

Rising Temperatures, Deadly Threat:

Recommendations to Prepare Outdoor Workers in Ahmedabad



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www.nrdc.org

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INTRODUCTION

Higher daily peak temperatures and longer, more intense heat waves are becoming increasingly frequent globally due to climate change.¹ Recent recognition in scientific and social circles of the growing threat of global warming has focused the attention of governments, research institutions, and academia on its severe economic and environmental impacts. Less attention, however, has been given to climate change's effects on the health and quality of life of the worldwide labor force.² In a changing climate, occupational exposure to heat poses particular health-endangering problems.³ In India, extreme heat events already have a significant impact on this vulnerable group since summer temperatures are historically high. Targeted policy interventions on multiple levels are needed to reduce the devastating health effects of heat stress on outdoor laborers in India and to increase resilience in local communities to rising temperatures.

Through the Ahmedabad Municipal Corporation (AMC), Ahmedabad is leading as the first Indian city to create a comprehensive early warning system and preparedness plan for extreme heat events. The Indian Institute of Public Health (IIPH), Public Health Foundation of India (PHFI), Natural Resources Defense Council (NRDC), Mount Sinai School of Medicine, and Rollins School of Public Health at Emory University have partnered with the AMC to protect and prepare Ahmedabad for extreme heat events. This brief is one of four published to provide specific recommendations for leading stakeholders and the most vulnerable residents who will be impacted by extreme heat: key government agencies, health care professionals, outdoor workers, and slum communities.

Ahmedabad Snapshot

One of India's fastest-growing cities, Ahmedabad is the economic center of the state of Gujarat. The Ahmedabad district, including the surrounding suburban and rural areas, is home to 7.2 million people.⁴ Ahmedabad is predicted to be one of the world's 19 fastest-growing urban areas in the coming decade, according to Forbes magazine.⁵

The city is located in the arid northwest region of India, where warm, dry conditions are conducive to heat waves. While summer is defined as spanning March, April, and May, Ahmedabad's hottest temperatures can run from March through June, with temperatures generally peaking in May and warm days through November.⁶ Ahmedabad's average monthly maximum summer temperature from March through June is 38.8°C (101.8°F); in winter, November through February, the average monthly high is 28°C (82°F). The average monthly minimum temperature is 24°C (75°F) in the summertime and 15°C (59°F) in the winter.⁷ Temperature peaks in Ahmedabad can be extreme, as experienced during the May 2010 heat wave when the temperature spiked to 46.8°C (116°F).

REDUCING EXTREME HEAT VULNERABILITY IN AHMEDABAD

During the historic May 2010 heat wave in Ahmedabad, temperatures reached 46.8°C (116°F). Estimated daily mortality rates increased substantially during the heat wave.⁸ IIPH and NRDC are further investigating this extreme heat period to better understand its effects on the health of Ahmedabad's population. With climate change fueling higher temperatures in Ahmedabad and elsewhere, a new scale of coordinated action among municipal and other government agencies is needed to address and prevent the harmful health effects of heat stress. It is critical to first identify which populations are most vulnerable to extreme heat, including their places of residence and work. It is also necessary to identify and prioritize policies and programs to address current and projected future health risks. In addition to these assessment steps, creating and maintaining collaborative systems within the different government departments (e.g., emergency response, emergency management, health agencies, and meteorological services) is essential to ensure streamlined coordination of existing services, create successful early warning communications, promote data sharing and health education, and identify service gaps, as a foundation for an effective early warning system before extreme heat events.



Construction workers exposed to direct sun at noon, March 2012.

OUTDOOR WORKERS' VULNERABILITY TO EXTREME HEAT

In the city of Ahmedabad, outdoor and construction workers have increased exposure to extreme heat and are susceptible to its negative health effects. The recent construction boom in this fast-growing city, particularly in the New West Zone, has caused a surge in migrant worker populations to meet labor demands. These populations are extremely vulnerable to illnesses related to heat stress as they perform heavy labor outdoors.

The physical stress associated with this type of work leads to heightened physiological responses to heat.¹⁰ The combination of heat exposures specific to outdoor laborers, in addition to other vulnerability factors, makes occupational exposures to heat especially dangerous. Identifying the specific factors that increase exposure and vulnerability to extreme heat is necessary to craft targeted recommendations to build resilience to future heat events.

Heat Stress Symptoms and Impacts

If high work intensity is maintained in workplaces with high heat exposure, serious and even deadly health effects can occur. At-risk occupations include construction workers, rickshaw drivers, street vendors, factory, kiln, quarry, and kitchen workers.

Signs and symptoms of heat-related illnesses include:⁹

- Heat cramps, edema (swelling), and syncope (fainting). These conditions are accompanied by fevers generally under 39°C (102°F) and are readily treatable; however, they are important warning signs to immediately move the affected individual to a cool location and provide first aid.
- Heat exhaustion, which is marked by fatigue, weakness, dizziness, headache, nausea, vomiting, muscle cramps, and sweating.
- Heatstroke, defined as a core body temperature of 40°C (104°F) or greater, with the presence of altered mental status such as delirium, seizures, or coma. It can be fatal.

Severe long-term health impacts of heatstroke include:

- Renal insufficiency, kidney malfunction and failure.
- Neurological defects, headaches, and blurred vision.
- Cardiac disease, chest pain, and heart attacks.
- Increased mortality risk for years following heatstroke for those who survive.

Increased Exposure to Extreme Heat

- **Labor Outdoors in Direct Sun or Indoors Without Effective Cooling:** Daily heat exposure during hot weather is particularly dangerous for people working in jobs that cannot be, or are not, cooled by ventilation, air conditioning, or other methods.¹¹ Most outdoor jobs cannot usually provide cooling systems other than natural shade or sheds with fans. The average construction worker often works more than nine hours a day regardless of the climatic conditions with prolonged sun exposure.
- **Protective Clothing:** Occupations requiring protective clothing can exacerbate heat exposure. In Ahmedabad, many workers, particularly women, wear a shirt over their sari or other clothing, hampering the cooling effect of sweat evaporation.¹² Wearing lighter and more breathable clothing can help reduce the impacts of extreme heat because it allows the body's natural cooling systems to function better.¹³

- **Urban Heat Island Effect:** The densely built urban environment creates hotter temperatures than its rural surroundings due to many factors, including high traffic and heat-trapping materials like concrete and black tar. Heat island effect is associated with negative health impacts such as increased mortality rates and hospital asthma admissions.
- **Industrial Sources of Heat:** Many workplaces contain an industrial source of heat, such as a factory furnace, further impacting workers.

Greater Susceptibility to Health Effects of Extreme Heat

- **Heavy Physical Stress:** Physical labor and work activity, such as in agriculture, mining, construction, and manufacturing, induce high heat production in workers' bodies.¹⁴ Heat cannot easily be released from the body in hot working environments, causing a rise in body temperature and subsequent illness. Laborers have to slow down their work in order to reduce body heat production and the risk of heatstroke. Thus, unless preventive interventions are used to reduce workers' heat stress, their personal health and productivity will be affected and economic output will be reduced.
- **Lower Income:** Poorer laborers without access to household or workplace cooling devices, such as fans, have a higher susceptibility to negative health effects from extreme heat. Low income also results in less access to, and means to afford, potable water, good sanitation, reliable transportation, and medical care.
- **Public Misperception:** Supervisors and workers often misperceive heat stress caused by outdoor labor as a “natural phenomenon”—something individuals simply need to cope with—despite evidence to the contrary and technical and administrative solutions to develop better and more effective prevention approaches. In addition to supervisors who are unaware of, or not sensitized to, the dangers of extreme heat exposure, outdoor laborers (such as construction workers) may also lack awareness of the dangers of heat stress.

Few Adaptation Options

- **Organizational Factors:** Insufficient rest, increased physical activity at the hottest times of the day, dehydration, and a lack of variation in the duration and frequency of physical activity based on environmental conditions impede adaptation strategies employed by individual workers.¹⁵
- **Lack of Control Over Work Environment:** A lack of control over the work environment—including access to air conditioning or nearby cooling spaces during the hottest times of day—reduce outdoor workers' opportunities to adapt to increasing temperatures.



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An outdoor laborer wearing a protective head covering in Ahmedabad, July 2012.

Climate Change and Occupational Heat Exposure: Current Knowledge

Outdoor laborers are widely affected in tropical and subtropical countries, where these sectors make up a large proportion of the workforce. Many of these workers, especially in small- and medium-scale enterprises and informal work situations, work outdoors in largely uncontrolled environments that are subject to extreme levels of heat stress. Construction work in particular is conducted almost completely outdoors without any forced ventilation system and involves a very heavy workload, putting laborers at great risk of developing illnesses related to heat stress. Despite these facts, few attempts have been made to study the impacts of occupational heat stress-related exposure in different sectors, particularly in developing countries like India.

Climate change will lead to a significant increase in heat exposure during the hot seasons in most parts of India, where heat in outdoor work and indoor work lacking ventilation or air conditioning already causes significant heat stress. Heat stress causes health risks, a decrease in worker productivity, increased irritability, increased risk of accidental injury in workplaces, and—when severe—heatstroke and death, negatively impacting family income and the community economy.¹⁶ Several studies have identified heat stress as an important health risk in agricultural and industrial sectors in India.¹⁷ The major industries studied so far include automotive, coal mines, ceramics and pottery, ironworks, stone quarries, and textiles, leaving many other occupational sectors, such as construction, to be analyzed.¹⁸



Ahmedabad residents working in the shade, July 2012.

What Defines a Heat Wave in Ahmedabad?

The Met Centre currently determines whether to declare a heat wave once the daily maximum temperature exceeds 40°C (104°F).²⁰ A heat wave is declared if the normal maximum temperature should be 40°C or lower and the forecast maximum temperature is actually 5°C to 6°C above normal; it is also declared if the forecast maximum is higher than 45°C (113°F) regardless of the normal maximum. A severe heat wave is declared if the forecast maximum temperature is 7°C higher than the normal maximum.²¹ A heat wave is forecast 48 hours in advance and can be declared for a single day.²²

HEAT HEALTH SURVEY METHODOLOGY FOR CONSTRUCTION WORKERS IN AHMEDABAD

An assessment of construction workers was conducted in 2011 and 2012 by IIPH and NRDC and as part of a M.P.H. thesis by Ajit Rajiva (advised by Dr. Vidhya Venugopal) in the department of environmental health engineering at Sri Ramachandra University in Chennai. The survey was done in collaboration with Mount Sinai School of Medicine and Rollins School of Public Health at Emory University.

The study used a cross-sectional design including defined groups of workers with high heat exposure at work who were studied at least twice. For each worker, the reported health status and perception about work output/productivity during hot and cooler days of work were compared. Potential target groups were adults in occupations vulnerable to heat exposure who (i) work outdoors in hot sun, and (ii) perform work that requires high physical activity. One hundred

workers from four construction sites in the New West Zone of Ahmedabad (see Figure 1 for a map of site locations) whose work activities are similar during hot and cool periods were selected. Sampling of construction workers, including (but not limited to) laborers, masons, quarrymen, electricians, and plumbers, was conducted on the basis of convenience among workers who could speak and understand the language/languages spoken by the interviewer.

The following data were collected:

- Climate outdoors at the location, including outdoor and indoor average air temperature and humidity.
- Daily work schedule, including start and finish times of work each day, the type of work carried out, the length of breaks, the common means of travel to work, and travel time.
- Self-reported health effects (description of illness and symptoms).
- Perceptions of heat stress, health effects, and productivity.

SURVEY FINDINGS: CONSTRUCTION WORKERS' PERCEPTION OF, AND VULNERABILITY TO, EXTREME HEAT EXPOSURE

- **Every construction worker surveyed who worked the afternoon shift was found to be exposed to occupational heat stress conditions at levels above what is considered safe for the intensity of work performed**, regardless of whether the work was being carried out indoors or outdoors.²³ Additionally, working outdoors in the afternoon yielded the greatest occupational heat exposure compared to working indoors at the same time, despite no appreciable difference in actual indoor and outdoor temperatures.
- **During Ahmedabad's hottest months (from March through June), workers often reported experiencing the effects of heat stress in their workplace.** Although 80 percent of the surveyed workforce was already acclimatized to the work at hand, the remaining 20 percent (new workers) was more vulnerable to heat stress initially.
- **Among workers, the most common complaint related to heat stress was the loss of productivity.** Other major issues posed included interpersonal issues and absenteeism. Workers self-reported missing work due to excessive heat for an average of 11 days per year, amounting to a loss of about 2,915 INR (\$53.26) per year from heat—a significant amount given that these workers earned an average of 265 INR (\$4.84) a day.²⁴

Figure 1: Work Sites in New West Zone of Ahmedabad Selected for Heat-Health Survey



SITE 1: Houses 15 & 16, Ornet - II, Sindhu Bhavan Road, Shilaj

SITE 2: Unnamed residential complex, Bopal Shilaj Road

SITE 3: Neptune offices, behind Rajpath Club, off SG Highway

SITE 4: K-18, New Avalon Hotel, Thalje

Source: Google Maps.

■ **10 percent of those surveyed were hospitalized at least once during the summer for heat-related issues.**

Workers reported that excessive sweating and fatigue were the most common symptoms experienced while working in hot conditions, followed by muscle cramps and fainting. Other symptoms such as dizziness, headaches, and prickly heat were also reported.

■ **50 percent of those surveyed wore thick cotton clothing for work, which generally increases the effects of heat stress by 3.5°C (6.3°F).²⁵**

Additionally, workers who were exposed to high heat in the workplace were generally not provided with a protective uniform to wear on-site. Traditional garb worn by men in Gujarat may be too heavy to be appropriate in the workplace, but few workers believed it should be the contractor's duty to provide them with suitable attire for the season.

SURVEY FINDINGS: CONSTRUCTION WORKER COPING MECHANISMS

Surveyed workers adopted straightforward coping mechanisms during excessive summer temperatures:

- 70 percent of workers reported that drinking more water helped them cope with the heat.²⁶
- 8 percent of workers were comfortable removing layers of clothing to work in the heat.
- 24 percent of workers would rest in a shady area until temperatures became tolerable.
- 75 percent of workers claimed they had no particular diet for the summer season. Of the 25 percent of workers who reported a dietary change during the summer months, the most common responses were that they would consume less meat and eat smaller portions. They also reported consuming more cold beverages, particularly buttermilk (*chaas*).

Occupational Studies

Leading researchers are conducting surveys of employees' perceptions of safety and health in the work environment. These surveys include:

■ **HOTHAPS:** The High Occupational Temperature Health and Productivity Suppression program is a multicenter health research and prevention program aimed at quantifying the extent to which working people are affected by, or adapt to, heat exposure while working, and how global climate change may increase such effects.²⁷ This project thus aims to chart heat exposures among construction workers, including many migrant workers, and to report the impacts of heat stress on this population using the methods described in the HOTHAPS program.²⁸

■ **Taiwan Institute of Occupational Safety and Health:** Since 1988, the Taiwan Institute of Occupational Safety and Health has surveyed workers via questionnaires every three years. The most recent survey of 19,000 workers found that 42 percent of employees perceived a risk of excessive heat at the workplace. The proportion who perceived such risk was particularly high in the construction industry (76 percent), as well as agriculture, forestry, and fishing (71 percent).²⁹

RECOMMENDATIONS: BUILDING OUTDOOR LABORERS' RESILIENCE TO EXTREME HEAT

Coordinated early action by government, labor groups, local employers, health care providers, and community stakeholders is one of the most effective ways to reduce workers' vulnerability to heat and protect human health from its effects.³⁰ Based on the 2012 Ahmedabad construction worker survey and our research and analysis with local partners over the past two years, we have identified several recommended strategies to protect outdoor laborers (e.g., construction workers, rickshaw drivers, street vendors, traffic police, factory, kiln, quarry, and kitchen workers) in Ahmedabad from increasing temperatures. These strategies require education, local employer actions, and municipal policies.

EDUCATIONAL ACTIONS: In coordination with AMC, local labor organizations, local businesses and employers, and the health sector, the following educational strategies could improve worker awareness of, and coping mechanisms to deal with, the negative health impacts of extreme heat:

■ *Educate laborers and workers whose occupations require intensive work outdoors during extreme heat about the risks, signs, and symptoms of heat stress.* Specifically, organize a training and educational workshop on recognizing and reacting to extreme heat using AMC's Heat Vulnerability Reduction Communication Strategies.

- *Encourage hydration by drinking water and replenishing the body's salt and electrolyte content.* Spiced buttermilk, or *chaas*, is excellent at replacing lost electrolytes.
- *Encourage adoption of behaviors that mitigate heat stress.* For example, workers should eat less, but more frequently. Consumption of alcohol and/or caffeinated beverages increases core body temperatures and increases diuresis, thereby increasing the risk of heat stress. Smoking and chewing tobacco have also been shown to cause similar effects and should also be discouraged.
- *Encourage workers to seek medical attention if heat-stress-related discomfort persists.*
- *Foster an awareness of the side effects of certain medications (e.g., certain diabetes and hypertension drugs) and lifestyle choices (drinking, smoking, etc.) that can affect the body's ability to self-regulate when overheated.*
- *Implement a "buddy system" in which each worker is charged with recognizing the onset of illness in others so that early intervention is possible.*

LOCAL EMPLOYER ACTIONS: In addition to the educational strategies outlined above, local employers and businesses can individually make the following changes to reduce outdoor laborers' vulnerability to heat stress:

- *Adopt work shift policies to avoid outdoor work during the dangerous afternoon shift to protect laborers from developing heat-stress-related illnesses and increase worker productivity.*³¹ Construction workers should be allowed to perform the majority of their work in the early morning and late evening, particularly during the hottest summer months of May and June. Alternatively, workers should be allowed to focus their work indoors during the afternoon shift, thus escaping the intensity of the summer heat.
- *Recommend that unessential travel or work be avoided altogether during the hottest predicted days* to limit occupational exposure during heat waves. AMC can work with municipal labor departments and related stakeholders to notify employers ahead of predicted heat waves (see AMC communication recommendations described below).
- *Schedule breaks if the heat becomes too intense* on a given day. Employers can adopt a company-wide policy to encourage these breaks when necessary.
- *Encourage workers to wear light summer clothing such as thin, breathable cotton* while on the job to decrease vulnerability to heat stress during work. If uniforms are provided, ensure the material is suitable for the hot climate and work environment.
- *Provide water, or ensure its availability, at the workplace.* Although most surveyed workers drank water while at construction sites, it was personally collected for individual use rather than provided by contractors.

- *Explore the use of mechanical assistance in the workplace* (dollies, hoists, cranes, etc.) to reduce the physical demands of tasks on the workforce.
- *Incorporate an acclimatization period for new workers.* Allow new workers to get used to the hot outdoor work environment by starting them with 50 percent of the workload for the first few days, then gradually increasing until they can work at full capacity in the hot environment.

MUNICIPAL GOVERNMENT ACTIONS: Ahmedabad's municipal government has a leading role to play in developing an early heat warning system and helping its vulnerable residents adapt to rising temperatures. The Ahmedabad Municipal Corporation and related municipal labor and transportation departments can also adopt the following strategies to build outdoor workers' resilience to increasing temperatures.³²

Labour and Employment Department

- *Incentivize cooling practices for local businesses.* AMC can create incentives and supplemental requirements for local businesses employing outdoor occupational workers, particularly slum residents, to provide cool water, shade, and rest periods in cool areas.
- *Improve labor law enforcement and coordination.* Although some labor laws and other safeguards currently exist to protect workers, including site visits from labor officers and sanitary inspectors, the number of inspectors and protections could be bolstered to protect workers exposed to high-heat situations in Ahmedabad. The number of government officials and inspectors overseeing construction sites, quarries, factories, and other vulnerable work sites could also be increased, particularly during high-temperature periods, to enforce such labor laws related to heat safety.
- *Coordinate enforcement between the state and central government jurisdictions* that share responsibilities for implementing labor laws to help alleviate heat stress on workers, particularly during heat waves.

Municipal Transport Services

- *Install additional traffic booths or covered boxes for traffic police* to stand in during their shifts in hot weather, and equip traffic police with oxygen.³³
- *Implement shorter and flexible shift times for traffic officers* to protect them from exposure to extreme heat. Use cameras for stringent enforcement of rules at traffic signals to reduce the number of police who must regulate traffic at road intersections.

- *Ahmedabad Municipal Corporation Communication Strategies.* As laid out in the related issue brief regarding the role of Ahmedabad's local government ("Rising Temperatures, Deadly Threat: Recommendations for Government Officials in Ahmedabad"), the AMC and related departments should also enact an effective early heat warning system citywide. Vital strategies include communicating early heat warnings, delivering heat and health information, and providing cooling opportunities through water supply and shaded locations.
 - *Install temperature and forecast displays.* Working with the Meteorological Center, Ahmedabad could publicly display temperature and weather forecasts to warn people so unessential travel or work can be avoided on the hottest predicted days. High-traffic locations where most people can view the information and highly vulnerable sites where the possibility of the heat island effect is magnified due to lack of trees, dense vehicle traffic, large amounts of paved area, and local heat-generating sources should be prioritized.
 - *Issue early heat warnings.* Ahmedabad can identify community leaders and neighborhood "gatekeepers" to disseminate heat warnings and information in low-income communities, including slums. When a heat wave or extremely hot weather is forecasted, these trusted individuals could help activate community networks to warn residents and also provide information on how individuals can protect themselves. AMC and partner stakeholders can promote and coordinate public service announcements via television, radio, newspapers, and text messages, ideally at least two to five days ahead of forecasted heat waves.
 - *Mount media information campaigns.* AMC can work with local press and media outlets to kick off a media campaign delivering important health and heat information. This campaign can focus on newspapers, radio, and television outlets, which should be encouraged to provide low- or no-cost space in their venue for public interest announcements. These campaigns could include tips to stay cool, how to prevent getting sick from heat, and what to do in the event of extreme heat advisories. Telephone companies can also play an important role in sending text messages as alerts.
 - *Distribute informational pamphlets.* AMC can work with the health department to create pamphlets on heat stress prevention in English, Gujarati, and Hindi to distribute to hospital staff, labor unions and professional associations serving at-risk occupations, community groups (with a focus on slum neighborhoods), and schools.³⁴ An initial pamphlet for the general public with tips and illustrations was circulated in English and Gujarati during Ahmedabad's hottest months in 2012 (see Figure 2).



Covered booth for traffic police in Ahmedabad, March 2012

- *Establish a “heat line” call center.* AMC can create a free telephone call center to support the public during heat waves, and publicize the service at construction sites, other at-risk workplaces, and within slum communities. The heat line could have an information system to provide guidance to heat stroke victims and tips on heat stress prevention. The Met Department currently has a phone line that periodically provides temperature information, but it is not widely operational.

ADDITIONAL STUDIES: Concerned parties should follow up on this first heat health study of construction workers, glean more information from at-risk workers in Ahmedabad to better tailor future recommendations for avoiding the health effects of extreme heat in the workplace.

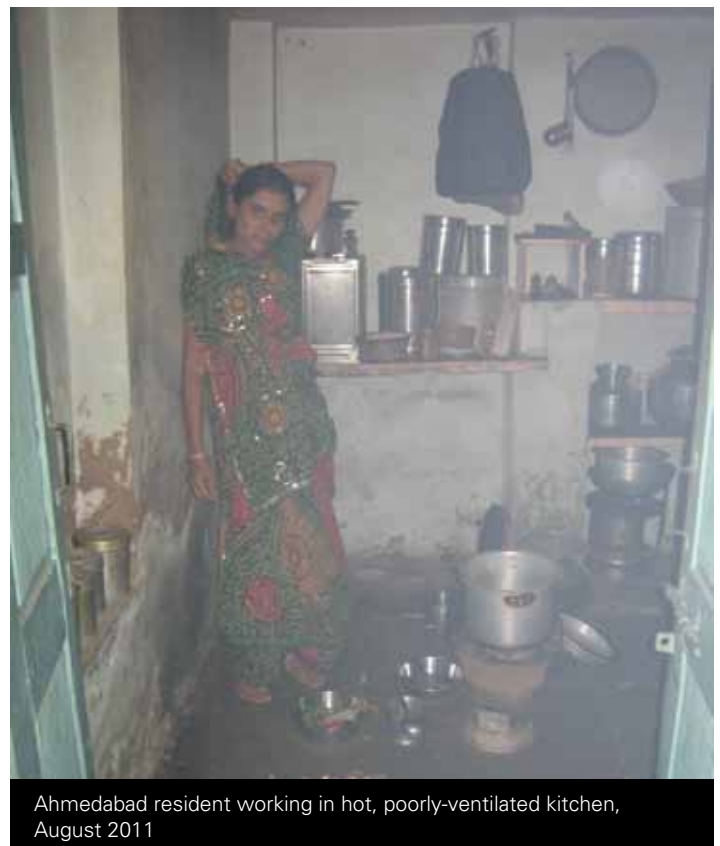
- *Conduct an additional study evaluating the impact of heat stress on women in the workplace.* Women make up 25 to 30 percent of the average construction workforce, but only 10 percent of workers surveyed were female.³⁵ Additionally, women in poorly-ventilated kitchens and working near other indoor heat sources are also at risk for occupational heat stress.
- *Conduct future surveys to extend to other occupational groups at risk for high heat stress,* including traffic policemen, bus drivers, rickshaw pullers, and street vendors. Develop targeted recommendations for these outdoor laborers as well.

Figure 2: Informational pamphlets with tips on keeping cool in Gujarati (left) and English (right), circulated to the public during Ahmedabad's hottest months in 2012



CONCLUSION

In the arid northwest region of India, extreme heat events already have had a deadly impact on Ahmedabad's population. Outdoor laborers, including construction workers, are more exposed to extreme heat, and more susceptible to heat's effects on health, and they have fewer adaptation options available. With peak daily temperatures and the frequency and intensity of heat waves predicted to increase with climate change, targeted policy interventions coordinated across multiple levels are needed to reduce the devastating health effects of heat stress in India. Under the Ahmedabad Municipal Corporation, Ahmedabad is leading as the first Indian city to create a comprehensive early warning system and preparedness plan for extreme heat events, but more remains to be done. This report's recommendations aim to increase this vulnerable population's resilience to rising temperatures within Ahmedabad. Looking ahead, these strategies for mitigating the effects of extreme heat can be adapted for other at-risk workers and for other regions within and beyond India, helping to protect outdoor workers from the increasingly severe effects of climate change.



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- 22 Discussion at the Heat-Health Roundtable with representatives from the Met Centre, NHL Municipal Medical College, Health and Family Welfare Department, IIPH, and NRDC, Ahmedabad, September 2012.
- 23 This conclusion was reached by calculating the heat stress exposures each worker and comparing to Threshold Limit Values as determined by international industrial hygiene standards.
- 24 61 percent of all workers interviewed responded that they had lost wages from heat exposure and stress at some point during summer. The average worker earns about 265 INR (\$5.10) a day from a job at a construction site.
- 25 Determined from international industrial hygiene standards. This conclusion was reached by calculating the heat stress exposures each worker and comparing to Threshold Limit Values as determined by international industrial hygiene standards.
- 26 The average amount of water consumed by each worker was 4.53 liters per day.
- 27 The HOTHAPS program aims to produce essential new evidence for local, national, and global assessment of negative occupational impacts of climate change that have largely been overlooked. It also hopes to identify and evaluate preventive interventions in different social and economic settings. The HOTHAPS program includes studies in any part of the world where hourly heat exposure exceeds physiological stress limits and may affect workers. This usually happens at temperatures above 25°C (77°F), depending on humidity, wind movement, and heat radiation.
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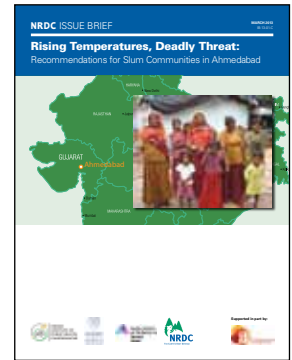
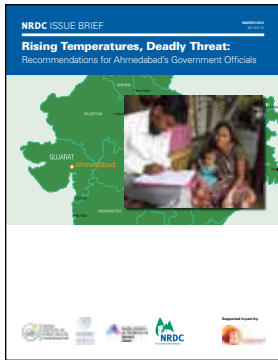
31 According to the heat health assessment data, every construction worker on the afternoon shift experienced occupational heat stress conditions above the threshold limit value assigned to their given situation.

32 The AMC provides and administers a number of other institutions that are relevant to a heat adaption system, including the Ahmedabad Urban Development Authority, Municipal Transport Services, Labour and Employment Department, and Municipal Corporation Water Project Department. The AMC also operates civic centers where citizens can transact business with government entities, municipal libraries, swimming pools, and schools. See "Citizens" tab, Ahmedabad Municipal Corporation, www.egovamc.com/home.aspx.

33 Higher temperatures can dramatically worsen ground-level ozone smog concentrations, especially for traffic police who work in high-ozone areas.

34 Providing written materials raises literacy issues. Developing alternative approaches to communicate with the illiterate population warrants further discussion, but this issue is beyond the scope of this report.

35 The survey monitoring teams were entirely composed of men, potentially making women less likely to engage in conversation.



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