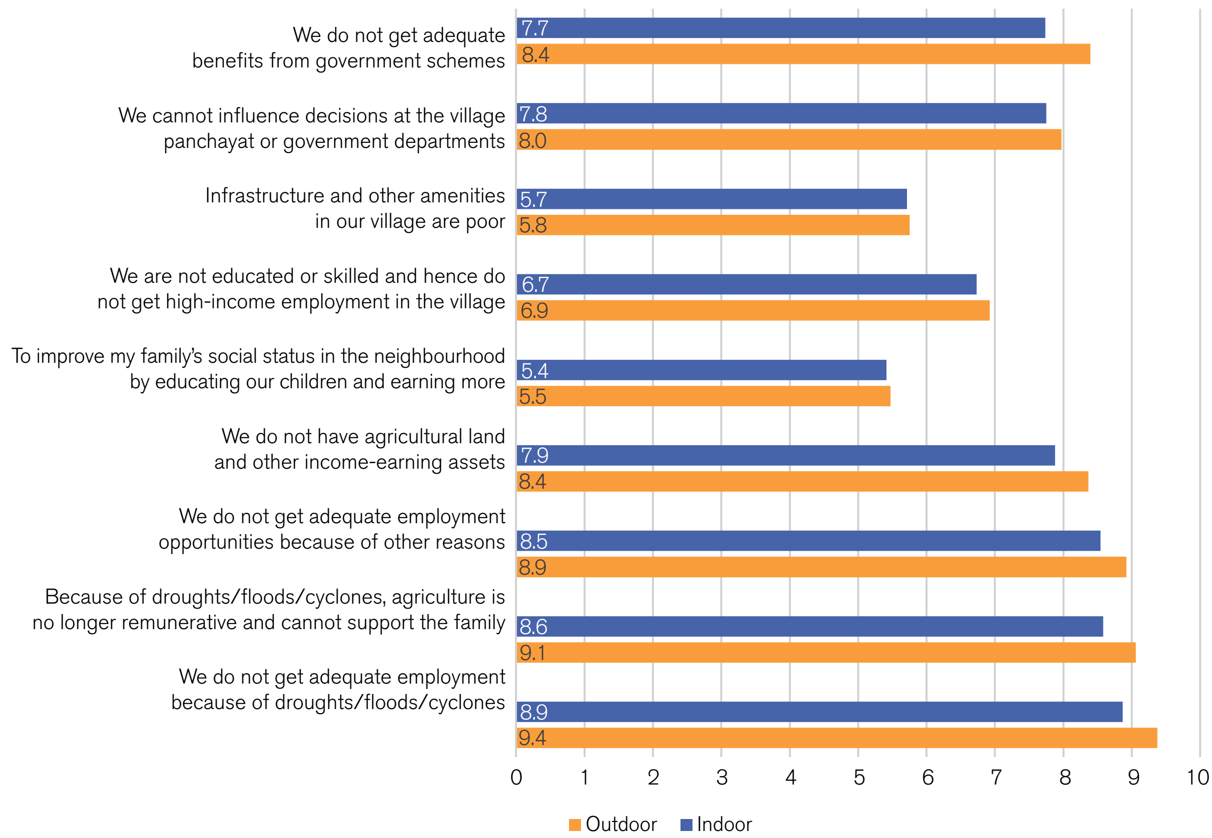


2.3.4 Heat as a driver of migration

Heat and climate change shape workers' lives in the city, but for many, climate stress also played a role in their decision to migrate. We asked workers to rank the reasons for migration and combined their responses into an index, where higher scores indicate greater importance. Climate-related factors emerged as the most important drivers.

Among both outdoor and indoor workers, the two highest-ranked reasons for migration were linked to climate shocks in their places of origin (see Figure 31). Outdoor workers gave the highest score to inadequate employment caused by droughts, floods and cyclones (9.38), followed closely by agriculture no longer providing enough income due to these same events (9.06). A more general lack of employment ranked next (8.92), followed by inadequate access to government scheme benefits (8.40) and the absence of agricultural land or other income-generating assets (8.36). Indoor workers reported a similar pattern, with slightly lower scores across most indicators.

Figure 31. Reasons for migration, by work setting



The findings suggest that many workers were pushed out of their rural livelihoods by climate and weather shocks that made farming and local employment increasingly unreliable, which is reflected in the higher trend of migration in recent years.

"We get work only for about eight to nine months in a year. The work is seasonal. We migrate to the kiln during the dry season and return home during the monsoon. When we are in our village, we do some agricultural work. But most of us do not have stable employment there."

Participant in FGD with men and women brick kiln workers, Ajmer

Many workers arrive in cities after experiencing climate-related stress in rural areas, only to enter informal occupations that expose them to extreme heat. Their vulnerability does not begin in the city; rather, urban heat exposure becomes part of a longer chain of climate-related pressures that affect their livelihoods and wellbeing.

This has important implications for policy. Responses that focus only on conditions at the urban workplace overlook the role that climate stress has already played in shaping migration and vulnerability. For many workers, heat-related loss and damage began before they arrived in the city, and effective responses need to recognise this wider trajectory.

Case study 2. Raghuveer: heat and the cycle of poverty

Like his father before him, Raghuveer is a migrant construction labourer. He is from Datpura village in Tikamgarh district, Madhya Pradesh, where his family's land is too small to support them through a full year.

"Farming in the village is not enough. Our plot is too small."

He migrated to Agra for construction work a decade ago. On site, he carries heavy loads, mixes cement and does whatever the contractor requires. The heat in April, May and June make construction work difficult.

"Every summer, I get rashes on [my] arm. Sometimes I feel faint, sometimes my stomach goes bad."

When the heat is too much, the contractor stops the work. But every stopped day is a loss for the workers, who receive no compensation.

Raghuveer lives in a makeshift hut, made of tarpaulin sheets and other scrap material. Even at night, the hut remains hot well past midnight, and getting a good sleep is hard.

"Our income is also not enough to rent a house. We find an empty plot near the worksite, take the owner's permission, and put up a hut."

His wife and two children remain in their village.

"I want their lives to be different, but construction work cannot change their future."

Migrant construction workers face the dual challenge of earning a livelihood and enduring relentless summer heat in northern India. Photo: Achin Phulre/Quirky Tokri

2.4 Protective factors: the social protection safety net and its gaps

The third element of the 3P framework is protection: the support that should reduce the losses and damages caused by heat exposure. India has an extensive social protection architecture, ranging from food assistance and health cover to labour welfare schemes. In principle, these programmes should help workers cope with the income, health and food security impacts of extreme heat. But in practice, we found substantial gaps in coverage, particularly among migrants.

2.4.1 Identity and financial inclusion

To access most social protection programmes, workers generally need proof of identity and a bank account for receiving benefits. These are the gateway to the wider social protection system, and on all three measures examined here, migrants are less well covered than non-migrants, regardless of work setting (see Figure 32).

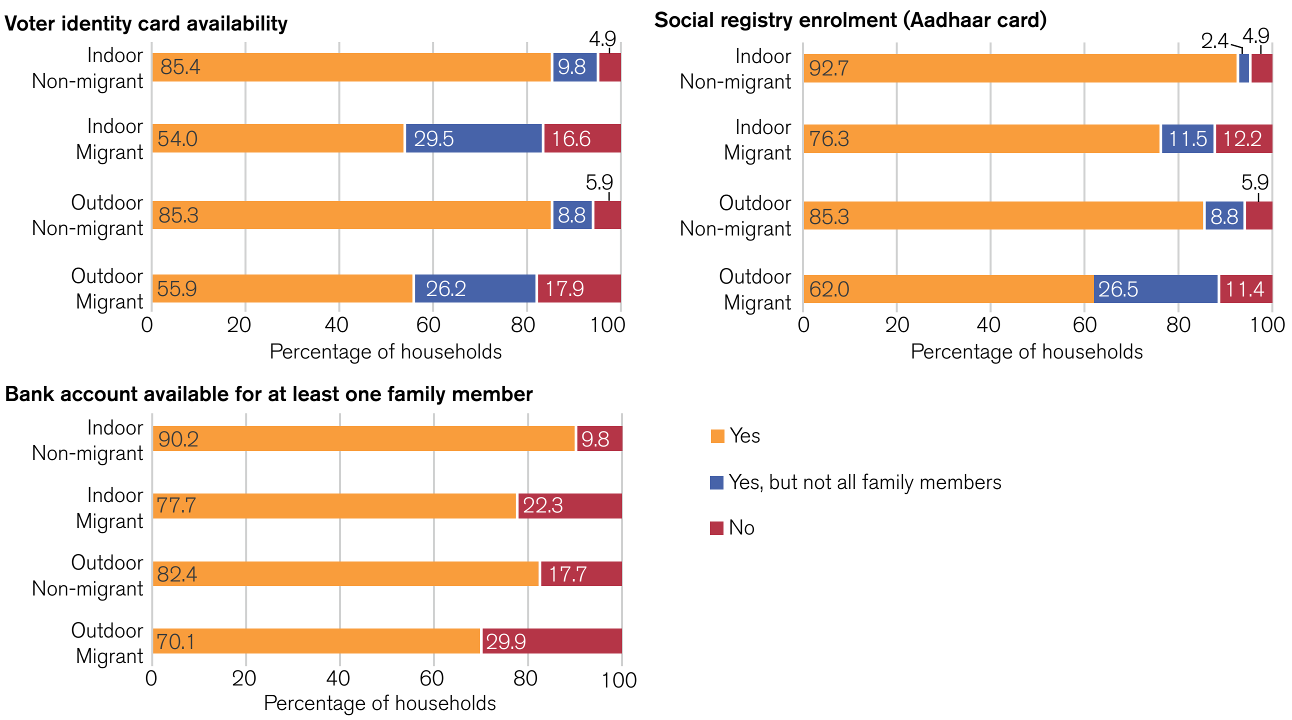
The largest gap is in voter identity cards. Only 55.9% of migrant outdoor worker households and 54% of migrant indoor worker households have voter IDs for all family members, compared with 85% of non-migrant households in both settings. Just over a quarter of migrant households hold voter IDs for only some family members, while 17.9% of migrant outdoor and 16.5% of indoor migrants have no ID. This reflects the fact that many migrants remain registered to vote in their place of origin rather than the cities where they now live and work.

Aadhaar, the national biometric identity number used to access many government schemes, has broader coverage but shows a similar pattern. Full household Aadhaar coverage is higher among non-migrants (85.3% of outdoor and 92.7% of indoor worker households) than migrants (62% of outdoor and 76.3% of indoor worker households). Among migrant outdoor worker households, 11.4% hold no Aadhaar and 26.5% only have cover for some family members.

Bank account ownership follows a similar pattern. Among non-migrants, at least one family member has a bank account in 82.4% of outdoor and 90.2% of indoor worker households, while among migrants, this falls to 70.1% and 77.7%, respectively. Nearly one-third of outdoor migrant households (29.9%) have no bank account, limiting their ability to receive cash transfers and other scheme payments.

The findings show that migrant workers are less likely to own the documents and have access to the financial instruments they need to participate in social protection programmes. Even where they hold the required documents, migrants are often registered in their home districts rather than the cities where they work, making it difficult to access entitlements in practice (Srivastava, 2020b). So, while documentation is a necessary condition for protection, for many migrants, it is not enough.

Figure 32. Identity documents and financial inclusion, by work setting and migration status

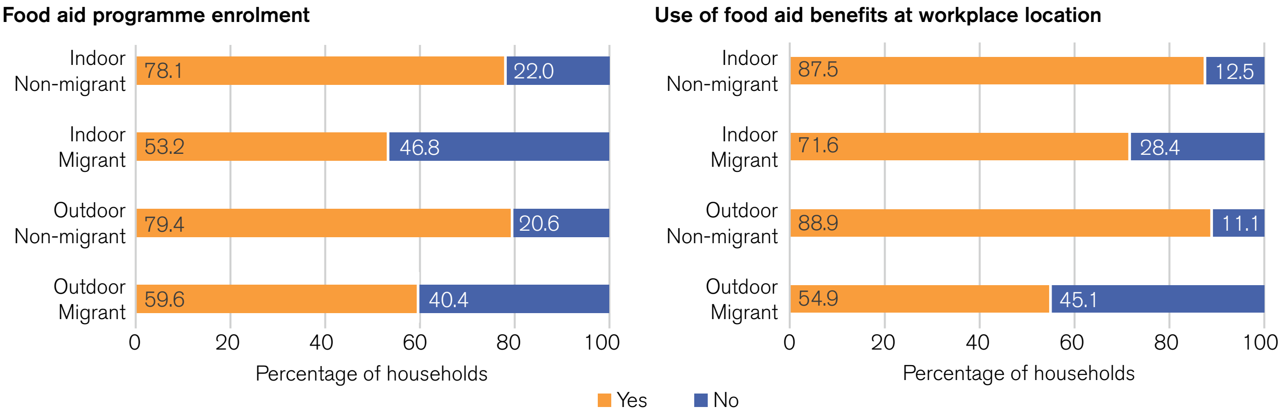


2.4.2 Food assistance

India's main food security programme, the Public Distribution System (PDS), provides subsidised grain to eligible households through a ration card. It is potentially one of the most important forms of support for workers facing heat-related income loss, particularly during the summer months when food shortages are most common.

Our survey asked respondents about both enrolment in the programme and whether households can access their entitlement where they live and work (see Figure 33).

Figure 33. Food aid enrolment and access at the workplace location, by work setting and migration status



Among migrants, 59.6% of outdoor and 53.2% of indoor worker households are enrolled in food aid, compared with 78–79% of non-migrant households. This means that 4–5 in 10 migrant households are not enrolled, compared with roughly 2 in 10 non-migrant households.

But the larger challenge is at the point of access. Even among enrolled households, only 54.9% of outdoor migrant workers and 71.6% of indoor migrant workers can collect food aid where they work, compared with 88.9% of outdoor and 87.5% of indoor non-migrant workers.

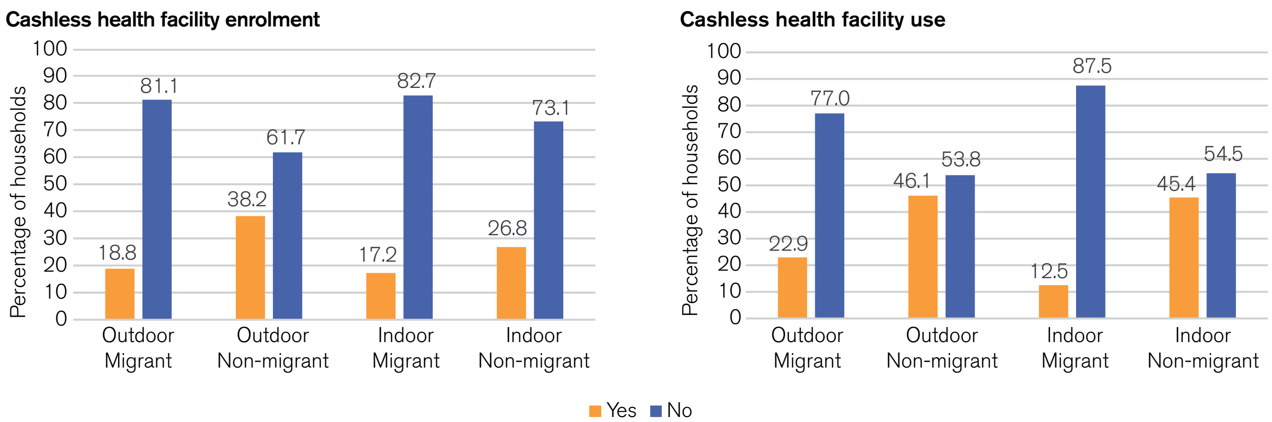
"Our ration card is from the village, we don't get anything here." Participant in FGD with women construction workers, Agra

These findings point to a continuing portability gap. India introduced the One Nation One Ration Card scheme so workers could take their entitlements across state and district boundaries; yet many migrants still appear unable to access rations at their destination, facing administrative and technical barriers, or remaining tied to the systems that operate in their home areas. Similar challenges have been documented elsewhere (John et al., 2020; Srivastava, 2020b).

2.4.3 Cashless health cover

Ayushman Bharat, India's flagship health protection scheme, provides eligible households with cashless hospital treatment up to a specified annual limit. It is particularly relevant to workers who are exposed to extreme heat, since heat-related illness can generate significant healthcare costs, ranging from treatment for dehydration and heatstroke to longer-term care associated with kidney disease. Our survey asked respondents about both enrolment in the scheme and the use of cashless health facilities (see Figure 34).

Figure 34. Cashless health cover: Ayushman Bharat enrolment and use of a cashless facility, by work setting and migration status



Although low across all groups, enrolment is lowest among migrants, with only 18.8% of outdoor and 17.3% of indoor worker migrant households holding an Ayushman Bharat card, compared with 38.2% and 26.8%, respectively, among non-migrants. In other words, more than 8 in 10 migrant households are outside the scheme designed to protect them from major health expenditure.

The use of cashless care is even lower. Only 23% of outdoor and 12.5% of indoor worker migrant households have used a cashless health facility, compared with around 46% of both types of non-migrant households. So, as well as being likely to be enrolled, migrants are substantially less likely to receive treatment without paying out of pocket.

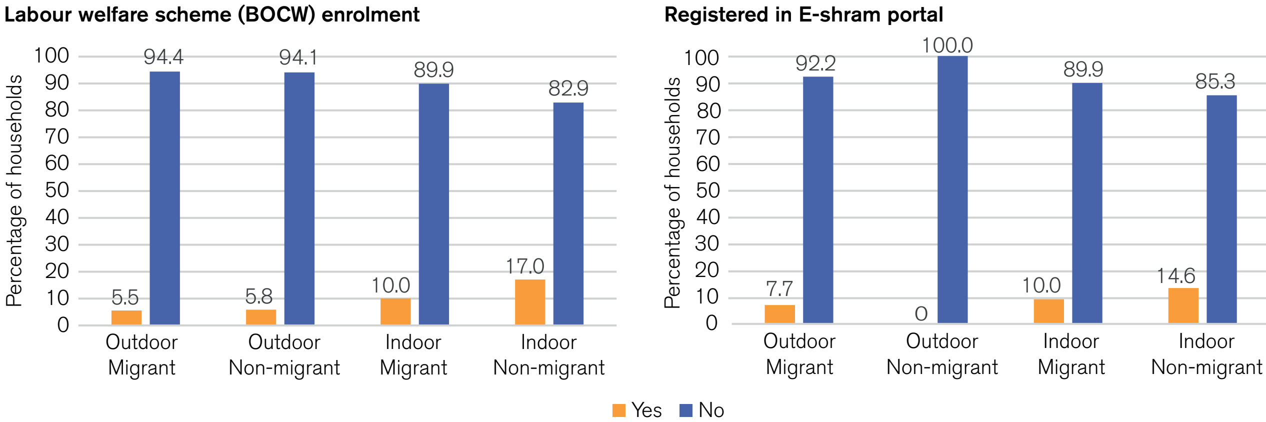
"We pay for our treatment ourselves, and the cost of medicines and glucose drips adds to our financial burden." Participant in FGD with men and women brick kiln workers, Ajmer

Heat-related illness imposes recurring healthcare costs on already vulnerable households, yet the scheme intended to shield them from those costs reaches only a minority of workers.

2.4.4 Labour welfare and registration

Two mechanisms are intended specifically to support informal workers. The Building and Other Construction Workers (BOCW) Welfare Board provides registered construction workers with accident compensation, pensions, health support, education assistance and other benefits, funded through a construction cess (1% levy on the total cost of construction projects, which is explicitly earmarked to fund the BOCW Welfare Board's support schemes). The e-Shram portal is a national register of unorganised workers that serves as an entry point into the wider social protection system (Ministry of Labour and Employment, 2021). Both are designed to reach informal workers, so our survey asked about respondents' enrolment in each (see Figure 35).

Figure 35. Access to labour welfare and social protection schemes: BOCW Welfare Board enrolment and e-Shram registration, by work setting and migration status



BOCW enrolment is extremely low, even among the construction workers it was created to support. Among outdoor workers, only 5.6% of migrants and 5.9% of non-migrants are enrolled. Coverage among indoor workers is slightly higher but remains low overall, at 10.1% of migrants and 17.1% of non-migrants. As a result, the benefits that could help households absorb heat-related losses reach only a small minority of workers.

Registration with e-Shram is similarly limited. Among outdoor workers, only 7.7% of migrants and no non-migrants are registered, while among indoor workers, 10.1% of migrants and 14.6% of non-migrants are. It is clear that this national register, which aims to bring unorganised workers into the social security system, has made little progress in reaching the workers we surveyed. Unlike food assistance and health cover, where migrants are consistently worse off than non-migrants, exclusion from these schemes appears to be widespread across both groups. Workers attribute this to a combination of limited awareness, documentation requirements and a lack of support from employers or contractors.

"We don't know how to register, no one tells us." Participant in FGD with men construction workers, Agra

Women construction workers in Delhi similarly reported difficulties in obtaining or renewing labour cards, often due to documentation requirements and a lack of help from contractors.

These findings suggest a broader implementation problem rather than a portability issue alone. The labour welfare architecture established specifically for informal workers exists in principle but does not reach many of the workers it was designed to serve.

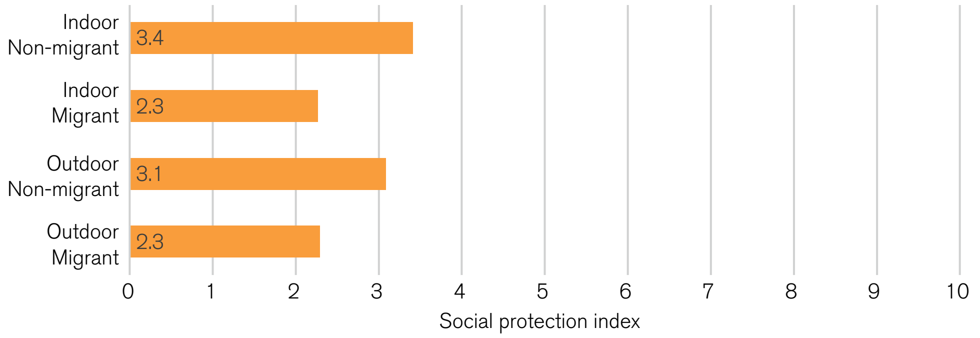
2.4.5 The social protection index

To bring the different dimensions of social protection together into a single measure, we constructed a social protection index that combines the social protection variables examined here: enrolment in food assistance, the social registry, cashless health cover and labour welfare schemes, together with whether households were able to access those benefits. Following the C-CIQ approach, it is scaled from 0 to 10, with higher scores indicating stronger social protection.

All groups scored poorly on the index (see Figure 36), with outdoor migrant worker households scoring 2.29, indoor migrant worker households, 2.27, and outdoor and indoor non-migrant worker households scoring 3.09 and 3.41, respectively. The highest score (indoor non-migrants) only reaches around one-third of the scale, indicating weak social protection coverage across all groups.

Migration status emerges as the main dividing line. Migrant households score around 2.3 regardless of work setting, compared with between 3.1 and 3.4 among non-migrants. By contrast, the difference between outdoor and indoor workers is relatively small, particularly among migrants, reinforcing a pattern we have seen throughout this chapter: migrants are consistently less protected than non-migrants, but the wider social protection system provides only limited coverage, even for those who are better served.

Figure 36. Social protection index, by work setting and migration status



Note: The social protection index is a composite of variables, namely enrolment in food aid, social registry, cashless health facilities, and labour welfare schemes and availing of scheme benefits. It ranges from 0 to 10, with higher scores meaning better social protection.

3

Exposure, health and lived experience of working in the heat

Informal workers make up the overwhelming majority of India's workforce, accounting for close to 9 in 10 workers and typically lacking written contracts, social security and the protections associated with formal employment (NSO, 2024). This pattern is not unique to India. Informal employment accounts for around 60% of workers globally and close to 90% in low-income countries (ILO, 2023). These workers are concentrated in some of the most physically demanding and least-protected occupations, many of which are highly exposed to extreme heat.

This chapter examines the consequences of that exposure. Some impacts — such as heat cramps, exhaustion, heatstroke and lost work during the summer months — are immediate. Others accumulate over years of exposure and may become permanent. We begin by examining work conditions, heat exposure and workplace facilities, before analysing the coping strategies workers rely on in their absence. We then assess the resulting health impacts and use regression analysis to identify the factors most strongly associated with heat-related illness.

3.1 Work conditions and heat exposure in the workplace

Before examining the health impacts of heat, we first consider the conditions that shape exposure. Two factors are particularly important: job security, which influences whether workers feel able to protect themselves from heat, and the extent of heat exposure during the working day.

3.1.1 Employment type and job security

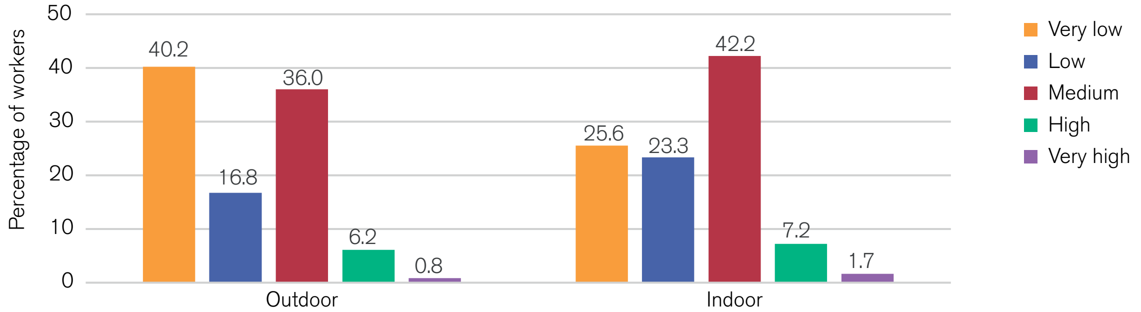
Insecure work is a heat risk in its own right. Workers who cannot rely on continued employment or income are rarely able to stop, slow down or take time off when heat becomes dangerous. We therefore examined how secure workers feel in their employment (see Figure 37).

Employment is precarious for a large share of both groups. A slim majority (54.7% of outdoor and 50% of indoor workers) hold contracts that cover a full month, but the remainder work on far less certain terms. Among outdoor workers, 23.7% search for work on a daily basis and 14.8% are contracted for only part of a month. Among indoor workers, 26.1% work on roll call or attendance-based arrangements and 17.2% search for work daily. This means that 4–4.5 in 10 workers in each group lack secure monthly employment.

"Do we get work every evening? No, some days there's no work... sometimes we sit idle for five days." Participant in FGD with men construction workers, Agra

Workers' own assessments of job security reflect this uncertainty. Among outdoor workers, 40.2% rated their job security as very low and 16.8% rated it as low. This means 57% feel insecure, compared with only 7% who feel secure. Indoor workers reported slightly greater security, but almost half (48.9%) rate their security as low or very low, while only 8.9% feel secure. The findings challenge any assumption that indoor employment is substantially more secure than outdoor work. Neither group enjoys a meaningful degree of job security.

Figure 37. Perceived job security, by work setting



This insecurity helps explain why workers continue working through heat-related illness, delay seeking treatment and tolerate unsafe conditions rather than risk losing income or employment. It is also central to the coping strategies discussed in Section 3.3.

"As doctors we tend to see heat illness increasing during summer months. The progression from dehydration to acute kidney injury to chronic kidney disease is well established in the medical literature, and we are now seeing the early stages of it in the workforce. These conditions reduce the ability to work and earn long before they are diagnosed. Recognising heat exposure as an occupational health risk, and acting on it, would prevent a great deal of avoidable illness."

Dr Neeraj Pandey, professor and head of anatomy, and vice principal, Maharshi Vishwamitra Autonomous State Medical College, Ghazipur (Uttar Pradesh)

Case study 3. Shamshad: enduring extreme heat and insecure work

Shamshad, 28, has been migrating for work since 2008, when he and his elder brother first started moving across states for jobs. They come from Gursinar village in Sambhal district, Uttar Pradesh.

"We left because there was no money at home. We had to find work somewhere."

Today, he works at construction sites in Ajmer, Rajasthan. He lives in a small 10x10-foot room, which he shares with two other labourers. Three cots are pushed side by side and there is hardly any space to stand between them.

Years of low and irregular wages have pushed him into debt. He owes around 200,000 rupees and despite working 8–10 hours a day and often seven days a week, repayment is slow.

"The debt is always in my mind."

May and June are the hardest months, as temperatures in Rajasthan often exceed 45°C. Shamshad works outdoors, in direct sun with no shade.

"I sweat so much. Sometimes I feel dizzy. Sometimes I feel like vomiting. But we have to keep working."

When the afternoon heat becomes unbearable, he covers his head with a light cloth to reduce exposure to the sun.

"When it gets too hard, I try to sit in the shade for a bit. If the contractor says no, I have no choice."

Shamshad chews ghutka (a smokeless tobacco product) to distract himself from the physical strain. When contractors halt work during the hottest days of summer, his earnings reduce. Workers are paid only for the days they work. Every lost day means lost income.

Neither electrolytes nor first aid are available at his workplace, and Shamshad has no access to regular healthcare.

"When something small happens, I manage on my own. Going to a doctor costs money and time."

Living away from his family also affects his diet. After long hours of physical work, he struggles to cook. Water at his residence is supplied by tanker and is often of poor quality.

"I eat whatever I can get. Sometimes I cook."

For construction workers, prolonged exposure to extreme summer heat is part of daily life. Photo: Achin Phulre/Quirky Tokri

3.1.2 Hours of heat exposure

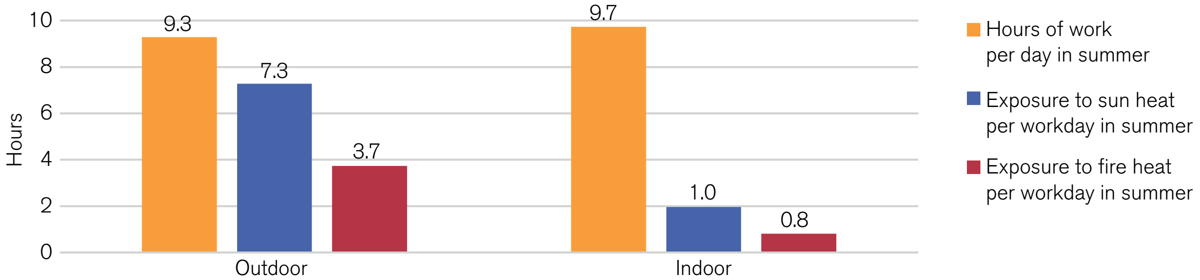
The working day is long for both groups. In summer months, outdoor workers report working an average of 9.3 hours per day and indoor workers, slightly longer days, at 9.7 hours (see Figure 38). What differs is the route through which heat reaches them. Outdoor workers are exposed to direct sunlight for an average of 7.3 hours a day and to radiant heat from fire and hot surfaces — such as brick kilns and freshly laid road material — for 3.7 hours. Indoor workers report much lower exposure to both, averaging 2 hours of direct sun and 0.8 hours of radiant heat.

These lower exposure figures do not mean that indoor work is substantially cooler. Rather, they reflect a different pathway of exposure. Indoor workers spend long hours in enclosed and poorly ventilated workplaces where heat accumulates throughout the day. This is consistent with the high levels of perceived indoor heat reported (see Section 2.3.3) and the health outcomes presented in Sections 3.5–3.7, where indoor workers experience heat-related illness at rates close to those of outdoor workers. Exposure measures based only on direct sunlight and radiant heat understate the heat burden faced by indoor workers.

Heat also takes paid time from workers before they reach the workplace. When water becomes scarce, workers may lose work time collecting it (see Section 2.2.6). In the summer months, 11.4% of outdoor workers and 3.6% of indoor workers report missing work for this reason. The higher figure among outdoor workers reflects their poorer access to water, particularly among those living in temporary or workplace accommodation, illustrating how living conditions can translate directly into lost work.

Both groups work long and heat-intensive days, only to then go to homes that offer little opportunity for recovery.

Figure 38. Daily work hours and heat exposure at work in summer months, by work setting



Case study 4. Kusum: same room, same heat, ten years on

"The machines are still in the same place. The fans are still the same. We just sit in the heat."

Kusum, a tailor at a garment manufacturing and export unit in Kapashera, Delhi, explains that the press machines used to iron finished garments are not in a separate section. Working in one tiny room where workers sew, finish work and press the items, steam and hot air from the press machines build around the workstations through the shift. The fans are too widely spaced to move the air.

"In summer, the unit feels like a furnace. The hot air just stays."

She has worked seven to eight-hour shifts in these conditions for over a decade. Nothing has changed.

"No one has ever asked us how hot it gets."

A view of Kapashera, Delhi: a neighbourhood of garment units, workshops, godowns and housing built side by side where summer heat is amplified by the tightly packed structures. Photo: Achin Phulre/Quirky Tokri

3.2 Workplace facilities and adaptable work practices

If the work itself is hot and insecure, the availability of workplace facilities — such as rest, water, shade and medical cover — and work practices that adapt to extreme heat can enable workers to tolerate the heat.

These protections are set out in labour law. Factory-based work falls under the Factories Act, 1948, which requires wholesome drinking water, with cool water during hot weather in larger factories, a workroom temperature that secures reasonable conditions of comfort, first aid provision, shelters and rest rooms. Construction falls under the BOCW Act, 1996 and its Central Rules, 1998, which require employers to provide drinking water, latrines, accommodation at or near the site, first aid with a trained first aider and occupational health services. From November 2025, both statutes are being consolidated into the Occupational Safety, Health and Working Conditions Code, 2020, with draft rules issued for consultation in December 2025 (Government of India, 1948b, 1996, 1998, 2020). But these legal and regulatory provisions have two limitations. First, most welfare requirements apply only to workplaces above certain worker count thresholds, and the 2020 Code raises this threshold further, so the smaller units sit outside them. And second, none of these statutes set a temperature threshold for heat to provide additional support to workers.

Despite the limitations, there are employer-side mandatory protection measures, but we found most of them are missing. In this section, we consider rest, water, electrolytes and shade, medical provision, protective work practices, and sanitation, before pulling them together in a workplace facilities index.

3.2.1 Rest, water, electrolytes and shade

The simplest measures for preventing heat-related illness are regular rest, cool drinking water, electrolyte replacement and somewhere shaded to recover. We found substantial gaps in all of these, particularly among outdoor workers.

Rest breaks are limited and do not increase as temperatures rise. Most workers (80.4% of outdoor and 74.4% of indoor workers) take only one break a day (see Figure 39), while the average number of breaks is 1.2 and 1.4 per day for outdoor and indoor workers, respectively. This changes little between summer months and the rest of the year, remaining at around 1.2 breaks per day for outdoor workers and 1.3–1.4 for indoor workers. Work routines remain largely unchanged during the hottest months, when the need for recovery is greatest. Around 1 in 20 workers receive no break at all.

The availability of cool drinking water is also unreliable, especially for outdoor workers, as only 19% always have access to cool water at work and 31.8% never do. Once we include those who have it only rarely, more than half of all outdoor workers lack a dependable supply. Indoor workers are better served: 61.1% always have cool water available, although 21.1% never have access (see Figure 40).

Electrolyte replacement is almost entirely absent. Around three-quarters of both outdoor (74.9%) and indoor (71.7%) workers report that electrolytes are never available at work, and only around 7% can access them throughout the extreme heat period. Despite being an inexpensive and effective measure for reducing dehydration, electrolytes are unavailable to most workers.

Shaded rest areas are similarly scarce for outdoor workers. Only 11.2% always have access to a shaded place to rest, while 53.1% never do. Indoor workers fare somewhat better: 33.3% always have access to shade, although 34.4% do not (see Figure 40).

Figure 39. Number of work breaks per day, by work setting

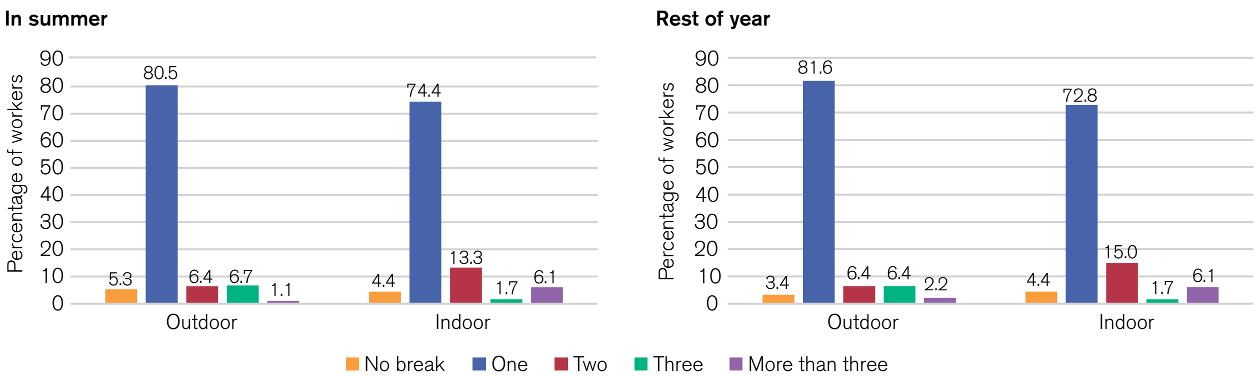
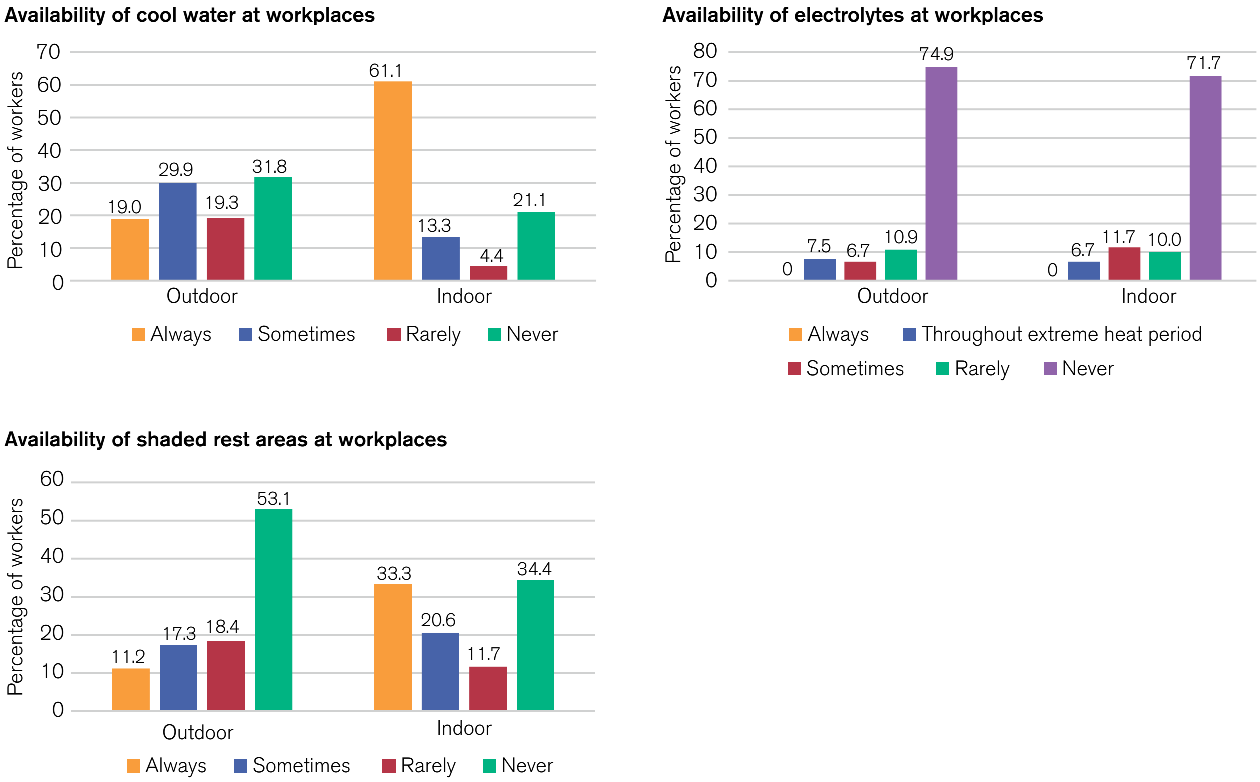


Figure 40. Availability of cool water, electrolytes and shaded rest at work, by work setting



The pattern across the four measures show that basic protections against heat exposure are largely missing, particularly for outdoor workers. These gaps are among the conditions that turn heat exposure into the acute illness.

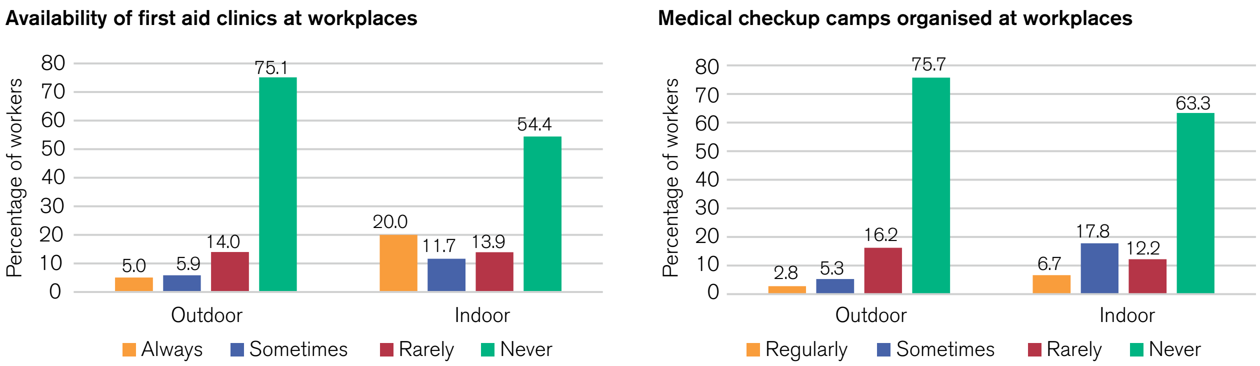
3.2.2 Medical provision

When heat-related illness occurs, access to medical support becomes critical. Two forms of provision are particularly important: workplace first aid facilities that can respond to heat cramps, exhaustion or heatstroke; and periodic medical check-up camps that can identify dehydration and other emerging health problems before they become severe. We examined both and found them largely absent (see Figure 41).

A first aid clinic is unavailable for most workers, and for almost all outdoor workers, only 5% of whom always have access to a first aid clinic at work, while 75.1% do not. Indoor workers are somewhat better served: 20% always have access, but more than half (54.4%) lack any first aid facility. Heatstroke is a medical emergency in which rapid treatment can be critical, yet most workers have no immediate source of assistance where they work.

Preventive medical camps are even rarer: 75.7% of outdoor and 63.3% of indoor workers reported that medical check-up camps are never organised at their workplace, and only 2.8% of outdoor and 6.7% of indoor workers reported having regular access to them. This means opportunities to identify dehydration, early kidney stress and other heat-related health problems before they become serious are extremely limited.

Figure 41. Medical provision at work, by work setting



Workers who fall ill often have little choice but to seek care away from the workplace.

"The nearest government PHC [primary healthcare facility] is about three kilometres away. In emergencies, we depend on borrowed motorbikes or tractors to reach it."

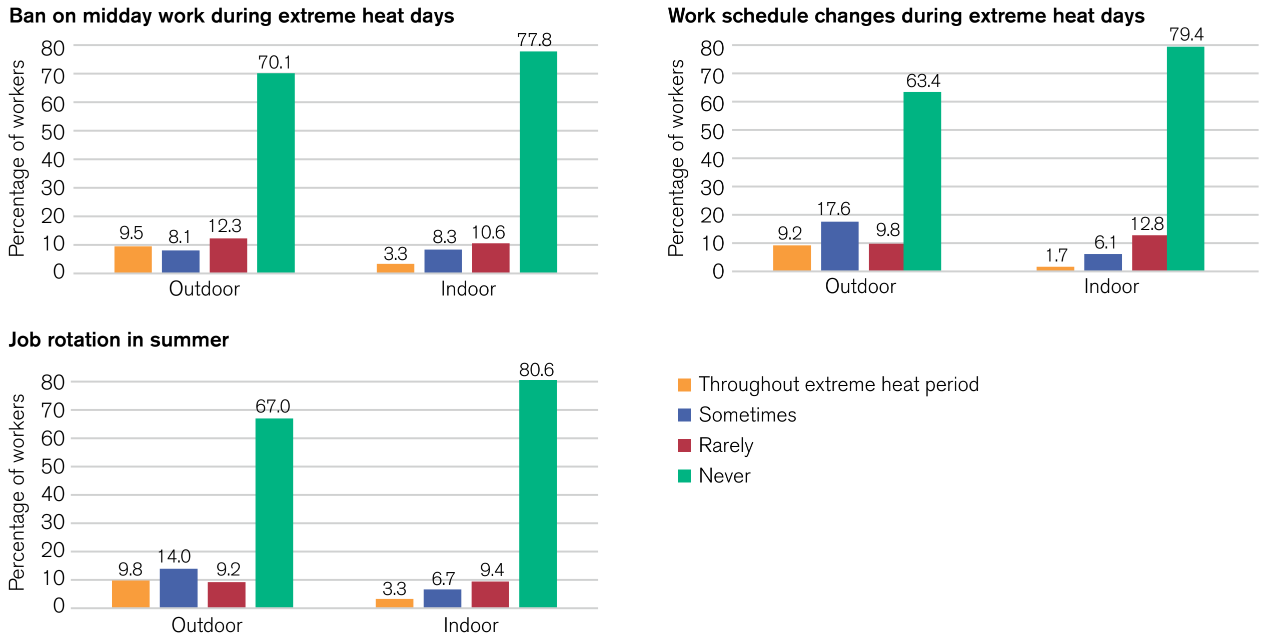
Participant in FGD with men and women brick kiln workers, Ajmer

The findings suggest that medical support is largely absent at the point where heat exposure occurs. Indoor workers are somewhat better served than outdoor workers; but for both groups, access to immediate treatment and preventive health monitoring remains limited.

3.2.3 Protective work practices

Beyond facilities, employers can organise the work itself to reduce heat exposure. Three measures are particularly important: stopping work during the hottest part of the day, shifting work to cooler hours and rotating workers between hotter and cooler tasks. Examining how often these practices are used during extreme heat, we found that work routines change little in response to rising temperatures (see Figure 42). The most basic measure — suspending work during the hottest midday hours — is rarely applied. A majority (70.1% of outdoor and 77.8% of indoor workers) reported that midday work bans during extreme heat are never implemented, while only 9.5% and 3.3% of outdoor and indoor workers, respectively, reported that it is applied throughout summer.

Figure 42. Heat-protective work practices at work, by work setting



"During peak summer, the district administration may issue orders to stop work, but these are only advisories. It's like wearing a seatbelt [in cars]. Advisable, but not punishable."

KII with labour department official, Agra

This reflects the wider regulatory framework. While the Ministry of Labour and Employment and the National Disaster Management Authority issue heatwave advisories recommending measures such as rescheduling work and providing water and shaded rest, these are not legally enforceable. Neither existing labour legislation nor the Occupational Safety, Health and Working Conditions Code, 2020 establishes a temperature threshold that requires additional protections for workers (Government of India, 2020; Ministry of Labour and Employment, 2026; NDMA, 2019).

The other two measures are similarly uncommon. Work schedules are never adjusted during extreme heat for 63.4% of outdoor and 79.4% of indoor workers, while job rotation is never used for 67% and 80.6% of outdoor and indoor workers, respectively. In both cases, only around 1 in 10 workers at best reported that the measure is applied throughout summer.

On all three measures, indoor workplaces adapt less to heat than outdoor workplaces. Indoor workers reported higher rates of non-use for midday work bans, schedule changes and job rotation, reflecting production systems that continue to operate to fixed targets regardless of temperature.

"They are scolded if they slow down. There is no relaxation even when it's 45 degrees."

KII with nongovernmental organisation (NGO) representative, Delhi

The findings suggest that work organisation remains largely unchanged during periods of extreme heat. Most workers manage exposure through endurance rather than adaptation.

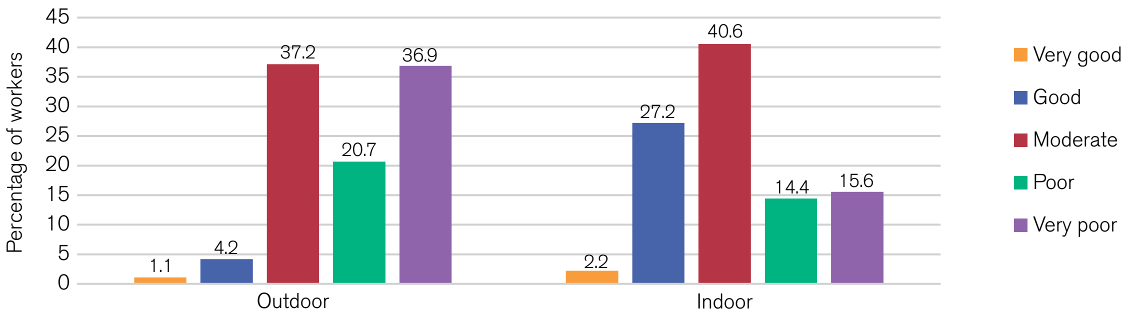
3.2.4 Workplace sanitation

Sanitation at work is as much a heat issue as a question of dignity, because the quality of toilet facilities influences how much water workers are willing to drink during the day. So, we asked workers to rate the toilets available at their workplace (see Figure 43).

For outdoor workers, sanitation conditions are generally poor. More than half (57.5%) rated toilet facilities as poor (20.7%) or very poor (36.9%). Only 5.3% rated them as good or very good, while 37.2% considered them moderate. Indoor workers are somewhat better served, with 29.4% rating facilities as good or very good and 40.6% as moderate. But 30% still rated them as poor or very poor.

The implications extend beyond hygiene. When toilets are dirty, unusable or lack privacy, workers often reduce their water intake to avoid using them, increasing the risk of dehydration during periods of extreme heat. Women are particularly affected because inadequate sanitation creates additional concerns around privacy and safety. As discussed in Section 3.3, restricting fluid intake becomes one of the coping strategies workers adopt in response to poor workplace conditions, with direct consequences for heat-related health risks.

Figure 43. Quality of toilet facilities at work, by work setting

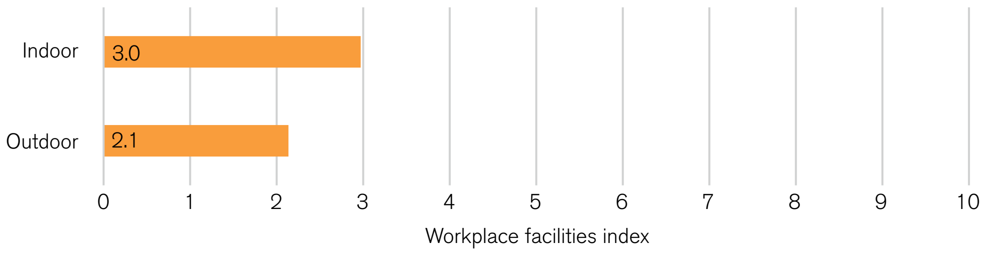


3.2.5 The workplace facilities index

To bring together the facilities and work practices that can help workers cope with heat, we constructed a workplace facilities index. The index combines the availability of work breaks, cool drinking water, electrolytes, shaded rest areas, first aid clinics and medical camps with the use of midday work bans, job rotation and schedule changes during summer. Following the C-CIQ approach, it is scaled from 0 to 10, with higher scores indicating better protection in the workplace.

Outdoor workers score 2.1 on the index and indoor workers, nearly 3.0 (see Figure 44). Both scores are low, indicating that the facilities and practices needed to reduce heat exposure are largely absent. Indoor workers score somewhat higher, reflecting better access to water, shade and first aid, but this advantage is partly offset by the fact that indoor workplaces adapt less to extreme heat through measures such as midday work bans, schedule changes and job rotation. The overall picture is therefore one of limited protection for both groups, with workers left to manage heat exposure largely on their own.

Figure 44. Workplace facilities index, by work setting



Note: The workplace facilities index is a composite of variables, namely number of breaks, availability of cool water, electrolytes, shaded rest areas and first aid clinics, conduct of health camps, practice of work ban during extreme heat days, job rotation and work schedule changes during summer days. It ranges from 0 to 10, with higher scores meaning better workplace facilities.

3.3 Workplace coping strategies

We asked workers what they do to cope with heat exposure. The findings show that coping strategies are largely individual responses rather than workplace-supported measures, and that workers often have limited control over the actions that would protect them most.

Only 41.1% of outdoor and 17.8% of indoor workers carry water to their workplace, leaving most dependent on the often unreliable supply available there. A sizeable share also deliberately limits how much they drink. Around a quarter of workers avoid drinking water at work at least sometimes, while 12.3% of outdoor and 13.9% of indoor workers always do so. Closely linked to the poor sanitation conditions described in Section 3.2.4, this response increases the risk of dehydration.

Many outdoor workers cover their head against the sun, with 34.6% reporting that they always do so. Resting in the shade is much less common: 46.1% of outdoor and 39.4% of indoor workers never rest in the shade at work, either because there is no shade available or they do not have enough freedom to stop working.

"I can't work like before. I finish less work and take more breaks."

Participant in FGD with women construction workers, Delhi

Many workers regularly take a cool bath after work, with 39.7% of outdoor and 33.9% of indoor workers reporting that they always do, although around a quarter are unable to do so because water is scarce at home. Shifting work to cooler hours is less feasible, with more than half of outdoor workers (54.2%) and nearly two-thirds of indoor workers (64.4%) reporting that they never adjust their working hours, as schedules are largely determined by employers. Indoor workers, whose work is tied to production targets, have the least flexibility.

To examine these strategies together, we constructed a coping action index, scaled from 0 to 10, with higher scores indicating stronger coping capacity. Outdoor workers scored 4.3 and indoor workers 4.2, placing both groups below the midpoint of the scale (see Figure 46). The similarity of the scores reflects a common constraint across both groups: workers rely largely on individual actions, while many of the most effective responses, such as resting in shade or shifting work to cooler hours, depend on facilities and work practices that are often beyond their control.

Figure 45. Coping strategies adopted by workers, by work setting

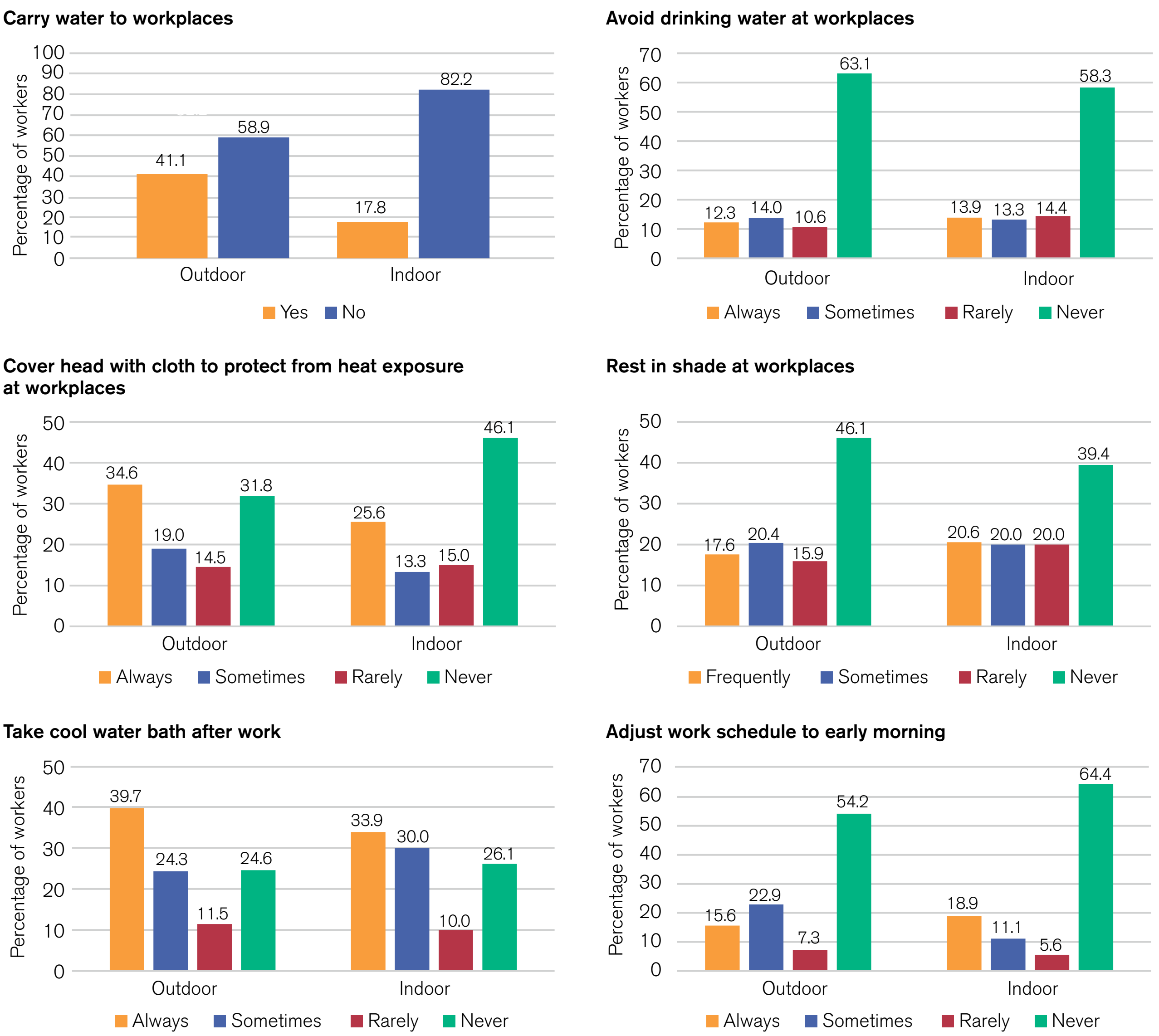
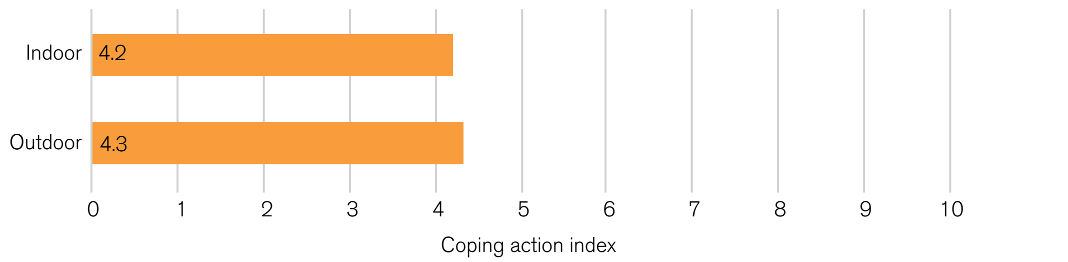


Figure 46. Coping action index, by work setting



Note: The coping action index is a composite of variables, namely drinking adequate water during work, covering the head with a cloth, resting in a shaded area, taking a cool bath after work and adjusting work schedules to early morning. It ranges from 0 to 10, with higher scores meaning better coping action to avoid heat impacts.

3.4 Indoor workers: no better off

Indoor work is often assumed to be safer because it is sheltered from direct sun. Much occupational heat research in India has followed this assumption, focusing on outdoor workers and treating indoor work as a lesser problem. Our findings do not support this. Across several measures, the indoor workers in our study are no better off than outdoor workers; and in some cases, they are worse off.

Their exposure is not lower; it is different. Indoor workers work slightly longer days during summer — 9.7 hours, compared with 9.3 for outdoor workers — and they spend those hours in enclosed, poorly ventilated workshops where heat builds through the day. And because this heat does not come mainly from direct sun or open fire, standard exposure measures can underestimate it. Workers' own responses show this clearly. Indoor workers rated heat inside their homes at 4.24 out of 5, almost the same as the 4.30 reported by outdoor workers, and they perceived summers becoming hotter and longer at least as strongly as outdoor workers.

Indoor workers have somewhat better access to cool water, shaded rest and first aid at work, which raises their workplace facilities index above that of outdoor workers. But this does not mean their workplace is better adapted to heat. Rest breaks do not increase with rising temperatures for either group, electrolytes are almost entirely absent and indoor workplaces are less likely than outdoor sites to apply midday work bans, schedule changes or implement job rotations. This reflects production systems where targets continue regardless of temperature. Their coping capacity is no better — indeed, their coping action index is slightly below that of outdoor workers (see Figure 46).

Indoor workers also carry important background disadvantages. They are more heavily concentrated among Scheduled Caste and Scheduled Tribe households than outdoor workers, and include a higher share of female-headed households.

Indoor heat goes undercounted for reasons unrelated to its severity. It is enclosed rather than open, assumed to be controlled and overlooked by exposure measures built around sun and radiant heat. So, heat protection strategies, which tend to focus on outdoor workers, leave out a large and highly exposed part of the informal workforce.

Case study 5. Chandronath: collapsed and uncounted

"I was doing my work. I was tired but did not realise what else was happening to my body until I fell."

Chandronath, 36, a labourer at a metal fabrication unit in Ajmer, Rajasthan, grew up in West Bengal, where his family farmed. But their income from farming was not enough, so he moved to Ajmer with his wife and two children, hoping for better work.

The family lives in a single rented room with shared toilets and unreliable access to clean water.

At the fabrication unit, Chandronath cuts iron and operates small machinery. He works 10–12 hours a day, with an hour off at lunch. There is no shade to rest in.

"You just keep working. There is no place to sit, no water that is cool. You drink whatever is there and carry on."

In July 2023, during an intense heat spell, Chandronath felt suddenly dizzy while operating machinery. Before he understood what was happening, he had collapsed. Nobody knew what to do; there was no medical support. His co-workers rushed him to the nearest government hospital, arranging transport themselves. Doctors diagnosed heatstroke and severe dehydration. He was kept under observation for 24 hours and advised to rest for at least five days. When he returned to work, his employer deducted six days' wages.

"I was in the hospital. The doctors told me to rest. And still they cut my pay? If I fall sick again, the same thing will happen. There is nothing to protect us here."

He still works at the same unit.

A multi-storey building comprising single-room rental homes. Most informal workers and their families return to these crowded living conditions after long hours of physically demanding work. Photo: Achin Phulre/Quirky Tokri

3.5 The health impact: heat cramp, heat exhaustion and heatstroke

Heat-related illness typically follows a recognised progression, from heat cramp as an early warning, through heat exhaustion at a moderate stage, to heatstroke at the severe and potentially fatal end. For each condition, we recorded the symptoms workers reported, scored its prevalence on a 0 to 10 index and classified workers against clinical criteria validated by a panel of doctors.

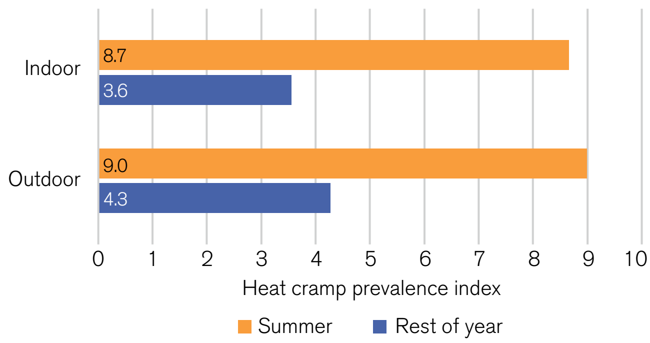
3.5.1 Heat cramp

The earliest stage of heat-related illness, heat cramp is caused by the loss of water and salt through heavy sweating, resulting in painful muscle cramps (NIOSH, 2016). On the 0–10 prevalence index, where higher values indicate a greater burden, heat cramp scored close to 9 among outdoor workers and 8.7 among indoor workers during summer (see Figure 47). Outside summer, the index falls to 4.3 for outdoor workers and 3.6 for indoor workers; but it remains well above zero.

The two defining symptoms of heat cramp are heavy sweating and muscle cramp (see Figure 48). During summer, 88% of outdoor workers and 84% of indoor workers reported heavy sweating, while 59% and 64%, respectively, reported muscle cramp, showing that the latter is slightly more common among indoor workers. In the cooler months, both symptoms are less common but remain widespread, with around a quarter of workers in both settings still reporting muscle cramp.

When classified against the clinical criteria, 89.9% of outdoor workers and 86.7% of indoor workers meet the threshold for heat cramp during summer (see Figure 49). Even in cooler months, the condition remains common, affecting 42.7% and 35.6% of outdoor and indoor workers, respectively. It is clear that heat cramp is not an occasional symptom affecting a small minority of workers, but a routine feature of working life for many during summer.

Figure 47. Heat cramp prevalence index, by work setting



Note: Heat cramp prevalence index measures the frequency and severity of heat cramps experienced by workers. It ranges on a scale from 0 to 10; a higher score indicates greater severity.

Figure 48. Prevalence of heat cramp symptoms, by work setting

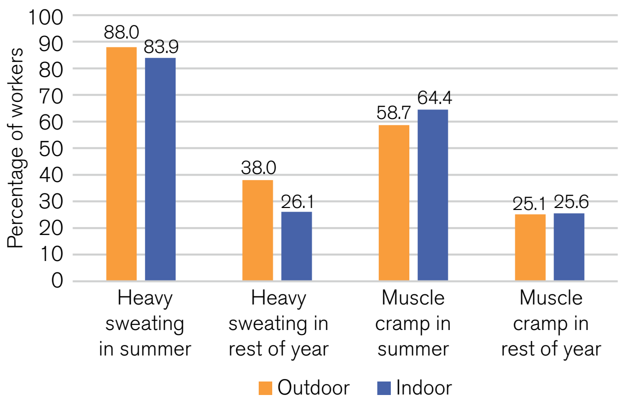
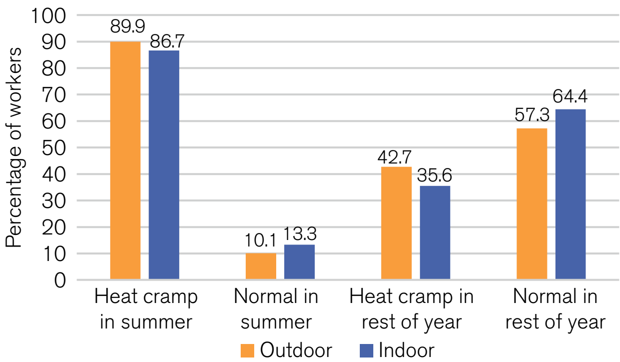


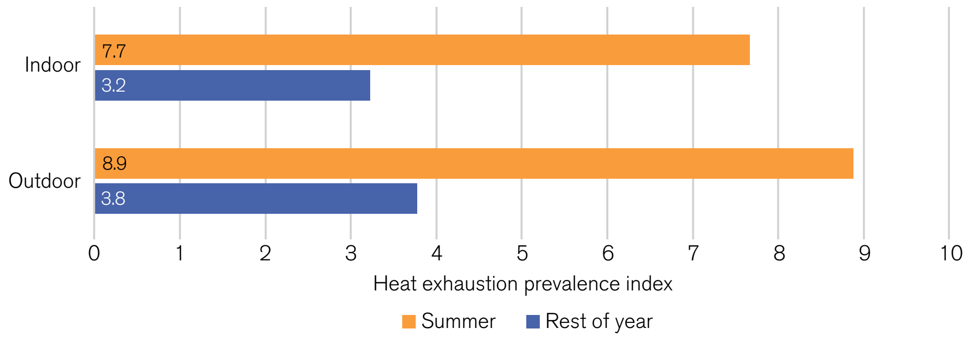
Figure 49. Heat cramp diagnosis, by work setting



3.5.2 Heat exhaustion

Heat exhaustion is the moderate stage of heat-related illness and occurs when the body loses water and salt faster than it can replace them. It is characterised by symptoms such as heavy sweating, weakness, headache, dizziness, nausea and elevated body temperature (NIOSH, 2016). On the 0–10 prevalence index, heat exhaustion scored 8.9 among outdoor workers and 7.7 among indoor workers during summer (see Figure 50). Although indoor workers scored lower than outdoor workers, the burden remains high in both groups. In the cooler months, the index falls to 3.8 for outdoor workers and 3.2 for indoor workers.

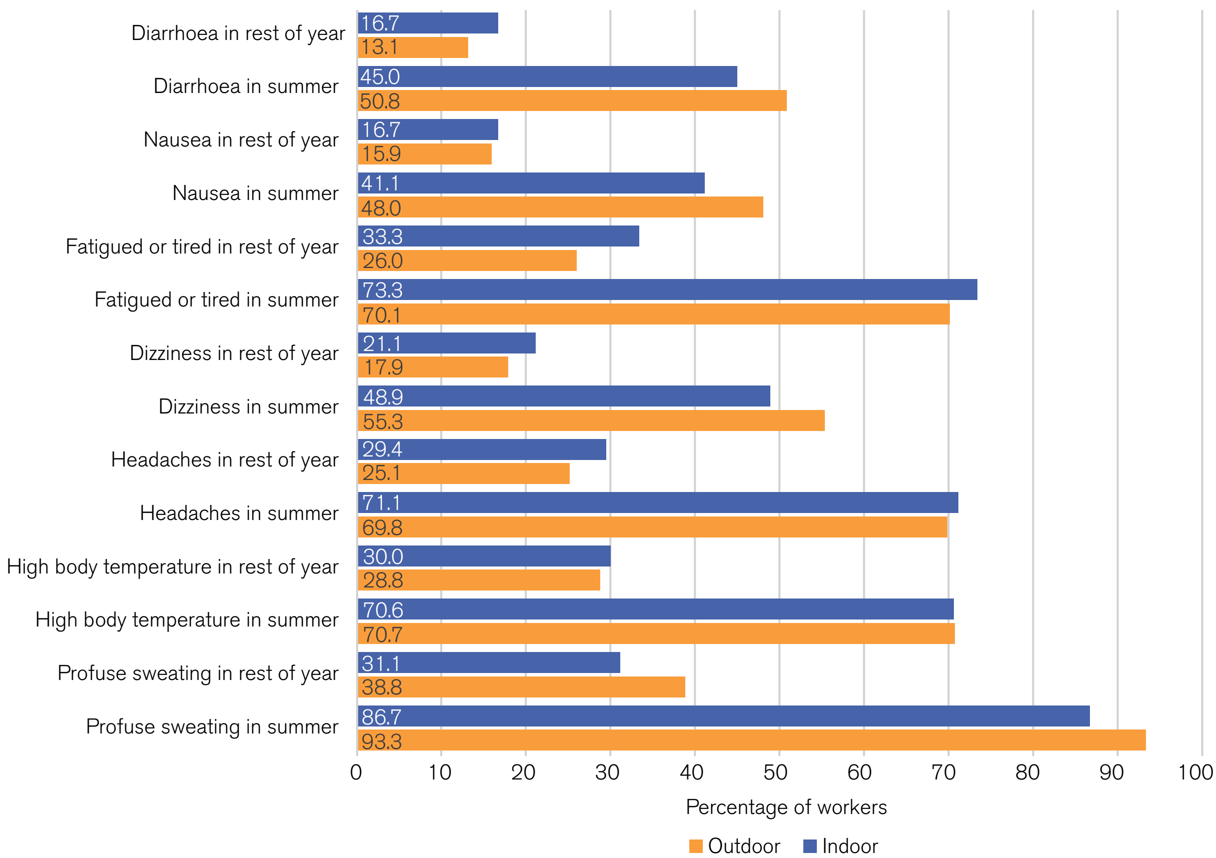
Figure 50. Heat exhaustion prevalence index, by work setting



Note: Heat exhaustion prevalence index measures the frequency and severity of heat exhaustion experienced by workers. It ranges on a scale from 0 to 10; a higher score indicates greater severity.

Heat exhaustion presents through a wider range of symptoms than heat cramp (see Figure 51). Profuse sweating is the most common symptom, affecting 93.3% of outdoor workers and 86.7% of indoor workers during summer. Fatigue, headache and elevated body temperature each affect around 7 in 10 workers in both settings. Indoor workers reported fatigue and headache slightly more often than outdoor workers, while outdoor workers reported somewhat higher rates of dizziness, nausea and diarrhoea. Many of these symptoms persist in the cooler months, with fatigue and headache remaining common among both groups.

Figure 51. Prevalence of heat exhaustion symptoms, by work setting

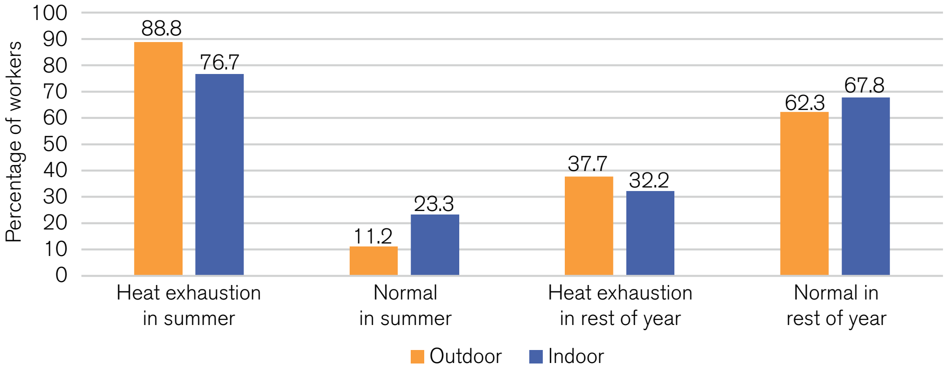


"We often experience fainting, excessive sweating, and weakness. Women among us face more fatigue and health problems during summer, including menstrual irregularities."

Participant in FGD with men and women brick kiln workers, Ajmer

When classified against the clinical criteria, 88.8% of outdoor workers and 76.7% of indoor workers meet the threshold for heat exhaustion during summer (see Figure 52). Although prevalence is higher among outdoor workers, more than three-quarters of indoor workers meet the threshold. In the cooler months, 37.7% of outdoor workers and 32.2% of indoor workers continue to meet the diagnostic threshold, showing that heat exhaustion affects a substantial share of workers even beyond the hottest months of the year.

Figure 52. Heat exhaustion diagnosis, by work setting



3.5.3 Heatstroke

The most severe form of heat-related illness, heatstroke occurs when the body can no longer regulate its temperature and the core body temperature rises to levels that can damage the brain and other organs. It is a medical emergency and can be fatal if treatment is delayed (NIOSH, 2016). On the 0–10 prevalence index, heatstroke scored 5.4 among outdoor workers and 5.1 among indoor workers during summer (see Figure 53). Unlike heat cramp and heat exhaustion, prevalence falls sharply outside the summer months, to 1.8 in both groups, indicating a closer link with periods of extreme heat.

Heatstroke is characterised by a cluster of severe symptoms (see Figure 54). During summer, very high body temperature is the most common symptom, affecting 64.2% of outdoor workers and 67.2% of indoor workers. Other signs of severe heat stress are also widespread, including hot and dry skin, reduced or extremely dark urine, confusion and clouding of thought, with indoor workers reporting several of these symptoms as frequently, or more frequently, than outdoor workers. Between a quarter and a third of all workers (27.2% of indoor workers and 34.4% of outdoor workers) reported loss of consciousness — one of the most serious manifestations of heatstroke — during summer.

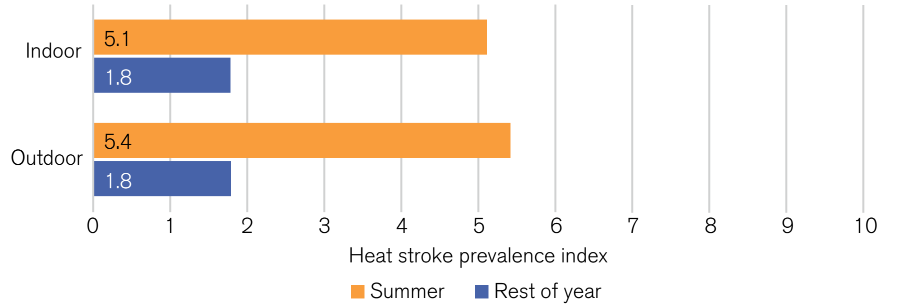
When classified against the clinical criteria, 54.2% of outdoor workers and 51.1% of indoor workers meet the threshold for heatstroke during summer (see Figure 55). In other words, more than half of workers in both settings experience symptoms that are consistent with the most dangerous stage of heat-related illness. Although prevalence declines in the cooler months, 17.9% of outdoor workers and 17.8% of indoor workers continue to meet the diagnostic threshold at this time, leaving nearly 1 in 5 workers affected beyond the peak heat season.

Local clinicians confirm that the severe end of this spectrum results in hospital admissions during periods of extreme heat.

"Sodium levels drop due to water loss, and that leads to complications." KII with a health professional, Ajmer

The findings challenge any perception that heatstroke is a rare event affecting only a small number of workers. Symptoms associated with severe heat-related illness are widespread in both work settings, and more than half of workers meet the clinical threshold during the summer months.

Figure 53. Heatstroke prevalence index, by work setting



Note: Heatstroke prevalence index measures the frequency and severity of heatstroke experienced by workers. It ranges on a scale from 0 to 10; a higher score indicates greater severity.

Figure 54. Prevalence of heatstroke symptoms, by work setting

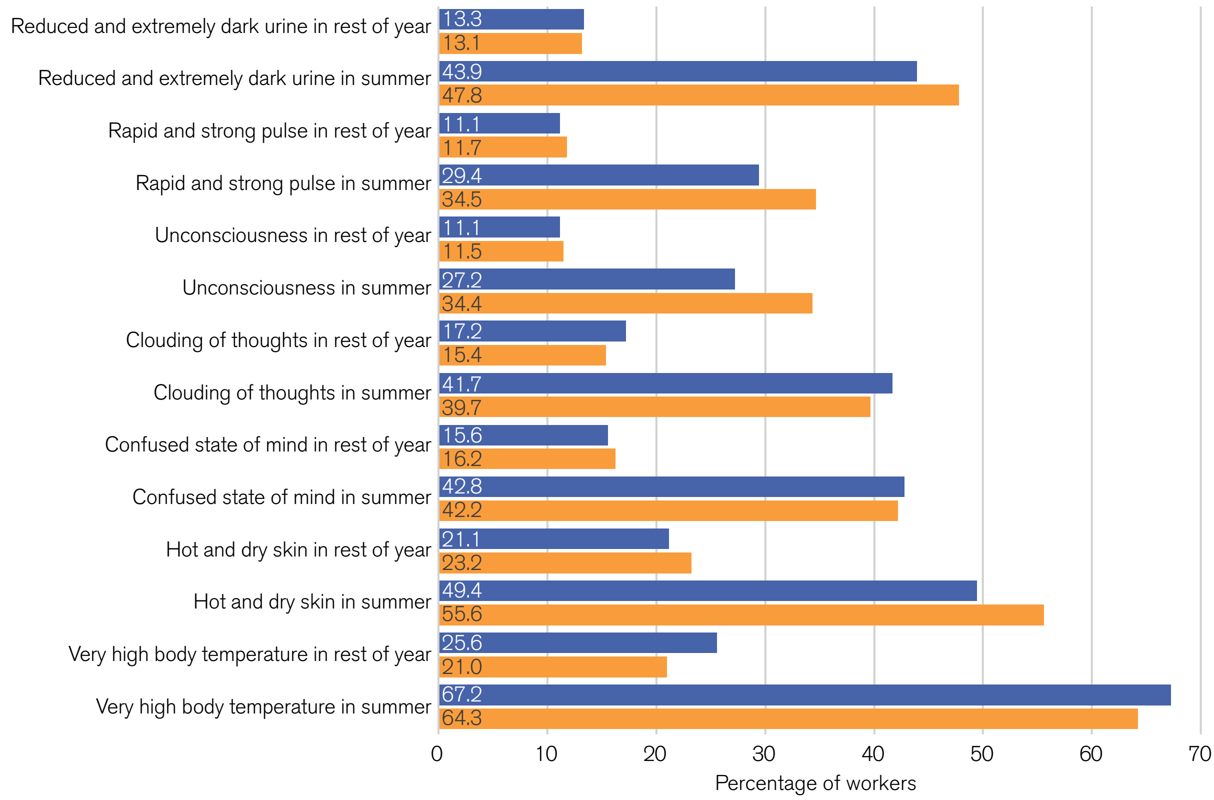
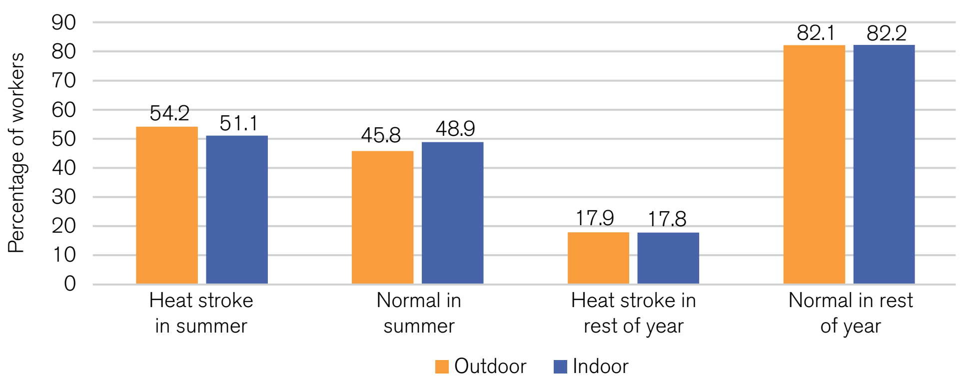


Figure 55. Heatstroke diagnosis, by work setting



Case study 6. Vishram Meena: the heatstroke that nearly killed him

"I lost my land and had to leave farming. Since then, I have worked as a labourer."

Vishram Meena, 45, migrated from Alwar, Rajasthan, and has worked as a mason's helper on construction sites in Ajmer for more than a decade. He works 10–12 hours under the open sky, carrying materials, mixing cement and doing whatever the site needs.

"There is no shade where we work. Drinking water is mostly unavailable."

Vishram lives with his wife in a rented room on the city's outskirts, where they share a badly maintained toilet facility with several other families. His wife also undertakes daily wage work.

On one of the hottest days of May 2024, Vishram fell seriously ill.

"I felt dizzy and then my nose started bleeding. I tried to continue working."

Soon afterwards, he collapsed.

His wife rushed to the contractor for help, but they ignored her. His co-workers arranged transport and got him to a government hospital, which referred him to a private facility for emergency treatment. He had suffered heatstroke.

"The doctors told my wife that if I had reached them 30 minutes later, I would not have survived. They also said that not overexerting in the heat could have prevented this."

He spent ten days in the hospital. After being discharged, Vishram was advised to rest. And, although his wife took on additional work to help cover household expenses, financial pressures made it difficult for him to stay away from work.

"I had to return to work. We needed the income."

When we went back, the site had not changed. There was still no shade, no water, no toilets, no first aid.

"I went back because what else could I do? We are not machines. We are human beings. The heat is killing us slowly."

Outdoor workers face prolonged exposure to extreme heat, often with limited protection or access to cooling facilities. Photo: Achin Phulre/Quirky Tokri

3.5.4 Treatment sought and the gap in care

The high prevalence of heat-related illness is not matched by treatment seeking. Most workers who experience heat-related symptoms do not seek medical care, even when their symptoms are severe.

Among those who have experienced heat cramp, only 14% of outdoor workers and 14.4% of indoor workers have sought treatment (see Figure 56). For heat exhaustion, the figures are slightly higher, with 23.5% and 26.1% of outdoor and indoor workers seeking treatment, respectively (see Figure 57). Even for heatstroke, a potentially life-threatening condition, only 21.8% of outdoor workers and 18.9% of indoor workers sought medical care (see Figure 58). This means that around 4 in 5 workers who have experienced heatstroke received no treatment.

Among the minority who did seek care, they mainly did so from informal providers. This includes 68% of outdoor and 61.5% of indoor workers who sought care for heat cramp, and 76.2% of outdoor workers and 59.6% of indoor workers who sought care for heat exhaustion. Only a small minority of workers sought formal healthcare; for heat exhaustion, this was almost absent.

The reasons for not seeking care are largely practical rather than clinical. Health facilities are often distant, transport may not be available, treatment costs fall directly on workers and seeking care usually means losing a day's wage.

"We pay for our treatment ourselves, and the cost of medicines and glucose drips adds to our financial burden." Participant in FGD with men and women brick kiln workers, Ajmer

"Fear of losing a day's wage discourages many workers from stopping to seek care."
KII with NGO representative, Delhi

"Migrant workers often delay treatment because of cost or low awareness, and women rarely come to the clinic at all." KII with health professional, Agra

Figure 56. Share of workers experiencing heat cramp who seek medical treatment, by work setting

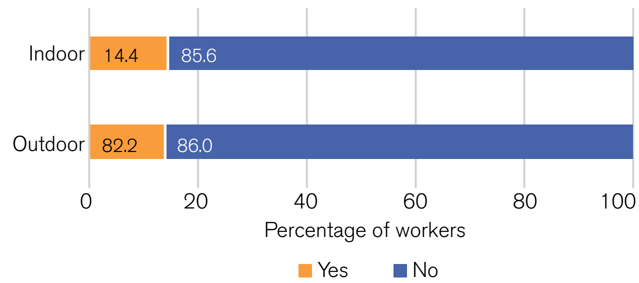


Figure 57. Share of workers experiencing heat exhaustion who seek medical treatment, by work setting

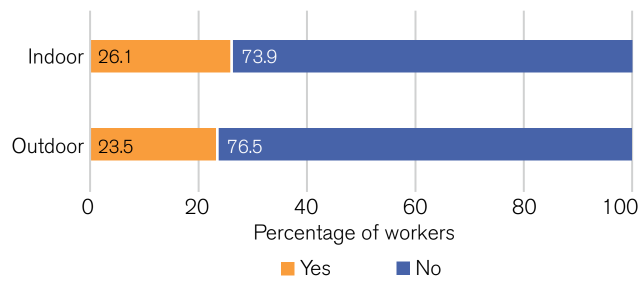
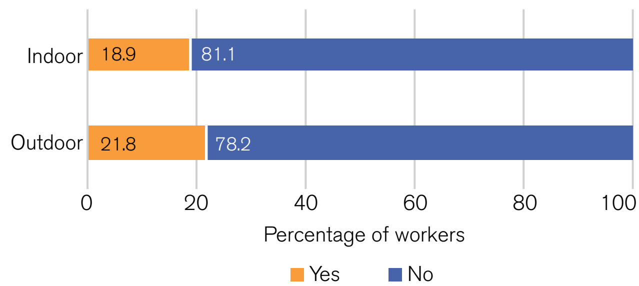


Figure 58. Share of workers experiencing heatstroke who seek medical treatment, by work setting



3.6 From dehydration to kidney damage

The acute conditions described in Section 3.5 are not isolated episodes. Repeated exposure to heat, and the dehydration that accompanies it, places a recurring strain on the kidneys. When the body loses fluid faster than it can replace it, blood flow to the kidneys falls and waste products become concentrated, increasing the risk of AKI, a sudden and often reversible decline in kidney function. The risk is greatest for workers undertaking strenuous physical labour in hot conditions with limited access to water and rest — precisely the conditions documented in this study. Research among construction and informal workers has found that heat exposure during summer increases the incidence of kidney injury, with dehydration emerging as a key risk factor (Al-Bouwarthan et al., 2020; Venugopal et al., 2025).

The concern is not a single AKI episode, but repeated injury over time. While an individual episode may resolve, recurring episodes can leave lasting damage and increase the likelihood of progression to CKD, an irreversible decline in kidney function (Veltkamp et al., 2025). For informal workers, CKD can mean rising healthcare costs, reduced productivity, lost workdays and, in severe cases, losing the ability to work altogether.

"Workers exposed to extreme heat for long hours lose large amounts of fluid through sweat. When that fluid is not replaced, blood volume falls and blood flow to the kidneys drops. The kidneys are very sensitive to this, and each episode of severe dehydration can cause acute injury. Repeated over many summers, these injuries can build into chronic, irreversible kidney disease, often in young workers with no other illness. This is why heat poses a serious long-term health risk for manual workers, well beyond the discomfort of a hot day." Dr Akhilesh Sharma, MD, FRCP (Liverpool), CClin (USA), CPV (UK), President and CMO, Alkem Laboratories Ltd, Founding Director/CEO, Alixer NexGen Therapeutics Ltd

In our survey, 18.7% of informal workers reported symptoms consistent with AKI. This means that nearly 1 in 5 workers are already showing signs of the kidney damage that can precede CKD. This finding is consistent with the working and living conditions already documented, where dehydration is common and opportunities for recovery are limited.

"Dehydration is one of the most common problems observed among indoor workers, as long working hours and inadequate water intake leave many workers dehydrated, even where fans or coolers are available." KII with health professional, Delhi

3.7 Psychological and other non-economic impacts

The impacts of heat extend beyond physical illness and lost income, affecting workers' mental wellbeing and contributing to a range of non-economic losses that are rarely captured in conventional assessments of heat-related harm.

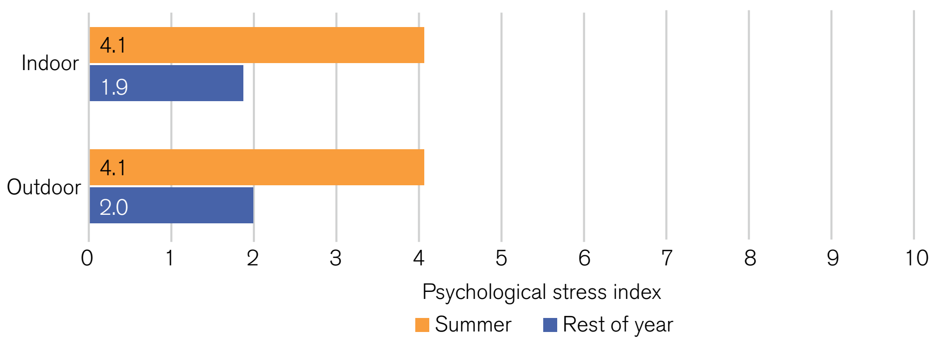
3.7.1 The psychological stress index

To assess the mental health impacts of heat, we constructed a psychological stress index based on nine indicators of mental strain. The index is scaled 0–10, with higher scores indicating greater psychological stress. During summer, the index reached 4.1 for both outdoor and indoor workers (see Figure 59). In the cooler months, it fell to below 2 among both groups, showing that psychological stress more than doubles during summer.

The identical summer scores for indoor and outdoor workers reinforce a pattern seen throughout this study: the mental burden of heat is no lower for those working indoors. Workers linked this strain directly to rising temperatures.

"In the heat, we get angry, nothing feels good." Participant in FGD with men construction workers, Agra

Figure 59. Psychological stress index, by work setting



Note: The psychological stress index is a composite of nine individual variables. It ranges from 0 to 10, with higher scores meaning more severe stress is experienced.

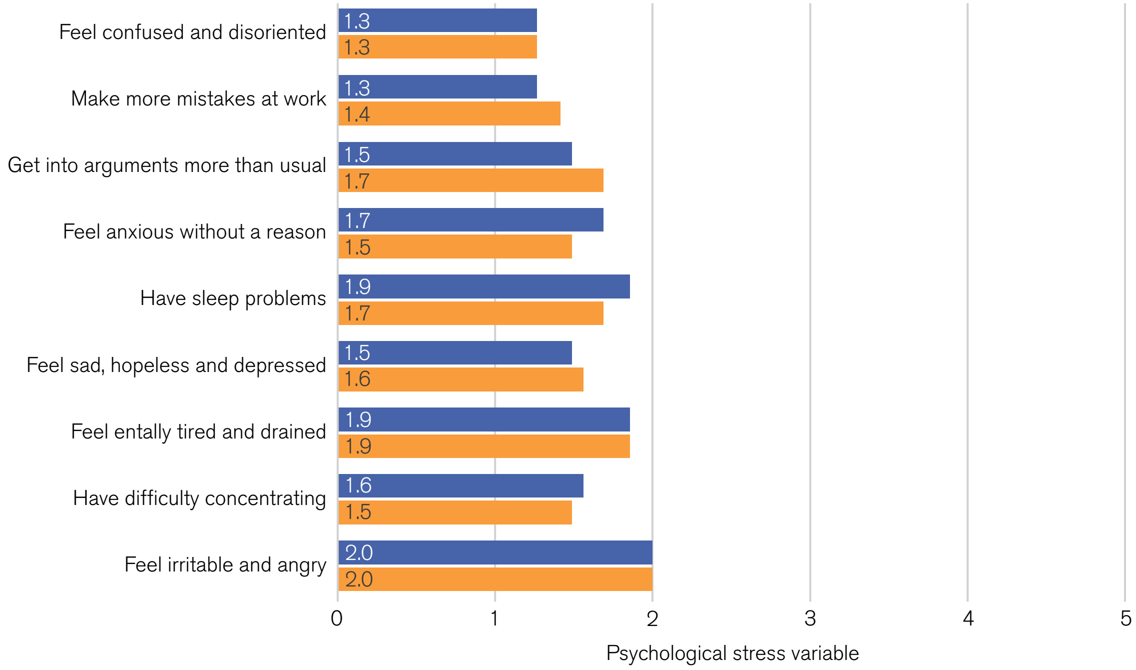
3.7.2 Dimensions of psychological stress

The psychological stress index is built from nine dimensions of psychological strain, each scored on a 0–5 scale, where higher values indicate more frequent or more severe symptoms. During summer, irritability and anger emerges as the most prominent dimension, scoring 2 among both groups, followed closely by mental tiredness and feeling drained at 1.9 in both settings (see Figure 60). Scores for difficulty concentrating, low mood, anxiety, arguments, mistakes at work and confusion range from 1.3 to 1.9.

Indoor workers reported slightly higher levels of sleep problems, anxiety and difficulty concentrating, while outdoor workers reported somewhat higher levels of arguments, mistakes at work and low mood. The higher score for sleep problems among indoor workers is consistent with the hot and poorly ventilated housing conditions described earlier.

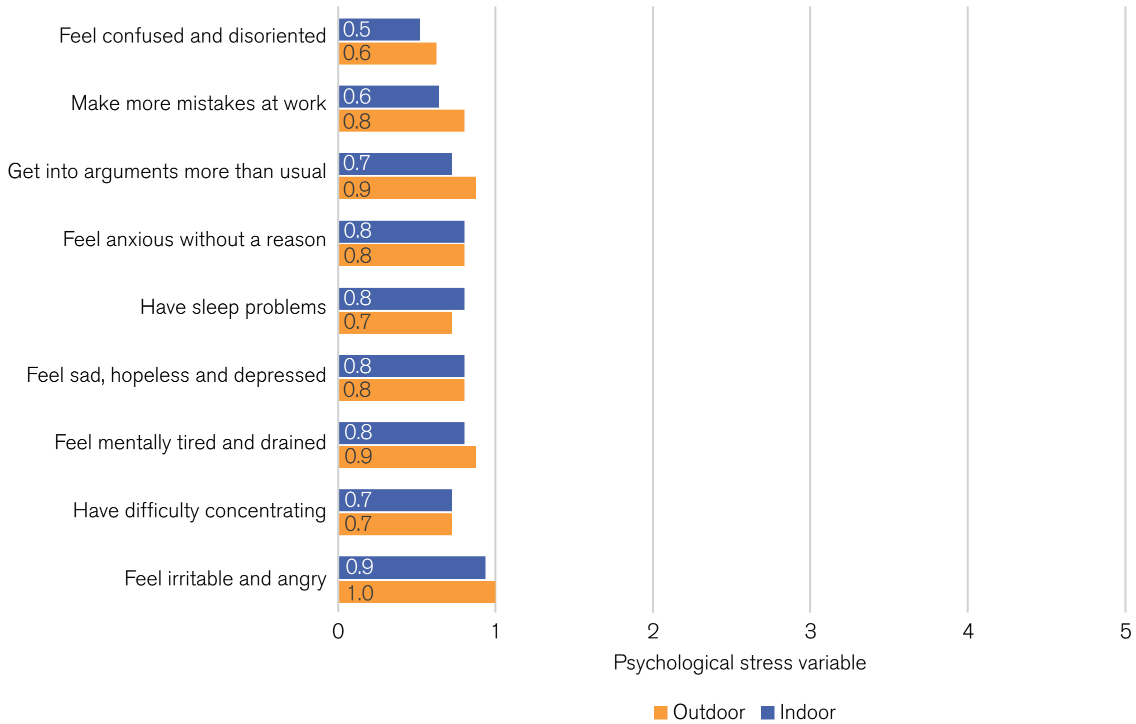
All dimensions decline sharply outside summer (see Figure 61), indicating that heightened psychological strain is closely associated with periods of extreme heat.

Figure 60. Psychological stress variable scores in summer, by work setting



The psychological stress variable scores represent individual indicators of mental strain reported by workers during summer. Each indicator is measured on a scale from 0 to 5, where higher score reflects greater severity or frequency of that specific stressor.

Figure 61. Psychological stress variable scores in the rest of the year, by work setting



The psychological stress variable scores represent individual indicators of mental strain reported by workers during summer. Each indicator is measured on a scale from 0 to 5, where higher score reflects greater severity or frequency of that specific stressor.

3.7.3 Other non-economic impacts

The focus groups, interviews and case studies reveal a range of non-economic impacts that extend beyond illness itself. Workers repeatedly described a sense that their bodies were wearing down and their capacity to work was diminishing.

"Our bodies have weakened, we can't work long hours anymore."

Participant in FGD with men construction workers, Agra

Women construction workers in Delhi described feeling weak and dizzy by the afternoon, and at times unable to remain standing.

The effects extend beyond individual workers to their households. When illness occurs, it is often down to the family to absorb lost income and treatment costs. Case studies from Ajmer illustrate how heat-related illness can increase debt, force other household members to take on additional work and deepen existing financial pressures (see Case studies 5 and 6).

Heat also affects those who are not directly exposed at work. Women construction workers in Delhi reported sleeping only three to four hours a night during peak summer, while families described children suffering from heat rashes and diarrhoea. The burden of heat extends across the household rather than falling solely on the worker.

Running through many accounts is a loss of dignity. Workers described being denied water, shade and opportunities to rest, while being expected to maintain output regardless of temperature. Women construction workers in Agra reported being prevented from sitting and spoken to disrespectfully by supervisors, while garment workers in Delhi said they were reprimanded if they slowed down during extreme heat. The sense of being treated as expendable is captured by two workers in Ajmer who were hospitalised following heatstroke (see Case studies 5 and 6).

3.8 Determinants of heat-related illness

So far, this chapter has documented the scale of heat-related illness among informal workers. In this section, we examine what drives it.

3.8.1 The model

Heat-related illness is shaped by multiple influences operating at the same time, from the nature of work to conditions at home. To disentangle these effects, we used binomial logistic regression, which estimates how strongly each factor is associated with the likelihood of illness while holding the others constant. This allows us to assess, for example, whether physically demanding work increases the risk of heat-related illness independently of housing conditions or age.

We examined seven explanatory variables grouped into three categories. The first captures work-related exposure: whether a worker is employed outdoors or indoors, the temperature intensity of the area where they work and the physical intensity of their labour. The second captures protection: the availability of workplace facilities, the level of heat protection provided by housing and the use of coping strategies. The final variable is age, distinguishing workers above and below 45 years.

Estimating separate models for heat cramp, heat exhaustion and heatstroke, we present results as odds ratios, where values above 1 indicate higher odds of illness, values below 1 indicate lower odds, and values close to 1 indicate little effect (see Box 1).

Box 1. Identifying what drives heat-related illness

For this analysis, we drew on the records of surveyed workers, each classified by doctors as having or not having experienced heat cramp, heat exhaustion and heatstroke. Our purpose was to identify which conditions are most strongly associated with heat-related illness across the sample, rather than to predict whether a particular worker would fall ill, so that policy can act on the factors that matter most.

Using binomial logistic regression, a standard method for explaining a yes or no outcome, we estimated the same model three times — once for each illness — using an identical set of seven explanatory variables to ensure results stayed comparable across the three conditions.

The binomial logistic regression model

$\ln(p/1 - p) = \beta_0+\beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7$

X_1 = heat exposure (outdoor work = 1; indoor work = 0)

X_2 = regional temperature intensity (very high = 1, high = 0)

X_3 = physical labour intensity (high = 1, moderate/low = 0)

X_4 = safety measure facilities availability at workplace (always/often = 1, rarely/never = 0)

X_5 = heat protection housing facilities (poor = 1, good = 0)

X_6 = practice of coping actions (never/rarely = 1, always/often = 0)

X_7 = age (> 45 years = 1, ≤ 45 years = 0)

Y = prevalence of heat cramp/heat exhaustion/heatstroke

p = probability of the event (Y = 1)

p/1 – p = odds of the event

β_0 = intercept

β_i = coefficient for predictors X_i

The model reports an odds ratio for each factor. We assessed the statistical significance of each factor using standard tests, and checked the fit of each model with the Hosmer and Lemeshow goodness-of-fit test (Hosmer and Lemeshow, 1980).

See Appendix 1 for the full specification, coefficients and diagnostics for all three models.

3.8.2 Drivers of heat-related illness

The outcome of the three models (see Table 3) reveal three important patterns.

First, the work setting itself does not determine who falls ill. The variable distinguishing outdoor and indoor work was not a statistically significant predictor of heat cramp, heat exhaustion or heatstroke. Once we consider other factors, indoor workers face odds of illness that are similar to those of outdoor workers. This reinforces a consistent finding in this study that heat-related illness cannot be considered a problem that affects outdoor workers alone.

Second, the drivers of illness change as conditions become more severe. Heat cramp is primarily associated with physically demanding work and the absence of coping strategies. Workers engaged in high-intensity labour have 3.4 times the odds of heat cramp, while workers who rarely or never adopt coping actions are 1.9 times more likely to experience it. As illness progresses to heat exhaustion and heatstroke, structural factors become increasingly important. Living in a very hot temperature zone increases the odds of heat exhaustion threefold and of heatstroke by 2.8 times. Poor housing has the strongest effect, more than doubling the odds of heat exhaustion and increasing the odds of heatstroke more than fourfold. High physical labour intensity remains a significant contributor throughout.

Third, vulnerability increases with age. Although age has no significant effect on heat cramp, workers over 45 are 1.8 and 2.9 times more likely to experience heat exhaustion and heatstroke, respectively. The risk of the most severe forms of heat-related illness therefore rises sharply with age.

The protective factors included in the model have more limited effects. Workplace facilities significantly reduce the odds of heatstroke, lowering the risk by 41%, while coping strategies are significant only for heat cramp. Neither is enough to offset the influence of broader structural factors such as climate, housing and labour intensity.

One result stands out in particular. Housing conditions are as important as workplace conditions in explaining severe heat-related illness — and for heatstroke, they are more important. This shows that the ability to recover from heat at home plays a critical role in determining health outcomes, reinforcing a central finding of the study, that heat exposure does not end when the working day ends.

The overall analysis suggests that the most serious forms of heat-related illness are driven less by individual behaviour and more by the environments in which workers live and work. Many of the strongest predictors — including climate conditions, housing quality, labour intensity and age — lie largely beyond the reach of individual coping strategies.

Table 3. Determinants of heat-related illness: odds ratios from binomial logistic regression

Factor (coded condition)	Heat cramp	Heat exhaustion	Heatstroke
Heat exposure (outdoor)	1.33	1.42	1.07
Regional temperature intensity (very high)	1.03	**3.03*** **	**2.78*** **
Physical labour intensity (high)	**3.44*** **	**2.31*** **	**1.93** **
Workplace facilities (available)	1.16	0.65	**0.59** **
Housing heat protection (poor)	1.38	**2.15*** **	**4.09*** **
Coping actions (never or rarely)	**1.88***	1.46	0.98
Age (over 45)	1.85	1.80*	**2.89*** **

Note: Significance: *** p<0.001, ** p<0.01, * p<0.05. Ratios shown in bold are statistically significant (p<0.05 or lower) and marked with asterisks; all others are not statistically significant. Ratios above 1 mean higher odds of experiencing the illness; those below 1 mean lower odds, each holding the other factors constant.

4

Quantifying the cost of heat-related loss and damage

Chapter 3 shows how heat exposure affects workers' health, livelihoods and wellbeing. Many of these impacts remain largely invisible in policy and planning because they are not routinely measured. Lost workdays, forgone wages, heat-related illness, long-term kidney damage and psychological stress are all real costs, yet most fall outside the systems used to assess economic damage. In this chapter, we use the C-CIQ framework to quantify these losses and damages and make visible the scale of the costs of heat exposure on informal workers and their households.

We begin by introducing the C-CIQ framework and the economic and non-economic dimensions of loss and damage that it captures. We then estimate workdays and wages lost during extreme heat events, assess the longer-term losses associated with heat-related kidney disease and examine how these losses deepen existing living wage deficits among worker households. Finally, we scale these impacts to the national level to estimate their implications for productivity, economic output and GDP.

4.1 Why it matters

Heat exposure imposes a wide range of losses on informal workers and their households. Some — such as workdays lost, wages forgone, healthcare expenditures and the loss of future earnings associated with long-term illness — are economic and can be measured directly. Others, including physical pain, psychological stress, loss of sleep, anxiety, strain on family relationships and the loss of dignity associated with working under unsafe conditions, are non-economic. Together, these impacts constitute the full burden of heat-related loss and damage.

Conventional assessments capture only a small part of this burden. Unlike floods or cyclones, heat rarely leaves visible physical destruction that we can count and value. Even where heatwaves appear in disaster databases such as EM-DAT, the impacts recorded are typically limited to deaths and immediate emergency losses. The cumulative effects experienced by workers — including reduced productivity, declining health, worsening mental wellbeing and lost income — are rarely measured. As a result, much of the damage caused by heat exposure remains invisible in policy and planning.

Quantifying such losses helps make them visible to the institutions responsible for planning and public investment. When we express heat-related losses in workdays, wages and national output, we can compare them with other economic risks and weigh them against the costs of interventions designed to reduce them. This shifts the view that heat exposure is solely a public health or welfare issue to recognising it as an economic challenge with implications for productivity, livelihoods and growth.

IIED developed the C-CIQ framework to address this gap by bringing economic and non-economic losses together within a single assessment framework. In doing so, the framework provides a more complete picture of what heat exposure takes from workers, who bears those losses and why they matter for policy and decision making.

4.2 Applying the C-CIQ framework to heat exposure

We adapted the C-CIQ framework to assess heat-related loss and damage among informal workers. The framework moves through three connected stages. First, it identifies the factors that shape vulnerability using the 3P framework presented in Chapter 2 (see Figure 2). Second, it categorises resulting losses and damages across four domains: tangible, intangible, intrinsic and functional. Third, it quantifies these losses using a combination of economic valuation, composite indices and qualitative evidence.

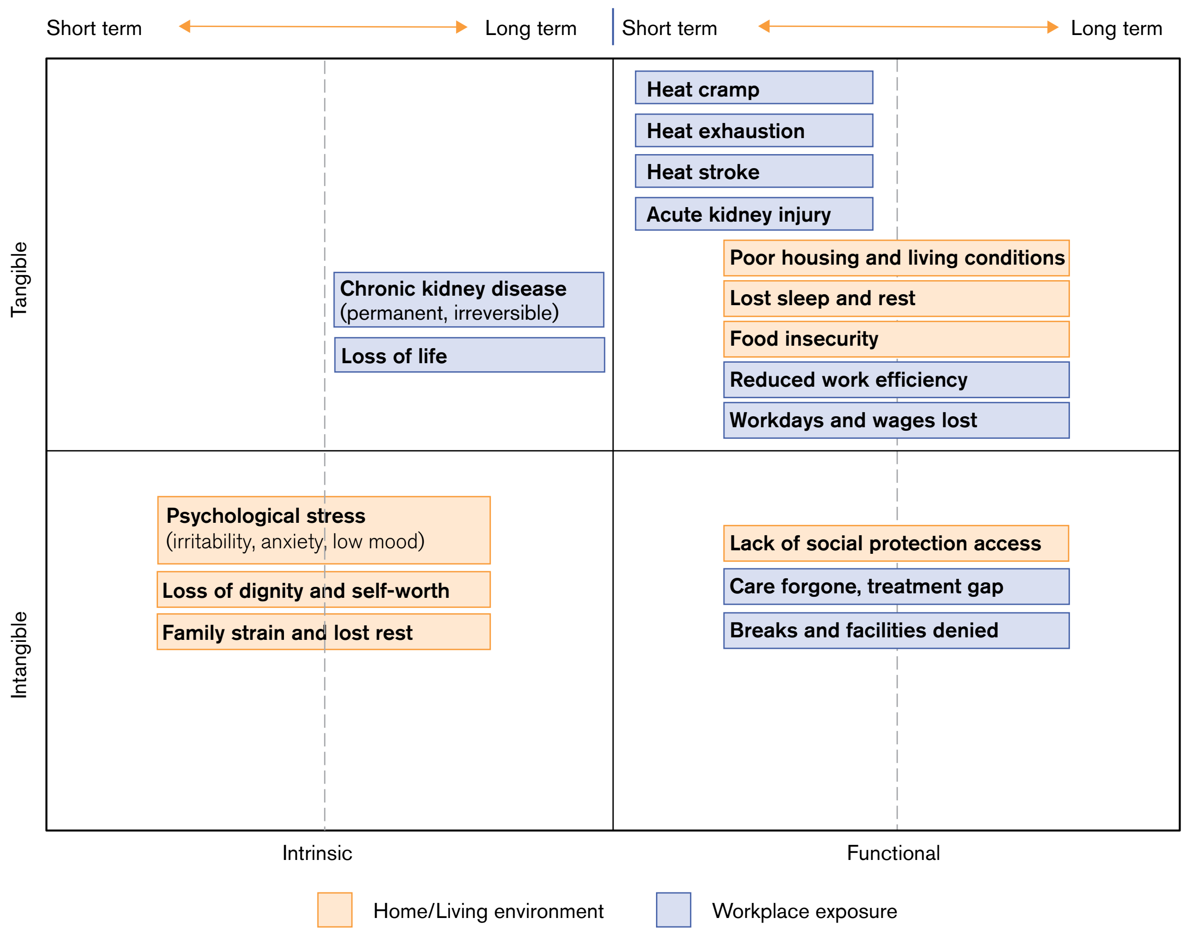
Tangible losses are those we can observe and measure directly, such as lost workdays, reduced earnings and healthcare costs. Intangible losses are more difficult to value economically, and include psychological stress, disrupted sleep and strain on family life. Intrinsic losses relate to health, wellbeing and human dignity, while functional losses concern people's and systems' ability to perform essential functions, such as working, earning an income or accessing services. Many impacts span multiple domains. CKD, for example, is an intrinsic loss because it damages health, a functional loss because it reduces the ability to work, and a tangible loss because it results in lost earnings.

The framework also captures how losses unfold over time and across different settings. Some occur immediately during periods of extreme heat, while others accumulate over years and may become permanent. Likewise, heat exposure affects workers both at work and at home, recognising that many have little opportunity to recover from heat once the working day ends.

4.3 Heat-related loss and damage across the C-CIQ domains

Figure 62 presents the heat-adapted C-CIQ matrix. The matrix pairs the four domains of loss and damage and shows how the impacts identified in this study are distributed across them.

Figure 62. The heat-adapted C-CIQ matrix: heat-related loss and damage across the four domains



The tangible functional quadrant captures the immediate economic losses associated with heat exposure, including lost workdays, forgone wages, reduced productivity and household expenditure on treatment and medicines. These arise both at work and at home and are the impacts we estimate monetary values for in this chapter.

The tangible intrinsic quadrant is dominated by long-term damage to health, particularly CKD. This loss is intrinsic because it affects health and wellbeing in their own right; but it is also tangible because it can be measured through lost working years and reduced earnings. Mortality is included in this quadrant as the most severe consequence of heat exposure, although we have not quantified it in this study.

The intangible intrinsic quadrant captures losses that are difficult to value economically but are central to workers' wellbeing. These include psychological stress, irritability, anxiety and low mood, lost rest, strain on family relationships and the loss of dignity and self-worth described by workers in FGDs, interviews and case studies.

The intangible functional quadrant captures the erosion of workers' ability to cope with heat. In this study, it includes: workplace conditions that deny workers access to water, shade, rest breaks and sanitation; lack of social protection; and the need to continue working through illness. These do not constitute losses in themselves but increase vulnerability by limiting workers' capacity to recover from heat exposure.

4.4 Non-economic dimensions of heat-related loss and damage

Under the C-CIQ framework, we assess losses that cannot readily be monetised through composite indices. This study uses the six indices introduced in Chapters 2 and 3 to quantify different dimensions of vulnerability, exposure and impacts. Three indicescapture the conditions that shape vulnerability (housing heat exposure, social protection and workplace facilities), and the other three capture workers' responses and outcomes (coping actions, heat-related illness prevalence and psychological stress). Together, they provide a quantitative assessment of the non-economic dimensions of heat-related loss and damage (see Table 4).

Table 4. The six composite indices used in this study

Index	What it measures	Outdoor	Indoor
Housing heat exposure index	How far workers' homes add to their heat exposure through construction, ventilation and cooling Higher score means more exposure	6.6	4.4
Social protection index	Access to the social safety net Higher score means more access Disaggregated by migration status	Migrant 2.3 Non-migrant 3.1	Migrant 2.3 Non-migrant 3.4
Workplace facilities index	Provision of water, shade, rest, sanitation and medical support at work Higher score means better protection at work	2.1	3.0
Coping action index	Coping strategies workers use to manage heat exposure in the absence of formal provision Higher score means stronger coping capacity	4.3	4.2
Heat-related illness prevalence indices, summer	How widespread and severe heat cramp, heat exhaustion and heatstroke are Higher score means more prevalent	Cramp 9.0 Exhaustion 8.9 Stroke 5.4	Cramp 8.7 Exhaustion 7.7 Stroke 5.1
Psychological stress index, summer	Mental strain during the working season Higher score means more stress	4.1	4.1

Notes: The heat-related illness prevalence and psychological stress indices are shown for summer; scores for the rest of the year are lower (the psychological stress index, for example, falls below 2 for both groups of workers). The social protection index is disaggregated by migration status rather than work setting, because migration, rather than work location, affects access to protection.

4.5 Workdays and wages lost during extreme heat events

The most immediate economic loss from heat exposure is the workdays it takes away from workers. We have quantified it here at individual level, first as workdays lost over a year, then as the wages those days represent.

4.5.1 Workdays lost per worker per year

Heat exposure reduces work through three pathways, which were all measured in our survey:

- Illness, when workers are unable to work because of heat cramp, heat exhaustion or heatstroke
- Reduced capacity working, when workers remain at work but are unable to maintain normal productivity because of the heat, and
- Workplace closures, when operations halt because conditions become too hot to work safely.

For outdoor workers, illness is the largest component of loss, accounting for 13.48 workdays per year, followed by reduced capacity working, responsible for 8.69 days, and workplace closures, accounting for 2.12 days. Reduced capacity working is the largest component for indoor workers, accounting for 7.38 workdays per year, followed by illness and workplace closures, responsible for 6.36 and 1.05 days, respectively (see Figure 63).

We estimated the reduced capacity component using workers' reports of how many hours they were unable to work effectively during periods of excessive heat, together with a conservative assumption that only 25% of those inefficient hours translate into lost output (see Table 5). Workers reported being unable to work effectively for an average of 2.78 hours per day outdoors and 2.36 hours per day indoors during periods of excessive heat. Applied across an assumed 100 days of excessive heat per year, this produces 278 and 236 inefficient hours, respectively. Counting only a quarter of those hours as lost output yields 8.69 workdays lost per year for outdoor workers and 7.38 for indoor workers.

Taken together, the three pathways result in an estimated loss of 24.29 workdays per year for outdoor workers and 14.78 workdays for indoor workers (see Figure 64). While outdoor workers lose more days overall, the results also highlight a form of loss that is often overlooked: for indoor workers, reduced productivity on days still worked accounts for a larger share of total losses than illness-related absence.

Table 5. Assumptions for estimating workdays lost to heat induced inefficiency, by work setting

Assumptions/variables	Outdoor	Indoor
Hours unable to work efficiently due to excessive heat (survey data)	2.78	2.36
Inefficient work hours per year (across an assumed 100 days of excessive heat per year)	278	236.05
Work hours lost per year (at 25% of the inefficient hours)	69.50	59.01
Workdays lost due to inefficient work in a year	8.69	7.38

Figure 63. Workdays lost to extreme heat per worker per year, by reason and work setting

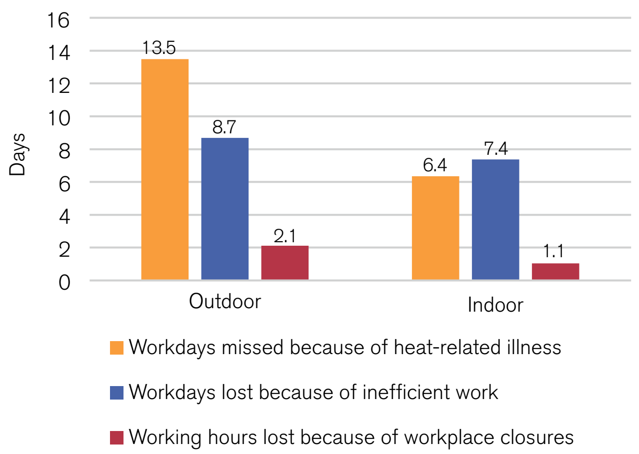
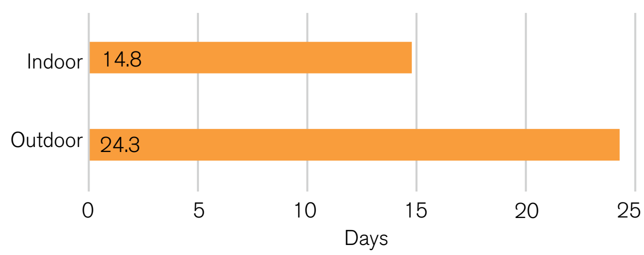


Figure 64. Total workdays lost to extreme heat per worker per year, by work setting



4.5.2 Wages lost per worker per year

For a daily wage earner, a lost workday is a lost day's income. Valuing the workdays lost above at each worker's daily wage gives an estimated annual wage loss of US$151.20 for outdoor workers and US$89.23 for indoor workers (see Figure 65).

Figure 65. Wages lost due to excessive heat per worker per year, by work setting

For workers in some of the lowest-paid occupations, losses of this magnitude are significant. With few savings to absorb the shock, households often cope through borrowing, by reducing expenditure on food and other essentials or by delaying healthcare. The loss therefore extends beyond income alone and can trigger a wider set of economic pressures.

We have deliberately kept these estimates conservative. They capture only wages lost through missed work and reduced productivity during periods of extreme heat, and do not include longer-term earning losses associated with CKD (see Section 4.6) or treatment costs borne by workers and their households. The figures presented here provide a baseline estimate of wage loss, which we use in the household and national calculations that follow.

4.6 Long-term wage loss from heat-related kidney disease

The losses set out in Section 4.5 are seasonal. They come with the heat and, for most workers, ease once summer is over. The loss we cover in this section is different, because it does not ease. Where repeated exposure to extreme heat damages the kidneys, the damage can become permanent, reducing workers' capacity to earn for the rest of their working life. This long-term wage loss sits in the tangible and intrinsic part of the matrix: a loss of health that is also a loss of income.

4.6.1 From AKI to CKD: method and assumptions

Repeated dehydration places strain on the kidneys and can lead to AKI. While a single episode may resolve, repeated episodes increase the risk of progression to CKD, an irreversible decline in kidney function. This pathway is particularly relevant for workers who experience repeated heat exposure and have limited opportunities for rest and rehydration.

We estimated long-term wage losses in several stages. First, we identified workers in the survey who reported symptoms that are consistent with AKI, providing the base population already showing signs of heat-related kidney damage. We then applied a progression rate of 25.8%, drawn from a recent systematic review and meta-analysis of long-term kidney outcomes following AKI (Veltkamp et al., 2025), to estimate the share expected to develop CKD. For those workers, we applied the 56% reduction in working time associated with end-stage kidney disease reported in the literature (Wang et al., 2024). We then valued the resulting loss of workdays using workers' daily wages to estimate long-term wage losses. We applied the same approach to the national informal workforce, using PLFS 2023–24 data to generate national estimates. We have kept the estimate deliberately conservative, capturing only long-term wage losses associated with CKD among workers already reporting symptoms of AKI. It excludes treatment costs such as dialysis, hospitalisation and medication, out-of-pocket household expenditures, premature mortality and wider social impacts. We therefore included mortality in the C-CIQ matrix as a loss but did not assign it a monetary value. As such, the estimates we present here should be interpreted as representing only part of the full burden of heat-related kidney disease.

4.6.2 Workers affected and workdays lost

In the survey, 18.7% of workers reported symptoms consistent with AKI. Applying the 25.8% progression rate, an estimated 4.8% of all workers are expected to develop CKD over time, equivalent to around 1 in 20 workers.

This risk is not confined to those working in direct sunlight. As shown in Chapter 3, dehydration is also common among indoor workers, particularly where access to drinking water and sanitation is limited. In some workplaces, workers reduce their water intake to avoid using inadequate toilet facilities, increasing the risk of kidney damage.

"Women in garment factories often suffer from dehydration, fainting and kidney infections due to a lack of access to toilets and drinking water." KII with NGO representative, Delhi

Scaled to the national informal workforce engaged in high physical labour, we estimate that some 26.35 million workers are expected to develop CKD as a long-term consequence of heat exposure. Applying the 56% reduction in working time to this group results in a loss of approximately 4.51 billion workdays per year.

These figures point to a substantial reduction in the productive capacity of the informal workforce, one that accumulates gradually rather than appearing within a single season. Workers themselves often describe it as a slow decline in their ability to work and earn.

4.6.3 Wage loss from CKD

Valuing the workdays lost to CKD at state-level daily wages and aggregating across states gives an estimated long-term wage loss of US$22.73 billion per year, equivalent to 0.58% of GDP.

Unlike the seasonal wage losses associated with extreme heat events, this reflects a permanent reduction in earning capacity. It is additional to the immediate wage losses experienced during periods of extreme heat and continues as workers live with CKD. Section 4.8 presents these long-term losses alongside the seasonal losses to show the full economic burden of heat exposure.

Much of this loss remains invisible in conventional assessments. It does not appear in disaster damage estimates or heat action budgets because it emerges gradually, across millions of workers and often years after the heat exposure that contributed to it. Yet it represents one of the clearest examples of the long-term and unrecorded damage associated with extreme heat.

4.7 The living wage deficit and heat

The significance of wage losses becomes clearer when they are compared with what households need to achieve a basic standard of living. In this section, we measure the gap between household income and a living wage and examine how heat exposure widens that gap.

4.7.1 The living wage benchmark

A living wage is the income required to afford a basic but decent standard of living, including food, housing, healthcare, education and a small margin for unexpected expenses. For this study, we use the Anker living wage for the Delhi National Capital Region, estimated at 22,696 rupee per month in 2024, equivalent to US$3,124.92 per year (Medinaceli et al., 2024). We apply this benchmark to both outdoor and indoor worker households, as it reflects the cost of a decent standard of living rather than the type of work undertaken.

4.7.2 Household income and the deficit

Both groups fall well short of this benchmark. Outdoor worker households earn an average of US$1,709 per year and indoor worker households, US$1,946, compared with the living wage benchmark of US$3,125. This leaves a living wage deficit of US$1,416 for outdoor worker households and US$1,179 for indoor worker households, equivalent to 45.3% and 37.7% of a living wage, respectively.

Indoor worker households are somewhat better placed, earning more and carrying a smaller deficit than outdoor worker households. But both groups remain substantially below what is required for a decent standard of living. FGD participants indicated that households manage this gap through borrowing, reducing food consumption, postponing healthcare and cutting other essential expenditure. Participants in an FGD with women construction workers in Delhi described borrowing to cover rising costs and sinking further into debt, with no compensation, sick leave or insurance to fall back on.

4.7.3 How heat widens the deficit

Heat exposure widens an already substantial shortfall in living wage. When the wage losses associated with extreme heat (see Section 4.5.2) are deducted from household income, annual earnings fall to US$1,558 for outdoor worker households and US$1,857 for indoor worker households (see Figure 66).

The living wage deficit consequently rises to US$1,567 for outdoor worker households and US$1,268 for indoor worker households, equivalent to 50.2% and 40.6% of a living wage, respectively, up from 45.3% and 37.7% before we even consider heat-related wage losses (see Figure 67). For outdoor worker households, the deficit exceeds half of a living wage.

Figure 66. Household income per year, before and after wages lost to heat, by work setting

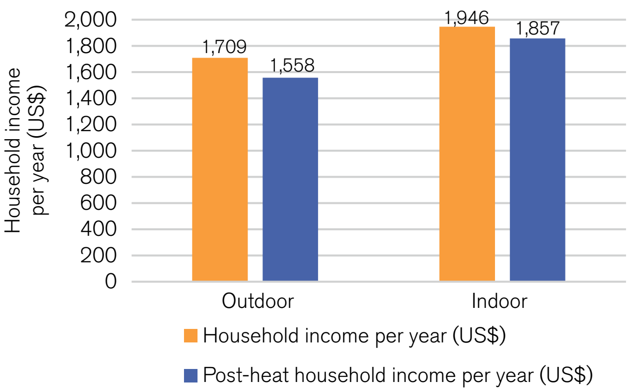
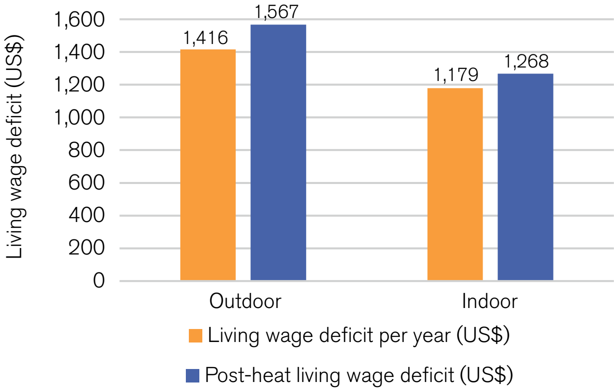


Figure 67. Living wage deficit, before and after wages lost to heat, by work setting



The increase is larger for outdoor worker households because they lose more work and income during extreme heat. But the impact extends across both groups, deepening already severe deficits. For households that are already struggling to meet basic needs, the loss of income during the hottest months can mean additional debt, reduced consumption or working through unsafe conditions.

"If it's too hot, I stay home. But then there's no money." Participant in FGD with women construction workers, Delhi

So, for many households, the choice is not between safety and comfort; it is between protecting their health and protecting their income.

4.8 National wage loss and its share of GDP

We used household-level loss to analyse what losses would look like at country level, including GDP losses.

Box 2. Estimating national wage loss

We built the national estimate from the state-level calculations. We first identified the workforce in each state exposed to heat, the informal workers in high physical labour sectors such as construction, manufacturing and transport, where heat directly affects the ability to work, based on the worker–population ratio and population in PLFS 2023–24, together with the share of workers in high physical labour industries (NSO, 2024).

Because heat is not uniform across the country, we gave each state a heat intensity weight based on its climate zone, drawn from the World Bank Climate Knowledge Portal (World Bank, no date). Hotter and more arid zones, such as Rajasthan, carry a higher weight, and cooler and mountain zones a lower one, so that the estimate reflects the heat burden in each state.

We then scaled workdays lost at state level and summed these to get the national figure:

Workdays lost (state) = workdays lost per worker × number of exposed workers × heat intensity weight

Workdays lost per worker is the combined outdoor and indoor average of 21.11 days, the sample weighted average of the per worker figures from our calculation. We then calculated wage loss by valuing those workdays at the state average daily wage from PLFS:

Wage loss (state) = workdays lost (state) × average daily wage (state)

We then expressed the national wage loss as a share of GDP for 2024 in current US dollars (World Bank, no date) and scaled the long-term wage loss from kidney disease in the same way.

Using the methodology outlined in Box 2, we estimate the immediate loss during extreme heat events at 11.08 billion workdays a year at national level. This is equal to 6.6% of the exposed workforce's total workdays and a wage loss of US$55.29 billion, or 1.4% of GDP. The long-term loss from heat-related kidney disease adds another 4.51 billion workdays and US$22.73 billion, or 0.58% of GDP. Together, heat exposure costs the Indian informal workforce 15.59 billion workdays and US$78.02 billion in lost wages each year, close to 2% of GDP (see Table 6).

These losses are substantial for two reasons. First, they fall disproportionately on low-income informal workers whose livelihoods depend directly on daily labour. For many households, lost workdays mean immediate cuts to income, consumption and savings, with little capacity to absorb the shock. Second, the workers bearing them are concentrated in sectors that underpin economic activity, such as construction, manufacturing and transport, so the impacts extend beyond individual workers and households to productivity across the wider economy.

The estimate is also conservative. It captures only wage losses among informal workers engaged in physically demanding work and excludes losses among formal workers, disruptions to supply chains and production, healthcare costs and other indirect effects. The true economic burden of heat exposure is therefore likely to be higher.

Expressing these losses as a share of GDP helps illustrate their macroeconomic significance, but the burden is first experienced at household level. For families with little or no financial reserve, each lost workday means lower earnings and less opportunity to meet daily costs, save against future shocks or invest in health and education, eroding both their wellbeing and their resilience.

Table 6. Estimated national wage loss from heat per year, India: immediate and long-term losses

Loss	Workdays lost per year (billions)	Wage loss per year (US$, billions)	Share of GDP
Immediate (during extreme heat events)	11.08	55.29	1.41%
Long-term (heat-related kidney disease)	4.51	22.73	0.58%
Total	**15.59**	**78.02**	**1.99%**

Yet in conventional economic accounting, much of this loss remains invisible. Unlike damage to infrastructure or crops, earnings lost to reduced work capacity are rarely measured or compensated. Instead, workers and their households quietly absorb the costs as forgone income, depleted savings, debt and reduced consumption. This is uncompensated loss and damage, borne directly by vulnerable households rather than reflected in any formal assessment or support mechanism. Aggregated to the national level, what looks like individual hardship is a significant and recurring economic cost, carried across millions of households and showing up as lower national output.

The longer-term burden does not lift when the heat does. Heat-related kidney disease can permanently reduce a worker's earning capacity, with effects that persist long after a heat event has passed. For affected households, this can mean years of reduced income alongside rising healthcare costs. At national level, it is a continuing loss of productive labour and a further drag on economic performance.

These estimates reflect current levels of heat exposure (see Box 3 for the summary of the overall cost of heat exposure on informal workers and their households). As temperatures continue to rise and heatwaves become more frequent and intense, both productivity losses and heat-related illness are likely to increase. The costs identified here are therefore a measure of present-day damage and an early indication of what a warming climate will add. Protecting workers from heat exposure should be seen as an investment in productivity, livelihoods and growth, rather than a welfare cost. These estimated costs also provide a benchmark for assessing the costs and benefits of worker protection.

Box 3. The costs of heat exposure for informal workers and their households

Table 7 brings together the costs of heat exposure to show the overall burden borne by informal workers and their households. Heat reduces working time and earnings, widens existing income deficits relative to a living wage and can lead to permanent health impacts through CKD.

Table 7. Annual household-level costs of heat exposure identified in this study

Indicator	Outdoor worker households	Indoor worker households
Workdays lost to heat per year (per worker)	24.29	14.78
Wages lost to heat per year (US$ per worker)	151.20	89.23
Annual household income (US$ per household)	1,708.74	1,946.24
Living wage deficit before heat (% below living wage)	45.3	37.7
Living wage deficit after heat (% below living wage)	50.2	40.6
Expected risk of CKD from heat exposure	Approximately 1 in 20 workers	Approximately 1 in 20 workers

The economic losses shown in Table 7 capture only part of the burden. Workers also experience a range of non-economic losses, including psychological stress, disrupted sleep, reduced wellbeing, strain on family life and a loss of dignity associated with inadequate access to water, shade and sanitation at work. Together, these findings show that heat exposure imposes a layered form of loss and damage on informal worker households: recurring income losses, deepening poverty, long-term health impacts for some workers and substantial non-economic costs that are rarely recognised or compensated.

5 Recommendations

Chapter 4 quantified what heat exposure takes from informal workers. At national level, these losses approach 2% of GDP. For workers and their households, this means lost workdays, forgone wages, declining health and a living wage deficit that was already substantial before the heat. And exposure does not end when the working day ends. Many workers return from hot workplaces to homes that remain hot through the evening and night, limiting their ability to recover before the next day's work. This chapter sets out practical measures to reduce these losses and protect the workers who are least able to absorb them.

The response does not require new institutions. India already has the worker registers, payment systems, social protection schemes and budget mechanisms needed to support heat-exposed workers. What is missing is a way to activate these systems when heat strikes and ensure they reach those most affected. We therefore recommend three actions: strengthening social assistance through a heat-triggered cash transfer and improved access to existing health and food entitlements; making heat protection at work a binding requirement rather than guidance; and adopting the most cost-effective financing model for income protection, drawing on evidence from existing heat insurance and cash transfer programmes. The common principle across all three recommendations is that acting early through systems that already exist costs far less than letting losses accumulate.

5.1 A living wage-based model: strengthening social assistance

Heat removes income from workers who are already earning well below a living wage. The losses are concentrated in the 13 states that the study's weighting places at or above full heat intensity: Rajasthan, Gujarat, Uttar Pradesh, Bihar, West Bengal, Madhya Pradesh, Telangana, Jharkhand, Chhattisgarh, Punjab, Haryana, Delhi and Chandigarh. Together, these highest-exposure states account for 350.67 million workers engaged in heat-exposed physical labour, who lose an estimated US$36.36 billion in wages each year due to heat. So, the challenge is not only to reduce exposure, but also to protect incomes when work is disrupted by extreme heat.

We recommend three complementary measures, outlined here: a heat-triggered cash transfer to compensate workers when heat prevents them from working; improving access to the flagship health protection scheme Ayushman Bharat so migrant workers can use the health benefits they are entitled to; and strengthening access to the PDS food security programme so food support remains available when incomes fall. Together, these measures can protect household income directly while reducing the indirect losses associated with healthcare costs and food insecurity.

The cost of providing this support is modest relative to the losses it can help prevent. Depending on the severity of the heat season, the estimated annual cost could range from US$0.78 billion in a normal year to US$2.11 billion in a record year. This is 2.1–5.8% of the US$36.36 billion in annual wage losses.

Evidence from anticipatory social protection shows that acting early is also substantially more cost-effective than responding after losses have occurred. Analysis across eight countries found that every US$1 invested in anticipatory action generates US$2.06–5.17 in avoided losses and development gains (Bharadwaj et al., 2025).

All three measures are designed to build on existing systems. The cash transfer can be delivered through India's Direct Benefit Transfer (DBT) architecture, which uses the Jan Dhan bank account-Aadhaar-Mobile (JAM) platform to transfer benefits directly into beneficiaries' bank accounts. The transfer can be targeted through the e-Shram register and activated using IMD heatwave declarations. The health and food measures can operate through the Pradhan Mantri Jan Arogya Yojana (PM-JAY) and PDS, which already have established beneficiary identification and delivery mechanisms.

5.1.1 A heat-triggered cash transfer

Income protection is the most immediate need for workers affected by extreme heat, yet no existing programme provides compensation when heat prevents people from working. As such, we propose a heat-triggered cash transfer delivered through the DBT system.

Under this system, we propose workers are paid a daily support of US$3.15, which is in line with the wage paid under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) public works programme, where notified daily rates range from 241–400 rupee across states (Ministry of Rural Development, 2025). This amount can then be aligned with the rate paid by the new rural employment guarantee scheme — the Viksit Bharat: Guarantee for Rozgar and Ajeevika Mission (Gramin) — once that is set.

The total budget needed would depend on the intensity of the heatwave. India has recorded 4–7 heatwave days in a normal year, rising to 10–11 in the hot states recently, with 2024 among the hottest summers in 14 years (IMD, 2025). We have therefore provided budget estimates for three levels of heat season severity: a normal year at 6 paid days; a hot year at 12; and a record year at 18. If targeted at the poorest 10% and with a floor of US$3.15, we estimate that the transfer will cost US$0.66 billion to US$1.99 billion per year, depending on the severity of the heat season (see Table 8).

Because payment would follow the heatwave trigger, the cost would rise in worse years. We therefore recommend financing is designed with a layered approach so the pressure of the peak year does not land as a shock on the government budget. Government funds could cover the normal and hot year payments, and insurance could cover any additional payments needed in rare record years, like 2024 (see Section 5.3).

Table 8. Annual cost of heat-triggered cash transfer, by season severity

Season severity	Paid days	Cost (US$ billion)	Share of the US$36.36 billion wage loss
Normal year	6	0.66	1.8%
Hot year	12	1.33	3.7%
Record year	18	1.99	5.5%

5.1.2 Cashless health: closing the access gap

Ayushman Bharat already provides hospitalisation cover for poor households, including migrant workers, and is intended to be portable across states. But in practice, low awareness, enrolment and documentation difficulties and weak portability when they fall ill away from their home state means that migrant workers often struggle to use the scheme (Srivastava, 2020b; Rajwar and Shukkoor, 2026). So, the challenge is not to create a new benefit, but to ensure existing coverage reaches the workers it was designed for.

The cost of closing this gap falls on migrant workers in the 13 highest-exposure states, estimated at 37.24 million people. This figure is derived from India's 58 million short-term circular migrants (Srivastava 2020a), scaled to the 64% of the exposed workforce located in these states. Unlike the cash transfer proposed in Section 5.1.1, which targets the poorest workers, we propose that this intervention should target workers whose main barrier is access and portability.

Four measures are required to address existing barriers to Ayushman Bharat access, based on FGDs and corroborated by other studies (Srivastava, 2020b; Rajwar and Shukkoor, 2026). These are: targeted assisted enrolment and awareness support; locating mobile enrolment and health camps near labour colonies; portability and digital support, including interstate verification, multilingual helpdesks and migrant facilitation centres; and facilitation allowances to offset transport and documentation costs (see Table 10).

Table 9. Cost of closing the Ayushman Bharat access gap

Support type	Cost (Rupee, millions)	Cost (US$, millions)
Assisted enrolment and awareness	931	10.71
Mobile camps and outreach	3,724	42.83
Portability and digital support	931	10.71
Access facilitation grants	1,117	12.85
Total	**6,703**	**77.09**

At US$77.09 million, the package would cost 0.21% of the wage losses it can help prevent and around 7% of the PM-JAY allocation of US$1.09 billion (Press Information Bureau, 2026). The largest component — mobile health camps — would also function as a form of primary care outreach and could be converged with other similar efforts and financed through the wider health budget, reducing the additional PM-JAY requirement to around 3%. Some of these would be one-off costs, as they would not be needed again once assisted enrolment and portability has been achieved.

5.1.3 Food aid: closing the access gap

The challenge for food assistance is similar to that faced for cashless health: the entitlement exists, but many migrant workers struggle to access it where they live and work. The PDS provides subsidised grain to poor households, and the One Nation One Ration Card was designed to make those entitlements portable across states. But in practice, interstate portability remains limited; there are fewer than half a million interstate transactions per month, compared with more than 20 million intrastate transactions (Tumbe and Jha, 2024). Low awareness, difficulty locating fair price shops, authentication failures and weak grievance redress continue to limit access for migrant workers in destination areas. So, although the entitlement exists, many workers cannot reliably access it where they live and work.

Closing this gap would cost less than the health package because most of the spending is on systems and service delivery rather than per-worker support. We propose five measures to address existing barriers to PDS access: awareness campaigns; destination facilitation desks in 200 blocks; strengthening 5,000 fair price shops in receiving areas; portability and grievance redress mechanisms; and monitoring and evaluation (see Table 10).

Table 10. Cost of closing the PDS access gap

Support type	Cost (Rupee, millions)	Cost (US$, millions)
Awareness and information	372	4.28
Facilitation desks (200 blocks)	400	4.60
Fair price shop strengthening (5,000 shops)	2,500	28.75
Grievance and portability	250	2.88
Monitoring and evaluation	200	2.30
Total	**3,722**	**42.81**

At US$42.81 million, the overall budget required is 0.16% of the national food subsidy allocation of US$26.15 billion (PRS Legislative Research, no date) and 0.12% of the annual wage losses experienced by heat-exposed workers across the 13 highest-exposure states. This support will be used to improve access systems and service delivery, with most of the spending going to strengthening fair price shops, alongside facilitation desks and portability mechanisms, rather than additional spending on grain.

5.1.4 Total cost of providing support to heat exposed workers

The total package required to support heat-exposed workers through cash, health and food aid would cost approximately US$0.78 billion in a normal year, US$1.45 billion in a hot year and US$2.11 billion in a record year (see Table 11). The two access components — Ayushman Bharat and PDS — are largely fixed in cost, at US$77.09 million and US$42.81 million, respectively. As a result, the overall cost of the package will rise only as heat-related losses increase, ensuring support expands when workers need it most.

Table 11. Overall cost of the proposed package, by season severity

Support (cost in US$, billions)	Normal year	Hot year	Record year
Heat-triggered cash transfer	0.66	1.33	1.99
Ayushman Bharat access	0.08	0.08	0.08
PDS access	0.04	0.04	0.04
Total package	**0.78**	**1.45**	**2.11**
Share of the US$36.36 billion wage loss	**2.1%**	**4%**	**5.8%**

5.2 Workplace protections and enforcement

The legal framework governing workplace safety has become weaker on heat at a time when protection is becoming more necessary. The Occupational Safety, Health and Working Conditions Code, which came into force in November 2025 with central rules notified in May 2026, consolidated 13 earlier labour laws, including the Factories and BOCW Acts (Government of India, 2020, 2026). Under the previous framework, some states — including Tamil Nadu, Maharashtra and Gujarat — specified wet bulb temperature limits above which work was considered unsafe (Government of Tamil Nadu, 1950). The new code and its rules contain no equivalent temperature threshold and treat heat primarily as a matter for guidance rather than enforceable duty (Government of India, 2026).

Coverage is also limited. The code applies only to establishments with ten or more workers (PRS Legislative Research, no date), thus excluding many of the workers who are most exposed to heat, including street vendors, head loaders and informal construction workers. A 2026 survey found that 89% of street vendors in Delhi had no access to free drinking water while working (WIEGO, 2026). Heat exposure is often greatest among workers who fall outside the protection of the law.

A further gap concerns compensation. The Employees' State Insurance Scheme does not recognise heatstroke and other heat-related illnesses as occupational diseases, leaving workers with no occupational claim for lost wages or treatment when they become ill due to heat exposure (Government of India, 1948a).

The following changes, which require little additional spending because they rely primarily on regulation and enforcement, would address these gaps:

- **Introducing a heat threshold into the code's rules:** a wet-bulb globe temperature trigger, reinstating and standardising the approach previously used in some states, should make a defined set of protections — including drinking water, electrolytes, shaded rest areas and adjusted working hours — mandatory once the threshold is crossed, with outdoor work suspended at higher thresholds. Linking this trigger to IMD heatwave declarations would align workplace protection with the heat-triggered income support proposed in Section 5.1.1.
- **Replacing the headcount threshold with a hazard-based approach:** the duty to protect workers from heat should depend on exposure rather than size of establishment. Any worker exposed to hazardous heat should be covered, whether the work is indoor or outdoor, and regardless of workplace size.
- **Recognising heatstroke and other heat-related illnesses as occupational diseases** under the Employees' State Insurance scheme and **placing responsibility for enforcement with the code's inspector-cum-facilitator:** heat protection should be enforceable rather than advisory.

These measures would protect workers when working; and when combined with income, heath and food support, would provide a comprehensive safety net when work is disrupted due to extreme heat.

5.3 Living wage compensation versus insurance: lessons from the Self Employed Women's Association (SEWA)

India already has the most developed real-world experience and learnings from an insurance-linked worker compensation scheme for extreme heat. Looking at the heat cover offered through SEWA since 2023 allows us to consider whether heat income support for workers should be based on a direct transfer or insurance.

The SEWA scheme is index-based insurance that pays automatically when local temperature crosses a specified threshold, with no claim required. Designed by SEWA, Climate Resilience for All and Blue Marble, the scheme in India is underwritten by ICICI Lombard, with Swiss Re covering the largest claims (Climate Resilience for All, 2024; Swiss Re, 2024). Piloted with 21,000 women in Gujarat in 2023, it covered around 50,000 women in 2024, scaling to 250,000 in 2025 (WEF, 2025; IGC, 2025). In Ahmedabad, members receive US$8.78 when daytime temperature exceeds 43.6°C for two consecutive days and US$14.63 when it exceeds 44.1°C, against an annual premium of about US$8, which is partly paid by the worker and partly subsidised (Thakur, 2025).

The SEWA pilot shows both the promise and limits of insurance (see Table 12).

The first challenge is **basis risk**: the gap between the temperature index and the loss that workers actually experience. In 2023, the threshold was set so high that some extremely hot days generated no payout (Thakur, 2025). Lowering the threshold would reduce missed losses but increase premiums, so calibrating that line is the main issue with parametric heat cover.

The second challenge is **timeliness**. Early rounds paid after the heat event, with several days' delay before the money arrived, but workers need income when the day's wages are lost (Desai, 2023). Later rounds have moved towards faster, forecast-linked automatic payments, which narrowed, but did not remove, this gap.

The third challenge is **adequacy**. In 2024, the scheme paid US$350,859 to around 46,000 women, close to US$8 per worker for the season (WEF, 2025). Set against the heat-related income loss estimated in this study of US$89–151 per worker per year, that payout replaced only 5–9% of the loss, functioning as a supplement, rather than a replacement.

SEWA's own design response is useful in this context. From 2024, the programme added a direct cash layer, paying a day's wage when temperatures reach 40°C, alongside the insurance payout reserved for higher thresholds (Climate Resilience for All, 2024). In practice, the model became a hybrid: direct cash for frequent, lower-threshold heat days and insurance for more extreme events.

The economics support that layering. Insurance has to cover administration, insurer margins and reinsurance costs, so it costs more than the payout returned to workers. For a risk that is frequent, predictable and worsening, direct transfers are better suited because nearly every rupee funded reaches the worker and there is no basis risk. Insurance still has a role in rare, extreme years, when losses are large and concentrated, and pooling and reinsurance can spread the fiscal cost.

We therefore recommend the design that SEWA has moved towards in practice, with the direct transfer (see Section 5.1.1) covering frequent heat days (which account for most income loss) and parametric insurance covering exceptional years when the fiscal cost spikes.

Table 12. Direct transfer versus parametric insurance for heat income support

Feature	Direct transfer	Parametric insurance (SEWA model)
Reach per dollar	Nearly all reaches the worker	Less; the balance is premium loading
Basis risk	None; pays on the district heatwave declaration	Real; the 2023 threshold missed extreme days
Timeliness	Same-season transfer based on the trigger	Pilot paid days late; has improved since
Income replaced (per worker, 2024 terms)	US$18.90–56.70	About US$8, or 5–9% of the loss
Best-suited layer	Frequent, predictable heat days	Rare, extreme heatwave years

6

Next steps

The recommendations in this report are designed to link existing programmes and systems to heat and activate them before losses occur. The steps outlined here provide a practical sequence for moving from recommendation to implementation.

1. **Establish a common heat trigger.** The first step is to define the signal that activates both income support and workplace protections. IMD heatwave declarations already provide a basis for this. Adding a wet bulb globe temperature threshold for workplace measures, together with a higher threshold at which outdoor work should be suspended can produce a trigger that activates both workplace protections and cash support.

2. **Pilot the heat-triggered cash transfer.** Piloting the proposed transfer in Ajmer, Delhi and Agra, targeting the poorest heat-exposed workers through the e-Shram register and DBT system would test the trigger, targeting mechanism and payment systems before wider scale-up. Niti Aayog is well placed to convene such a pilot, with implementation led by state governments, the National Disaster Management Authority and the Ministry of Labour and Employment.

3. **Strengthen the legal framework for heat protection.** This includes amending the Occupational Safety, Health and Working Conditions Code to include enforceable heat thresholds and associated workplace protections, with coverage based on heat exposure rather than establishment size; and recognising heatstroke and other heat-related illnesses under the Employees' State Insurance framework. Responsibility for enforcement should sit with the code's inspector-cum-facilitator.

4. **Invest in access to health and food entitlements.** Mobile enrolment camps, facilitation desks, portability support and strengthened service delivery should be concentrated along the migration corridors where heat-exposed workers live and work. These investments are modest in cost and build on already-funded schemes.

5. **Agree the financing model.** A layered approach — with direct public funding to support the recurring losses associated with normal and severe heat seasons, and parametric insurance for exceptional years when costs spike — combines the efficiency of direct transfers with the risk-sharing benefits of insurance.

6. **Extend protection beyond the workplace.** Our findings show that heat exposure does not end when the working day ends. Ensuring future heat responses extend beyond workplaces to include investments in cooling, water, sanitation and housing conditions in the informal settlements where heat-exposed workers live would offer workers cooler homes with adequate water and sanitation, allowing them to rest and recover from heat exposure at work.

7

Conclusion

This study has shown that heat exposure imposes substantial costs on workers, their households and the wider economy. In the 13 highest-exposure states alone, workers lose billions in wages each year, while millions face worsening health, rising debt and a widening gap between what they earn and what they need to live with dignity. Yet the systems needed to reduce these losses largely already exist. The Aadhar Bharat-linked registers are in place. The Jan Dhan DBT payment systems exist. The health and food programmes are funded. The weather information needed to trigger action is already produced. The challenge is therefore not one of invention, but of coordination. Connecting these systems to heat, activating them before losses occur and extending protection from the workplace into the home would transform heat response from a reactive exercise into a form of anticipatory social protection. The costs to provide this support are modest compared with the losses already being borne by workers. Acting early through existing systems is an economic investment in protecting livelihoods, health and productivity in a warming India.

Appendix 1. Study design and methodology

Site and sample

The study covered Ajmer (Rajasthan), Delhi and Agra (Uttar Pradesh), selected for their high exposure to extreme heat, their large informal workforces and the presence of grassroots organisations and unions able to reach workers who are hard to survey. We surveyed 538 informal worker households: 358 in outdoor sectors (brick kilns, construction and road building) and 180 in indoor sectors (food packaging, garment manufacturing, handloom, marble carving and granite cutting, shoe making and wooden block making). All selected households had an equal chance of inclusion and were grouped by workplace setting to allow direct comparison between the two samples. The India sample forms part of a wider study of more than 700 workers across India and Bangladesh.

Data collection

The household survey was the core instrument. Capturing demographics, income, housing, food security, water and sanitation access, work patterns, physical and mental health symptoms linked to heat, healthcare spending, productivity loss and access to employer or government support, it was supported by:

- Time motion studies, which tracked exertion, work and rest cycles, and changes in productivity during periods of extreme heat
- Self-reported health risk scoring tools, which recorded symptoms of heat-related illness, dehydration, fatigue and anxiety
- FGDs with men, women and young workers, which drew out subjective experience, coping strategies and perceptions of fairness
- KIIs with employers, contractors, doctors, health workers, union leaders and municipal officials, which examined barriers to and opportunities for institutional action, and
- In-depth family case studies, which documented how the effects of heat accumulate across a season for a household, impacting on income stability, children's schooling, health and so on.

The following local grassroots organisations and unions undertook fieldwork:

Data collection partners in India

- Change Alliance
- Ideal Youth for Revolutionary Changes, Delhi
- Community for Social Change and Development, Delhi
- DISHA-RCD social service society, Ajmer
- Uttar Pradesh Gramin Mazdoor Sangathan, Agra

Unions/Grassroots organisations consulted in FGDs/KIIs

- Uttar Pradesh Gramin Mazdoor Sangathan, Agra
- Uttar Pradesh Gramin Shiksha Sansthan, Agra
- Jan Sahas, grassroots NGO, New Delhi (focused on labour rights and social security for informal workers)
- Centre for Labour Research and Action, grassroots NGO, Ajmer (working primarily with migrant and informal labourers)

Government departments consulted in FGDs/KIIs

- District Labour Department in Agra
- District Labour Department in Ajmer

The trust established with workers allowed candid responses, reflected in the quality of the data collected via the survey, FGDs and case studies.

Clinical input

A panel of three doctors advised on the survey tools, questions asked and analysis, and reviewed our findings. Local health professionals — including general practitioners, urban health workers and community health volunteers — at each site took part in KIIs and helped validate the symptoms workers reported, strengthening the health risk scoring. Their clinical perspective on the recurring health effects of heat, patterns of diagnosis and the difficulty of providing care to informal workers also informed the recommendations.

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Knowledge Products

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Extreme heat is imposing a large and rising burden on India's informal workers, who face continuous exposure both at work and at home. Rising temperatures are reducing productivity, eroding incomes, worsening health and deepening poverty. Yet most of this burden goes unaccounted for, because conventional assessments rarely capture it. This report measures that burden and sets out what it would take to reduce it. Using the Comprehensive Climate Impact Quantification (C-CIQ) toolkit and a survey of 538 informal worker households across three heat-exposed cities — Agra, Ajmer and Delhi — we examine how heat affects workers both at work and at home, quantify the resulting economic and non-economic loss and damage, and assess the policy responses needed to protect those most exposed.

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