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Assessing Vulnerability to Extreme Heat Among Residents of Urban Slums in Ahmedabad, India

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Assessing Vulnerability to Extreme Heat Among Residents of Urban Slums in Ahmedabad, India

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2009

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An abstract of
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Abstract

Assessing Vulnerability to Extreme Heat Among Residents of Urban Slums in Ahmedabad, India

By Kathy Tran

India is expected to face increasingly frequent extreme weather events as a consequence of climate change. Extreme heat events may have particularly significant impact since summer temperatures are historically high. Little is known regarding factors that may drive population vulnerability to extreme heat as well as strategies for minimizing heat exposure and susceptibility in this rapidly developing nation. To facilitate public health preparedness for extreme heat, an assessment of factors affecting vulnerability was conducted in summer of 2011 in Ahmedabad, Gujarat, India, a city where seasonal highs have reached 46.8°C. The study focused on factors that affect heat exposure, susceptibility to heat related illness, and adaptive capacity, all of which feed into vulnerability to heat. Indicators of these factors were identified through literature review and expert opinion and assessed through a cross-sectional household survey. The survey used randomized multistage cluster sampling to identify target households in thirteen urban slum populations in Ahmedabad. This population was presumed by local public health authorities to be particularly vulnerable and have greater susceptibility and less resilience to extreme heat exposure. Associations between heat-related morbidity and individual and household demographics, medical history, access to weather warnings and health information, and social connectedness were determined. Findings were summarized through descriptive statistics of demographics, exposure, susceptibility, adaptive behaviors and outcomes. Multivariate logistic regression was performed with Generalized Estimating Equations using an exchangeable covariance matrix to account for clustering effects at the household and slum levels to test the various associations between outcomes and covariates. Results indicated that age, income, preexisting conditions, work location, drinking water sources, access to doctors and information, and social connectedness influence the occurrence of heat-related symptoms and illnesses among slum dwellers. These findings suggest several potentially worthwhile interventions targeting slum dwellers including: working with community health workers and physicians to disseminate information and prevent heat illnesses as well as delivering important health and heat information through television campaigns. Future research studies might include conducting other heat vulnerability studies with improvements to the survey used here, conducting focus groups, and evaluating the effectiveness of currently applied adaptive behaviors and future interventions.

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1 Background

India is a rapidly developing country with a host of environmental health concerns, climate change among them[1]. The incidence of weather-related illness in India is not known, but historically weather-related disease, particularly heat illness, has been a significant public health issue[2]. Several other prevalent diseases such as malaria and diarrhea are known to be climate-sensitive[2-3]. Despite this, there has been relatively little work exploring population vulnerability to weather-related illness in India. As elsewhere, climate change is expected to bring warmer temperatures and increasingly frequent and severe heat waves to India[4]. Given the vulnerability of the Indian population to these hazards, the issues affecting heat exposure and strategies to reduce the incidence of heat-related illness are of increasing interest and concern.

1.1 Vulnerability

Extremes of heat and cold are natural hazards. Vulnerability to natural hazards has several components and is a function of biophysical and socioeconomic determinants. It can be broken down into factors associated with the probability of the hazard's occurrence as well as factors associated with population exposure, susceptibility, and adaptive capacity.

Exposure refers to the degree to which the unit of analysis (e.g. a person, a household, a city, or other population) is physically exposed to the hazard and associated effects. Exposure can be affected by a hazard's type, magnitude, and variability as well as insulating factors (e.g. air conditioning, levees), amplifying factors (e.g. poorly ventilated buildings that retain heat), and behaviors (e.g. moving to a cooler location during hot periods)[5-6]. Susceptibility relates to the effect that exposure has, and includes population characteristics, such as demographics (e.g. age) and underlying health status of the population (e.g. obesity prevalence)[5]. Adaptive capacity is the ability or potential of a population to make changes in response to actual or expected hazard shifts (e.g. climate change) in order to cope with or reduce the burden of specific health outcomes[5-7].

To provide background to our study approach and to better organize our discussion on vulnerability to extreme heat in India, we have organized our introduction around these areas. We will first explore the hazard by briefly reviewing India's climate including recent shifts and associated trends in extreme heat events. Next we will consider factors that are known to affect heat exposure generally, focusing on exposure factors specific to India where possible. We then review factors conferring susceptibility to heat illness among the exposed, again focusing on India where specific information is available. Finally we consider factors affecting adaptive capacity.

1.2 Historical Hazard Distribution – India's Climate

A variety of climatic regions characterize India. Regions range from temperate, alpine in the Himalayan north to arid, semi-arid in the west and parts of the south to sub-tropical, tropical in the central, east and coasts[8] (Fig. 1). Due to the climatic variations and topological differences, the Indian Meteorological Department (IMD) has divided India into seven homogenous regions for meteorological analysis (Fig. 2)[8]. IMD has also officially designated four seasons: winter (December – early April), pre-monsoon or summer (April – June), monsoon (June – September), and post-monsoon (October – December). Because the Himalayan states far north are temperate, they also experience spring and autumn and temperatures are typically lower than other regions[8]. Summer temperatures are the highest across the entire country, with averages between 30°C-35°C in most of the interior[8]. Daily maximum temperatures reach about 40°C in many locations, and exceed 45°C in some north and north-west regions[8].

1.2.1 Recent Climate Shifts

India has seen an increase in annual mean temperatures above historical normals since 1990[8] (Fig. 3). Temperature trends have corresponded with those assessed by the Intergovernmental Panel on Climate Change (IPCC) as a consequence of climate change, with an

increase in hot days and hot nights as maximum and minimum temperatures increase[9]. Between 1901 and 2009, the annual mean temperature for India as a whole rose by 0.56°C[8]. Maximum and minimum temperatures have been steadily rising since 1990[8]. However, temperature minima have increased at a faster rate than maxima[8]. Accordingly, hot nights have increased while cold nights have decreased across all of India[10-11]. Significant trends with increasing hot nights and seasonal pre-monsoon minimum temperatures have especially been observed in three homogeneous region (i.e. Northwest, East Coast, and West coast) in recent years (1971-2003)[10] (Fig. 2).

Temperature trends in Gujarat state, located in the Northwest region, have coincided with that of India based on a study by Ray et al.[12]. The 30-year moving averages of both mean maximum and minimum temperatures over Gujarat showed an overall increase of 0.11°C in the past 40 years (1969-2005) (Fig. 4). Cold waves have decreased considerably over the past decade, more significantly in some cities than others, leading to an increase in minimum and night temperatures. For example, the cities of Saurashtra and Kutch had an average of 103 cold waves between 1969 and 1971, but only 13 between 1999 and 2008. Minimum temperatures rose higher in the winter months than in other months of the year[12]. An overall increase of less than one degree across a century appears minimal but could have significant implications for public health, as shifts in average temperature are also accompanied by shifts in the frequency and severity of extreme heat events.

1.2.2 Recent Shifts in Extreme Heat Events

The IPCC has assessed that it is *very likely* that extreme heat events, or heat waves, will increase in frequency, intensity and duration[13]. It is unclear whether this increase in India will be uniform across the country; while India has experienced an overall increase in temperatures across the entire country, heat wave incidence and severity have also varied by region. The IMD declares heat waves and their severity depending on how much temperatures exceed historical normals. In areas where normal maximum temperatures are below 40°C, an exceedence of 5-6

degrees is a moderate heat wave and 7 degrees or more is considered severe[3,14]. In areas where normal maximum temperatures are 40°C or higher, an exceedence of 3-4 degrees is a heat wave and 5 degrees or above is considered severe[3,14]. Major heat waves occurred in 1998 and 2003 across several states. In 1998, temperatures rose to 45.4-47.6°C across all states[15]. In 2003, heat waves were concentrated in central to southern India, where temperatures soared to 45-50°C (exceeded 50°C in Orissa), almost 9-10°C above normal in several locations[16]. These events resulted in significant public health impacts as noted later.

1.3 Exposure to the Hazard of Extreme Heat

Heat exposure results from both endogenous heat and exogenous sources. Exogenous exposure is amplified by a multitude of sources at the individual, household, and community levels. At the individual level, for example, individuals can be exposed to both exogenous and endogenous heat through occupational activities. In India, work-related heat stress has been studied in those working in the automotive, coal mines, ceramics, pottery, iron works, stone quarry, and textile industries[3]. Workers are exposed to heat through several routes including working outdoors directly under the sun, poorly ventilated workspaces, and working near furnaces[3,17]. Strenuous activities such as carrying large stones and digging also exacerbate environmental and/or occupational heat exposure, leading to heat stress[17]. Nag et al. have shown potential risk of high heat exposure among workers in the ceramics, pottery, iron and stone quarry industries during peak summer months[17]. Similarly, studies in the United States have also shown increased risk for those engaged in heavy labor[18-19]. Additionally, household level heat exposure might include housing characteristics and air conditioner usage[20]. Poorly ventilated spaces like top floor apartments[20-21], building materials with high thermal mass such as brick, and lack of or closed windows have been associated with increased risk of mortality during heat waves[20]. Air conditioner usage has been shown to be protective during heat waves likely by reducing exposure;

those who lack access to an air conditioner are exposed to higher temperatures than those who can access one at home or within their community[5,18-19,20,23-24].

Other community factors that might increase heat exposure are the urban heat island (UHI) effect[18-19,20,23] and lack of green space[20-21,23]. The UHI effect results from dense concentrations of impervious building materials and surfaces that trap more heat during the day and release heat more slowly at night than natural soil and vegetation[18,20]. Therefore, heat waves are expected to have a relatively greater impact on cities since the UHI effect causes urban centers to be warmer than surrounding suburban or rural areas[9,18,20-21,23]. Lack of green space, such as parks and gardens, facilitates the UHI effect since there are not enough trees and vegetation to provide shade and prevent heat from being trapped. Heat exposure is thus increased or decreased at a number of different scales by several different mechanisms.

1.4 Susceptibility to Extreme Heat

Heat stress occurs when the body's capability to dissipate heat and cool down by sweating is reduced[18,22]. Heat-related symptoms and illnesses include:

- Heat edema: swelling of the hands and feet[25].
- Heat syncope: fainting[22,25].
- Heat cramps: muscle spasms, usually in calves, thighs, shoulders[22,25].
- Heat exhaustion: fatigue, weakness, dizziness, headache, nausea, vomiting, diarrhea, muscle cramps, profuse sweating[18,22,25].
- Heat stroke: the most serious and potentially lethal if untreated in a timely manner, results in central nervous system (CNS) dysfunction which includes delirium, seizures, or coma, in the setting of a core temperature of 40°C and above[22,25].

- Classic heat stroke is often accompanied by anhidrosis (lack of sweating); other CNS dysfunctions might be hallucination, cerebellar dysfunction, and bizarre behavior[25].
- Exertional (due to strenuous activity) heat stroke is often typified by profuse sweating, tachycardia (abnormally fast heart rate), hypotension (low blood pressure), tachypnea (rapid breathing), vomiting/diarrhea, and acute renal failure[25]. When the temperature is high, endogenous heat adds to heat burden and can cause exertional heat illness.

Based on mainly mortality studies conducted in the United States and Europe, risk factors that increase susceptibility to heat-related mortality include certain socio-demographic factors, health status, and behaviors. Age[18-24], socioeconomic status (SES)[19-23], gender[19-20], and race[19,23] are fair predictors of heat-related illnesses in populations exposed to extreme heat that have been studied. The elderly (i.e. 60 and older) are less capable of thermoregulation due to disruption of sweating mechanisms and are more likely afflicted by chronic illnesses, disabilities, and susceptible to the effect of medications that may inhibit natural physiologic responses to heat[22]. Infants have higher risk for dehydration since they have higher volume of fluids in their bodies compared to adults[22], and because they are not able to exert control over their environment or to mobilize to protective resources. Those of lower SES often lack access to resources such as air conditioning and healthcare, live in neighborhoods lacking vegetation[23], and have poorer baseline health statuses. Males have been shown to have greater risk[19] as well as ethnic minorities, namely African Americans and Hispanics[19,23]. Chronic diseases and conditions associated with higher risk include respiratory, cardiovascular, cerebrovascular, diabetes, obesity, mental illnesses, and being bedridden[18-24]. Heat increases strain on the cardiovascular and pulmonary systems that can be fatal for those with chronically compromised cardiovascular or respiratory function[18,22]. Certain medications, such as stimulants and beta-blockers, may reduce the body's ability to cope with high temperatures[18-20,22]. Additionally, behaviors including alcoholism[18-19], inactivity[22,24], living

alone[18-24], and social isolation[18,20,23] also increase risk since individuals might lack mobility and/or be unaware of heat wave warnings and/or heat-related symptoms they experience before the symptoms become severe.

Given the moderate variability in susceptibility factors at a population level, susceptibility appears to be driven by a complex mix of physiological and socioeconomic factors that are to some degree place-specific. Currently, only mortality impacts of heat waves have been recorded in India. From 1978-1999, heat waves have claimed tens to thousands of lives each year (wide range due to variability between annual events without specific interannual trends) and have lasted from 2 to 34 days across India[2,14,26], setting several national temperature records. There has been a general upward decadal trend, with 2,098 recorded deaths between 1979 and 1988, 2,441 between 1989 and 1998, and 3,023 between 1999 and 2004[2]. The major heat waves of 1988, 1998, and 2003 across several states resulted in 1300[9], 2541[15], and 1900[16] deaths, respectively. Deaths were due to a variety of causes including heat stroke and heat-related diarrhea and vomiting[15-16], which were concentrated in certain states[9,15-16]. Compared with populations in more temperate and higher-resource settings, there has been relatively little examination of susceptibility factors in Indian populations.

1.5 Capacity to Adapt to Extreme Heat

Adaptive capacity is built upon individual and household coping behaviors, social capital, and institutional preparedness. To reduce risk of developing heat-related symptoms and illnesses, coping behaviors include regular fluid intake, accessing air conditioning, avoiding exertion during the day, traveling to cool areas, and wearing light and loose clothing[27]. However, the effectiveness of these individual behaviors have not been well studied; nor has the relationship between risk perception and the process of taking adaptive actions[7]. Social networks that connect individuals to community people- and place-based resources[7] also drive adaptability as people

support and protect one another and exchange information. Individuals are not only influenced by their family but also by their communities.

Adaptive capacity can be increased with large scale infrastructural interventions that provide early warning of dangerous temperatures. For example, after the St. Louis 1995 heat wave, both the state of Missouri and city of St. Louis developed prevention campaigns and emergency response systems to prevent morbidity and mortality[28]. Missouri held a "Hot Weather Safety Day," a month prior to the July 1999 heat wave, established a help hotline, and made multiple advisories days before and during the heat wave[28]. The city opened 50 cooling centers and offered to provide free transportation to anyone who needed help[28]. The St. Louis mayor also sent out hundreds of employees to check on the elderly while organizations, such as churches, also offered to help mobilize those in need[28]. While studies comparing the health outcomes of the 1995 and 1999 heat waves in St. Louis and Chicago, Illinois, and Milwaukie, Wisconsin have suggested that public health prevention measures likely reduced mortality in these cities[28-29], there is no direct evidence supporting those conclusions[20] or evaluations of individual behaviors in response to the warnings[7]. There is work focused on Philadelphia, however, that supports the marked cost-effectiveness of early heat warning systems[30]. Thus, efforts from all levels – individuals, communities, and institutions – and the interactions between them, all facilitate the development of adaptive capacity for individuals, households and communities.

1.6 Exploring Vulnerability to Extreme Heat in Context

We use the framework described above to explore vulnerability to extreme heat in Ahmedabad, India. Ahmedabad is a rapidly growing city of 7 million in the arid, Northwest region of India, which experiences very high summer temperatures annually. The city experienced severe heat waves most recently in 2010, setting the highest record in 40 years with a maximum temperature of 46.8°C in May (Fig. 5). The public health impacts of this event have not been studied, but public health officials are concerned about the potential public health

impacts of future heat waves and longer-term shifts in extreme heat hazards associated with climate change. They are also interested in learning more about how to reduce vulnerability. To help address this question, we explored the associations between outcomes of heat illness and exposure, susceptibility, and adaptive capacity factors. Our outcomes were self-reported heat-related illness, heat-related symptoms, and other health outcomes at individual and household levels. Exposure factors included geographic location, housing characteristics, and occupational and behavioral factors. Susceptibility components included age, preexisting health status, and socioeconomic factors. Adaptive capacity factors included access to health services and information, coping mechanisms, and societal factors (infrastructure, information, and social capital)[31]. No quantitative examinations of factors that may be related to heat vulnerability have been undertaken in a major Indian city. The goal of this investigation was to explore the distribution of factors thought *a priori* to be related to heat vulnerability in slum dwellers, a subset of the Ahmedabad population already known to have increased vulnerability in general. The expectation of participating public health agencies was that insight into these vulnerability factors could facilitate future interventions to limit the public health impact of extreme heat events in Ahmedabad.

2 Methods

To begin understanding heat vulnerability in urban settings in Northern India, a household survey was conducted in Ahmedabad, Gujarat, India between July and August 2011. Three hundred households were sampled using randomized cluster sampling techniques, and interviews were conducted in Gujarati by trained research assistants. Primary outcomes were self-reported diagnosis of heat illness and heat illness symptoms. Univariate and multiple regression techniques were used to analyze relationships between the outcomes and exposure, susceptibility, and adaptive capacity factors. The study was approved by the Emory University Institutional Review Board.

2.1 Study Goal and Objectives

The goal of this study was to explore factors that may affect individual and household vulnerability to heat related illness in low income neighborhoods in Ahmedabad, India. Specifically, the study objective was to identify factors that affect heat exposure, susceptibility to heat-related illness, and adaptive behaviors, all of which feed into vulnerability to heat. To assess these factors, our specific aims were:

1. To determine the prevalence of self-reported heat-related symptoms/illnesses, protective behaviors, and known risk factors for heat-related illness in the sampled populations. We specifically tested the hypothesis that there are likely associations between age, preexisting health conditions, and occupation and self-reported heat-related symptoms and/or illness (Hypothesis 1).
2. To understand how slum community members access information regarding weather, recognize the onset of heat waves, and identify symptoms and illnesses as heat-related. We specifically tested the hypothesis that access to heat information (excess heat warnings and discussions on heat-related illnesses with someone) is correlated with lower prevalence of self-reported heat-related symptoms and/or illnesses (Hypothesis 2).
3. To identify potential avenues for increasing heat-health awareness. We specifically tested the hypothesis that having higher degrees of social connectedness is correlated with lower prevalence of self-reported heat-related symptoms and/or illnesses (Hypothesis 3).

Hypothesis 1 was tested because literature has shown that the extremes of age, certain preexisting conditions, and certain occupations are risk factors for heat-related illnesses[18-24]. We tested hypothesis 2 because knowledge of the signs and symptoms of heat related illness is thought to be an important driver of reduced vulnerability to heat[19,24]. Hypothesis 3 was tested because social capital has been shown to be protective in other studies[7,23]. Social connectedness may serve as a means to better disseminate heat warning and heat-health information.

2.2 Study Setting

The study was conducted in Ahmedabad, the largest city of Gujarat state (Fig. 2), an area that is rapidly expanding in terms of both population and industrialization. The city spans an area of 220 km^2. As of 2011, the population size was about 7 million, with 3,787,050 males and 3,421,150 females (903 females per 1000 males)[32]. Because of growing industries, many migrants have moved to Ahmedabad working in all industries such as business, manufacturing and construction. Ahmedabad is historically a textile center. Across the entire population, aged 7 and above, 86.7% are literate, with 92.4% literate males and 80.3% literate females[32]. Approximately 11%, about 800,000, of the population is aged 6 and under[32]. The city is relatively densely populated with 890 people per square kilometer[32]. Approximately 85.1% live in urban areas while 15.9% live in rural areas[32].

The city is located in a sandy and dry area on the banks of Sabarmati River, which divides the city into eastern and western regions. The river frequently dries up in the summer, leaving only a small stream of water. The climate is generally very arid year-round, with summer temperatures rising to a maximum average of 45°C and minimum average of 23°C (Fig. 5). Between November and February, the average maximum temperature is 30°C and average minimum temperature is 15°C. On average, there are 21 to 54 rainfall days annually in Ahmedabad. Unlike the overall increasing trends in average minimum temperatures in the winter and increasing average maximum temperatures in summer months across all of Gujarat, mean minimum and maximum temperatures in Ahmedabad have remained relatively stable based on 30-year moving averages[12] (Figure 6). Additionally, decadal counts of cold waves and heat waves have also remained stable while the general trend across other Gujarat cities have shown significant decreases in cold waves and increases in heat waves[12]. However, the maximum temperatures during heat waves have intensified as, for example, the maximum temperature during the 1998 heat wave reached up to 45.4°C while rising to 46.8°C in May 2010[12] (Fig. 5).

The National Sample Survey Organization (NSSO) of the Government of India defines slums as any "compact settlement with a collection of poorly built tenements, mostly of temporary nature, crowded together usually with inadequate sanitary and drinking water facilities in unhygienic conditions"[33]. As of 2006, about 25.8%, or 900,000, of the 7 million in Ahmedabad resided in slums[34]. Eastern Ahmedabad (east of Sabarmati River) accounts for 47% of the slum units[35]. Compared to the high literacy rate across Ahmedabad, literacy rates were much lower in informal settlements: 16.8% among males and 5.6% among females in one Ahmedabad slum[36]. NSSO reports on slum conditions every few years, providing data on available resources including sanitation, electricity, paved roads, primary schools, and government hospitals. In 2002, among 43 slums sampled in Gujarat state, 63% had access to tap water while 9% obtained water from a tube well; 51% of slums had no latrines while 33% had either a septic or flush latrine; 30% of slums had an underground sewage system; 60% had electricity within their homes and on their streets while 19% only had electricity on their streets; 37% of slums had paved roads; primary schools were within 1 km of 98% of the slums; and a government hospital was within 1 km from 37% of slums and more than 1 km from 63% of slums[33].

Living in densely populated urban slums, slum dwellers are exposed to contaminated environments and at risk for fecal-oral communicable diseases[37]. The Gujarat State Multiple Indicator Surveys found that 52% of the slum population practiced open defecation[37]. Studies have found that acute diarrhea and respiratory infections are the most prevalent among this population[36-38], especially in young children[37-38]. Other common infectious diseases include malaria, intestinal infections, measles, jaundice, and tuberculosis among adults and children[37-38]. Chronic and non-communicable diseases, such as asthma, malnutrition, anemia, mental disorders and respiratory diseases, affect adults more commonly and increase with age[38]. Furthermore, smoking tobacco and alcohol intake increased with age with 63.3% of males aged 45-60 smoked and 27.9% drank alcohol while 14.8% of females aged 45-60 smoked and 4.9% drank alcohol in a study of an Ahmedabad slum[36].

Utilization of healthcare services among slum dwellers depends on availability and accessibility of healthcare facilities, and ability to pay for services[38]. In Ahmedabad, Ahmedabad Municipal Corporation (AMC) provides family welfare centers, municipal health treatment centers (where slum dwellers prefer to go), referral hospitals, and Anganwadi Centers for maternal and child health services[37]. Although all of these resources are accessible to slum dwellers and some services are even concentrated in slum areas, 77% in a study preferred to see a private practitioner for common diseases (colds, cough)[37]. Private practitioners, many of which work in the slum areas of Ahmedabad, are nearby, see patients after shorter waiting times, and sometimes even provide credit[37]. Public providers, offering services for lower fees, were used for immunization, maternal and child health services, and treatment of major illnesses[37]. Another key factor influencing usage patterns of healthcare service is risk perception. The most common reason among those residing in slums for not seeking treatment is the perception that an illness is not serious, with the second most common reason being financial constraints[38].

2.3 Sampling Strategy

Ahmedabad was divided into six zones: Central, North, South, East, West, and New West. Each zone was further subdivided into nine (New West) or ten (other five zones) wards, which were served by one urban health center (UHC) each. Slum dwellers were selected as the sampling population because they were hypothesized to be most vulnerable sub-populations in India based on lack of basic services such as electricity and improved water, health care access, regular employment, and social marginalization. Thousands of slums were dispersed among the 59 wards.

Within each zone, zonal sub-population demographics differed slightly in terms of common occupations and cultural and social backgrounds (e.g. social class, migrant status). To obtain a relatively representative sample of urban slum dwellers, two wards were randomly selected from each zone (12 total) by randomly selecting 12 Indian Rupee (INR) notes without replacement and using the last number of the serial number of the bill to select the wards (Fig. 7a).

The wards were numbered by the order they were listed on an AMC list of wards separated by zone. However, we ended up sampling from 13 wards because of redistricting in 2010 shifted New Naroda Ward, which was randomly selected for the North zone, to the East zone. This ward happened to border Nikol Ward, which had also been randomly selected for the East zone. Research assistants unknowingly sampled from two slums from those two wards even though we set out to sample from Nikol Ward alone. The largest urban slums in those thirteen wards were then selected since a complete list of all slums in all wards could not be accessed, for a total of thirteen slums (Fig. 8). Some of the selected slums were located next to or relatively close to the local UHC while others were farther away.

An AMC UHC employee recruited five local research assistants (RAs) for this project. As engineering students, all RAs lacked a background in public health and experience in survey interviewing. They were introduced to basic survey methodology in public health and trained in sampling and interviewing in a one day workshop (materials in Appendix E). They then piloted the survey at two conveniently selected slums to 1) revise questions that were not easily understood by respondents, 2) help the assistants become comfortable with the survey and interviewing, and 3) prevent errors in skip patterns and response recording. At all study sites, with the help of community health workers (link workers), each RA was assigned a random spot across each slum to begin sampling (Fig. 7b). This approach was used to prevent potential bias from differences among residents who, for example, might have resided in the center as opposed to the peripheral of a slum. Random households were intuitively selected by each RA as starting points, followed by systematic selection of every fourth or fifth house thereafter. The direction each RA chose to proceed from the first house differed from person to person and was unaccountable even though they were advised to go in one direction.

2.4 Data Collection Methods

The household survey was written in English by the investigators and translated to Gujarati by a professor at BJ Medical College, and translations were checked for errors by an IIPHG staff member (Appendix G). Face-to-face structured interviews were conducted in Gujarati by the five RAs. Questions and responses were all read to respondents. Interviews were conducted with self-identified male or female heads-of-households. Females were preferred since it was assumed they were the most familiar with their family members' activities and health histories. However, males were not denied if they were the only ones present or their wives preferred not to respond. Oral consent was obtained from all respondents and recorded on the survey cover sheet prior to conducting the survey (Appendix F). An information sheet designed by the Natural Resources Defense Council (NRDC) (Appendix H) regarding tips for reducing risk to heat exposure and preventing heat-related illnesses was given to each household after each interview. Twenty-five surveys were collected per slum (50 per zone) for a total of 300 surveys. Seven out of the 307 households approached rejected participation. Reasons included not wanting to provide information about their family, inconvenience, wanting monetary compensation and/or medical treatment, and distrust of a RA's identification even though a research support letter from AMC was presented (Appendix D). The principal investigator checked all surveys for completeness and errors at the end of each field work day and provided feedback to all RAs.

2.5 Data Management

All respondents were assigned unique household identifiers and these identifiers were used in the data analysis. Participants were not asked for any identifying information to ensure confidentiality. All responses were coded numerically by the principal investigator prior to data entry and then entered into a Microsoft Excel spreadsheet from which they were transferred into SAS 9.3 (SAS Institute, Inc., Cary, NC).

Most survey questions were close-ended with multiple choice responses; there were a few open-ended questions (Appendix G). Questions examined previous or preexisting health conditions, experience of heat-related illnesses and symptoms, indoor/outdoor heat exposure (home, transit, occupational), adaptations to high temperatures, how people acquired temperature and health information, and social networks to assess vulnerability to heat and heat-related illnesses. Open responses were translated from Gujarati to English by two IIPHG staff and translations were checked by a third IIPG staff member. Close-ended survey responses were either dichotomous or categorical. Dichotomous variables were coded as "0" for "no" or "1" for "yes," and categorical variables were numbered "1" through the number of available responses. For questions where respondents could select multiple responses, all answer choices were listed out as separate variables. For example, respondents were asked to list all previous and/or preexisting health conditions they and their family members ever had. Responses of two conditions were listed as "preexisting 1" and "preexisting 2" in the dataset. Any responses mistakenly or intentionally unanswered were considered "Missing" and represented by a period. Each row represented a household member; respondents served as proxy for their household members. Individual level questions included those regarding demographics, health conditions (preexisting and heat-related symptoms and diagnoses), and occupational settings. Most questions regarding behaviors collected information at the household level.

2.6 Outcomes and Independent Variables

The primary outcomes of interest were self-reported diagnosis of heat-related illnesses and self-reported symptoms of heat-related illnesses. Independent variables included *a priori* factors known to affect heat exposure, susceptibility, and adaptive capacity. Several independent variables were combined into indices and recoded for analysis.

2.6.1 Primary Outcomes

The primary outcomes of interest included self-reported heat-related symptoms (HRS) and diagnosed heat-related illnesses (HRI). Respondents reported any HRS (survey question (Q) 16) and HRI (question 21) they or any of their family members ever experienced in their lifetime (Appendix G). Symptoms included small blisters or pimples, dry mouth, fatigue, leg cramps, heavy sweating, intense thirst, rapid heartbeat, headache, and leg swelling. Because having one or several symptoms could result in heat-related illnesses of varying degrees, responses were combined into a single binary variable where "yes" corresponded to ever experiencing *any* of those symptoms before and "no" implied never experiencing those symptoms before. Heat-related illnesses diagnosed by a healthcare provider were ranked by severity from mild, moderate to severe for descriptive purposes. Mild diagnoses included heat rash, edema, and exhaustion. Moderate diagnoses included hyperthermia. Lastly, severe diagnoses included heat stroke. For regression analyses, self-reported heat-related illnesses were recoded as a dichotomous variable because reported diagnoses concentrated in the mild category and the low variability reduced the power to detect associations between the outcome and covariates. An additional dichotomous variable, HRI+HRS, accounting for those with reported heat-related symptoms and/or heat-related illnesses was also created and explored as an outcome.

2.6.2 Independent Variable Combinations and Recoding

To assess the effectiveness of coping methods and social connectedness in lowering the prevalence of self-reported heat-related symptoms and illnesses, each household was given a score for coping ability and social connectedness. The score for coping ability was based on the frequency of applying coping techniques including (Q37A-I, J-M excluded because questions were not well understood) (Appendix G): staying indoors, drinking plenty of water, seeking shade, wearing light clothing, wearing a hat/covering head, going to an air conditioned place, reducing activity, taking cool showers, and avoiding outdoor activity (8 total). Scores ranged from 0-16.

Observations were given a score of 2 for each coping mechanism where the response was "most of the time," 1 for "sometimes," and 0 for "rarely/none." Scores were then categorized into three coping ability levels: low (0 – 5), moderate (6 – 9), and high (10 – 16).

Similarly, a score for social connectedness (SC) was developed based on behaviors believed to be preventative for heat-related morbidity and mortality. These behaviors included (Appendix G): feeling safe in neighborhood because of positive/neutral relations within neighborhood (Q70-71); knowing most of their neighbors and talking to them often (Q72-73); nearest person they would call in an emergency (Q75); and the respondent and/or their neighbor(s) have checked on each other during heat wave and/or called on each other in an emergency (Q78-81). Responses for questions 78-81 were condensed into one variable because they were all highly correlated with one another. A score of 1 was given to responses of "yes" for those behaviors and 0 for "no." A score of 1 was also given to "in the neighborhood" and 0 for "no one" or "other" for nearest person respondent would call in an emergency. Because of the few categories of scores, those who had scores of 0 were combined with those who had scores of 1. Categories included low (0-1), moderate (2), and high (3, reference). The coping score was considered as continuous, while the coping level and recoded social connectedness score were regarded as categorical for the regression models.

2.7 Statistical Analysis

Findings were summarized through descriptive statistics based on response frequencies and relationships between variables. Variables were categorized as demographics, exposure, susceptibility, adaptive behaviors and outcomes and multiple logistic regression was performed to test the various hypotheses. Responses were also examined for regional differences between zones.

2.7.1 Management of Possible Clustering Effects

To account for clustering effects at the household and slum levels, Generalized Estimating Equations (GEE), which fitted generalized linear models by maximum quasi-likelihood, were used to test Hypotheses 1-3. Individual observations were not independent; rather, all responses for individuals within a household were correlated with one another and all responses from households within each slum were correlated with one another. An exchangeable (compound symmetry) within-subject covariance matrix was used, where responses from the i^{th} household and i^{th} slum were assumed to be equally correlated[39]. Compound symmetry was the only covariance matrix that could calculate odds ratios in this study. To estimate the odds ratios for the nonlinear binary correlated outcomes, self-reported HRS, HRI and HRI+HRS, logistic regression was run with a GEE procedure where the distribution was binomial, with logit transformation, and accounted for clustering at the household and slum levels. Outcomes and covariates were all examined at the individual level regardless of whether they were individual or household level data; accounting for clustering allowed us to do so.

2.7.2 Multivariate Modeling

Univariate associations between potential risk factors and the outcomes were first assessed to determine model covariates. The original 177 variables were combined, recoded, and narrowed down to 37 candidate independent variables (Table 1) (list of recoded variables in Appendix I). Covariates were selected based on statistically significant unadjusted odds ratios (ORs) for each outcome. Interactions were not considered because the study was not designed to detect interactions and a large number of candidate variables were examined. Interviewer was included in all final models as a possible confounder because 1) the chi-square was significant for all categorical variables, except chronic preexisting conditions, and 2) the beta estimates changed more than 10% for all covariates, except age, monthly household income, and chronic preexisting conditions. Missing variables, accounted for in models, existed for work location (sun, shade,

mix), and worried about getting sick from heat (no/don't know, yes). The final models for each of the three outcomes included the following covariates (Table 2):

ln(HRS/1-HRS) = -2.634 + 1.724(interviewer1) + 0.455(interviewer2) - 0.153(interviewer3) + 0.875(interviewer4) + 0.038(age) – 0.000(HH income) + 0.6220(work in sun) - 0.0664(work in mixed) + 0.898(chronic) + 0.427(infectious) - 0.807(drinking water source1) - 1.046(drinking water source2) - 0.254(drinking water source3) - 1.117(not worried) + 1.186(SC score=0/1) - 0.365 (SC score=2)

ln(HRI/1-HRI) = -4.390 + 0.412(interviewer1) 0.115(interviewer2) + 1.095(interviewer3) + 0.815(interviewer4) + 0.514(chronic) + 1.196(diarrheal) + 1.045(infectious) + 1.522(didn't seek HRI information) - 0.150(coping score) - 0.197 (SC score=0/1) - 0.870(SC score=2)

ln(HRI+HRS/1-HRI+HRS) = -1.883+ 1.441(interviewer1) + 0.208(interviewer2) + 0.366 (interviewer3) + 0.397(interviewer4) + 0.0248(age) + 0.672(chronic) + 0.533(diarrheal) + 0.546(infectious) - 1.110(has not visited Dr. for HRI) - 0.757(not worried) + 0.778(SC score=0/1) - 0.403(SC score=2)

After determining the final model for each outcome, covariates specifically being tested in the hypotheses were included into the model regardless of the statistical significance of their unadjusted ORs. ORs were also internally validated by creating 2x2 tables and estimating ORs (unadjusted for clustering) to check for agreement in general direction (less than or greater than 1) of the ORs. For hypothesis 1, age, occupation category, and preexisting health conditions (chronic, diarrheal, non-diarrheal infectious) were considered as the main risk factors for the three self-reported outcomes. For hypothesis 2, access to heat information was defined by the following:

source of heat warning this past summer, source of heat-related illness information, person previously talked to about preventing heat-related illnesses, and whether respondent was worried about getting sick from heat and sought information on heat-related illnesses before. For hypothesis 3, social connectedness was defined by the social connectedness score and levels.

3 Results

Thirteen wards were sampled in total. Here we present characteristics of the sampled communities, results of the descriptive analysis including demographic profiles for the overall sample, and results of our logistic regression analyses.

3.1 Characteristics of the Sampled Slums

Slums across Ahmedabad were similar in some ways and different in others (Fig. 9). Several neighborhoods were organized into rows while others sprawled in all directions. Some were also located in between new city development, apartment complexes a few stories high, which could potentially cause a small depression with limited air circulation. Among the slums visited, most lacked paved roads, sewage systems, and/or latrines. However, AMC provided a number of homes in each slum with electricity and water. Water was often only piped to homes once a day. Most lacked vegetation, trees were usually located at the perimeters of the neighborhoods. Neighborhoods consisted of either only single story homes or a mix of both single and two-story homes, with homes being made out of concrete or brick. Single story homes had either metal sheet roofs or asbestos, concrete sheet roofs. Some of the roofs were covered with blue tarps and/or leaves to reduce summer heat absorption, according to locals. Two-story homes had flat concrete roofs or asbestos, concrete sheet roofs. Most homes had about two windows at the front side of their homes; there were no doors or windows at the back. Some homes also had an enclosed front yard of their own. Space was particularly limited in many slums. They were densely populated with homes in close proximity to one another on both sides and

front and back, resulting in poor air circulation. Many residents hung their laundry to dry outside, reducing the amount of open space in between homes. Animals, such as cows and goats, were also allowed to roam freely throughout the neighborhoods.

3.2 Descriptive Analysis

Here we present findings on the demographic profile of the sample, descriptive analysis of the primary outcomes, modeling considerations for the descriptive analysis, and findings from the descriptive analyses of factors related to exposure, susceptibility, and adaptive capacity.

3.2.1 Demographic Profile of the Sample

Responses were relatively consistent across all zones, regardless of ward and slum. Across all zones, most respondents were female (78-90%), which aligned with our aim to interview female head-of-households under the assumption that they were the most familiar with their family members' health and working conditions (Table 3). Respondents served as proxy for their family members; the 300 respondents provided information for 1650 individuals, respondents included. On average, households had between 5-6 people. About half of the households in each slum and entire sample had at least one young child and/or elderly person within their household. However, the East zone had the least number of households with young children and/or elderly, 32%, among all six zones. This was a fairly young population with average ages between 24 and 27 across all zones.

The average monthly household income was approximately 6000 INR, which put each individual household member at about the poverty line since that amount equates to approximately 33.3 INR per person per day in a household of 6 (Table 3). The current official amount for the poverty line is 32 INR per person per day in India. In the East zone, the average monthly income was slightly higher than the other zones at about 7000 INR. These averages were also a slight overestimate since most households reported incomes between 2000 to 6000 INR,

and a few households reported more than 20,000 INR up to 40,000 INR. Few members in each household worked and provided income to their families; about 50% of household members of working age (15-50) actually possessed a job within each household. Most elderly (N=70) also did not work, the percentage of them who did in each zone ranged from 8-30%.

Most respondents in the slums owned their homes, between 74-88%, across all zones (Table 3). Accounting for their ancestors and parents, most reported living at their current residence for an average of 25 years among the entire sample. North zone residents reported living at their current residence the longest with an average of 33 years while East zone residents reported living at their current residence the shortest with an average of 16 years. Most also reported that they paid for electricity, 92% among all households, and their bi-monthly bills averaged about 6000 INR.

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3.2.2 Heat-related Outcomes

Self-reporting of heat-related symptoms and illnesses were proportionately different among the zones (Table 4). While HRS symptoms were reported for an average of 1 person within households across all slums, HRI were reported for an average of less than 1 person across all slums. In particular, the average number of persons reported with HRI was 0.20 in the New West zone and 0.38 in the Central zone, which are much lower than the average of 1.02 in the North zone. Across all of the zones, the percentage of individuals with reported HRS, ever experienced within their lifetimes, ranged between 14.9% (Central zone) and 26.0% (East zone) among all individuals within each zone. The North and East zones had both the most reported heat-related symptoms and illnesses. Most HRI, ever diagnosed in their lifetimes, reported were mildly severe i.e. heat rash, heat edema and heat exhaustion. Percentages for mildly severe HRI ranged from 2.2% (New West zone) to 15.7% (North zone) among all individuals within each zone. The second most frequently reported diagnosed HRI was hyperthermia, which was considered moderately severe. Percentages of reported cases ranged from 0.38% (East zone) to

2.5% (South zone); none were reported in the New West zone. The most severe HRI, heat stroke, was only reported for one person in the South zone. When self-reported HRS and HRI were combined, about 28.9% had experienced these outcomes. Fifty people had experienced both heat-related symptoms and illnesses in their lifetimes.

3.2.3 Model Considerations for Demographics

Among the demographic characteristics, age, monthly household income, bi-monthly electricity bill were all considered as candidate covariates. The unadjusted ORs for age (for every increase in one 5 years of age) and the outcomes were statistically significant for HRS and HRI+HRS and insignificant for HRI (Table 1). The unadjusted OR for monthly household income (for every increase in 100 INR) was only significant with HRS. Finally, the unadjusted ORs for bi-monthly electricity bill (for every increase in 100 INR) were significant with HRS and HRI+HRS.

3.2.4 Exposure Factors within Study Population

Exposure factors included occupational and behavioral factors (Table 5). Among all occupational categories, most individuals were homemakers or did not have jobs (63% of entire sample). Those who were unemployed included students, young children, and retirees. Common across all zones, many worked as physical laborers (11% of entire individual sample), service workers (9.3% of entire individual sample), and sales people (5.2% of entire individual sample) (full list of occupations in Appendix J). There were also some regional differences. In the New West and South zones, many were also artisans (6.7% in the New West and 11.3% in the South zones) while in the Central, North and East zones, many worked in factories or manufacturing (6% in the Central, 9.4% in the North, and 9.9% in the East zones).

Working conditions were similar for certain aspects and different for others between the zones. Work hours for about 90% of the employed did not depend on seasons, and about 99%

worked during the daytime (Table 5). About 90% worked outdoors during the summer. Between zones, fewer residents of the New West and South zones worked outdoors during the summer, with 77% and 73% compared to the overall 90% among individuals from all zones. The percentage of those who had indoor fans while working varied between 60% and 70% across the six zones. Most, 95-100%, of the employed also wore moderately thick clothing to work. Few people worked directly under the sun all day, with locations varying between a mix of sun and shade (37% of those employed) and only shade (47% of those employed). The West and Central zones had the most employees working in the sun, 22.9% in the West and 20.3% in the Central zones compared to 6.4% in the North and 10.9% in the East zones.

Besides occupational heat exposure, people were also exposed during transport and through cooking and cooling practices (Table 5). Most people, about 74%, walked as their main mode of transportation. While all respondents in all zones reported that they felt too hot inside their homes during the summer, 12% of respondents in the West, 6% in the New West, and 2% in the Central zones did not feel the inside of their homes were warmer than the outside during the summer. Most people cooked twice a day throughout the entire year (75-100% across the zones) during the morning (87.6% of households from all zones) and evening (93.8% households from all zones). A majority of respondents also cooked indoors in five zones (86-100% across the zones); only 64% of New West household had indoor kitchens. Fewer New West zone respondents, 21.2%, did not feel warmer inside their homes when they cooked while most respondents in the other five zones, from 84-100% did feel warmer. Almost all homes, 94.1% of all households across all zones, had opened their windows while cooking. Patterns of window use differed the most in the New West zone, where 57.1% of respondents always opened their windows and 23.8% of respondents opened their windows depending on the season unlike an approximate even divide of 40% between these two categories in the other five zones (Table 5). Among all households, 85% reported opening their windows during the summer. The majority of respondents, between 86 and 100% across all zones, used electric fans to keep cool. While most

households, 89.0% of all sampled households, reported not going to locations with air conditioning, the West zone had the most respondents, 12%, who were able to access air conditioning.

Among the 20 exposure factors, six were selected as candidate covariates including occupation group, working outdoors in the summer, location of work, mode of transit, location of kitchen, and cooling method. No adjusted ORs for the exposure factors were significant with HRI. The unadjusted ORs for location of work (reference: shade) was a significant exposure factor for HRS and HRS+HRI (Table 1). The unadjusted ORs for location of kitchen, mode of transit, and cooling method were significant with HRS and HRS+HRI as well. The unadjusted OR for cooling method and HRI could not be calculated because no one who had access to air conditioning or an evaporative air cooler reported HRI.

3.2.5 Susceptibility Factors within Study Population

Factors that potentially influenced susceptibility to the heat-related outcomes included preexisting conditions (chronic, diarrheal, infectious), lack of access to air conditioning, and limited access to water (Table 6). Self-reported health conditions varied considerably by zone, with most reported in the West, South, North and East zones, and the least in the New West and Central zones. Among the three categories of preexisting conditions, infectious diseases were most commonly reported for individuals across the entire sample (22.7%). However, 1.5% was reported in the New West zone compared to 44.7% in the East zone. Chronic conditions were reported for 17.8% across the entire sample while 7.8% was reported in the New West zone while 27.8% was reported in the North zone. Diarrheal diseases were reported the least, at 5.7% reported among all individuals reported by respondents. Again, there are stark differences between the New West zone, with 2.2% reported for diarrheal diseases, and North zone, with 8.4% reported diarrheal diseases (Table 6). Each household had an average of approximately three household members who had preexisting conditions. The New West and Central zones both

reported the least household members with preexisting conditions, with an average of 1 person among New West households and 2 in Central households. Among young children (<5) and elderly (>60), diarrheal diseases were more commonly reported among young children (14.2% among all young children) and chronic diseases were more commonly reported among elderly (55.7% among all elderly). Differences between the zones persisted. Diarrheal diseases were reported for 7.7% of young children in the South zone and for 30.8% of young children in the North zone. Chronic diseases were reported for 30.0% of elderly in the Central zone and for 91.7% of elderly in the North zone.

Although access to resources was limited, respondents did not all perceive them as barriers. While about 90% of respondents did not own an air conditioner or go to a place with one, the most common response for what prevented them from accessing air conditioning was "nothing" or "did not want to" (Table 6). Across the zones, percentages ranged minimally from 54.0% to maximally at 92.0% for no barriers. The three most common prevention factors included time of day (5.7% of all households), disability or elderly/young at home (8.0% of all households), and distance (7.3% across all households). In addition, in-home tap was the most common source of drinking water for most respondents, but only 70% of respondents in the West and 80.0% in the South zones drank tap water. Piped water was mostly supplied to most slums once a day, with morning being the most common time of day except in the East zone, where 65.2% of households got their water then and others at noon and night.

Nearly all susceptibility factors were tested for significance as an independent covariate of the outcomes and included all three preexisting condition categories, factors preventing access to air conditioning, time of day water was received, and main source of drinking water (Table 1). The unadjusted ORs for all three preexisting condition categories were significant for HRI and HRI+HRS. The unadjusted ORs for chronic and infectious were also significant with HRS but the OR for diarrheal was insignificant. The unadjusted ORs for barriers to air conditioning were insignificant with all three outcomes. Additionally, the unadjusted ORs for time of day water was

received, main source of drinking water were significant with HRS and HRI+HRS but insignificant for HRI. The OR for water time and HRI could not be calculated because no one who received their tap water at night had reported HRI.

3.2.6 Adaptive Behaviors within the Study Population

Access to health services and information, coping mechanisms, and social capital reflected households' adaptive capacity (Table 7). Approximately 99.0% of all households within sampled slums reported that seeing a doctor was convenient. However, the amount of households who had seen a doctor for heat-related illnesses varied greatly among the zones with a maximum of 74.0% of households in the North zone and minimum of 20.0% in the New West zone. Among various coping strategies, 92.0% and 90.3% of all households reported staying indoors and drinking plenty of water to protect them from heat. Behaviors that households reported doing rarely included going to a place with air conditioning (90.3% of sampled households), avoiding outdoor activities (93.3% of households), and reducing activity (84.7% of sampled households). The responses for reducing activity slightly varied among zones as 68% of households in the West and 74.0% of households in the East zones reported that they rarely reduced their activity. While all (100%) households reported drinking more water during the summer, only about 60.0% of sampled households reported drinking water and other fluids such as tea and chaas. Additionally, nearly all, 96.0% of households, reported protecting themselves during transit through means such as covering their heads with scarves or hats.

Most households reported hearing about an excess heat warning during the summer of 2011. Among all zones, respondents almost equally heard about the warning through people, about 53.3% among all households, and media sources, about 46.7% among all households (Table 7). By far, most households reported hearing a warning from television among all response choices; newspaper was the second main source. In the New West and East zones, slightly more households reported hearing about the warning through people (62.5% in the New West and 60.9%

in the East zones) as opposed to media sources. Although almost all households, 95.6%, reported being worried about their family getting sick from heat exposure, between 54.0 and 98.0% of respondents across the zones reported seeking information regarding heat-related symptoms and illnesses. The New West zone had the least respondents, 54.0%, who reported seeking that information. Most respondents, 90.8% of all sampled households, had or would look for heat-related information through media sources, mainly being television and, secondly, newspapers. In addition, even though a majority of households, approximately 77%, reported that they previously spoke with a healthcare professional (doctor or pharmacist) about heat-related illnesses, nearly 20% had not spoken to anyone. The largest discrepancies with the entire sample, again, rose from the New West and West zones. In the New West zone, 64.0% had spoken with a healthcare professional while 32.0% had never spoken to anyone about preventing HRI. Similarly, while 70% of respondents in the West zone reported speaking to a healthcare professional, 14.0% had spoken with community members and 16.0% had spoken with no one.

Social connectedness included feelings of safety, familiarity with neighbors, and past dependence and concern for neighbors during heat waves and emergencies (Table 7). Similar across all zones, nearly all households, 97.3%, felt safe in their neighborhoods due to positive or neutral relations with their neighbors. Approximately 86% of sampled respondents knew their neighbors and talked to them often, while 98.3% of them would call on someone within their neighborhood during an emergency. Those in the New West zone, 74.0%, reported knowing and talking with their neighbors the least. During a heat wave and/or emergency, 78.7% of all respondents or their neighbors have called on each other in the past. Those in the North and East zones, 82.0% and 86.0%, reported calling on the neighbors or their neighbors called on them during emergencies or heat waves the most.

Nearly all adaptive behaviors were considered as candidate variables for the three models including whether respondents had seen a doctor for HRI before, factors related to access to information, all coping methods, coping score, coping levels, all measures of social

connectedness, social connectedness score, and social connectedness levels. The unadjusted ORs for previously visiting a doctor for HRI were significant for both HRS and HRI+HRS (Table 1). The OR could not be calculated for HRI because those who reported HRI had all seen a doctor for HRI before. Similarly, the OR for HRI and being worried about getting sick from heat could not be calculated because those who reported HRI were all worried about getting sick from heat. With regards to measures of access to information, the unadjusted ORS for hearing a heat warning that summer of 2011, previously speaking with someone about HRI, and being worried about getting sick from heat were all significant with HRS and HRI+HRS. The unadjusted ORs for previously seeking information regarding HRI were significant for all three outcomes.

Although all variables related to coping behaviors and social connectedness were examined for significant associations with the outcomes, only one of the variables were included in the final model because two or more of them would have been highly correlated with one another (Table 1). The unadjusted ORs for several coping mechanisms were individually significant with the three outcomes; the coping score and levels were insignificant for all outcomes. However, because the coping score encompassed all individual coping methods, it was still tested for significance as a continuous variable in the multivariate models in addition to testing individual coping methods in separate models. Similarly, the unadjusted ORs for several measures of social connectedness were individually significant with the three outcomes as well as the SC score and levels. The SC score was tested as both a continuous and categorical variable because it was calculated based on other variables and, thus, was not a true continuous variable. Because the SC score was significant and it encompassed the four measures of social connectedness, it was the only variable included in the multivariate models even though the unadjusted ORs for individual measures of social connectedness with the outcomes were significant.

3.3 Regression Analysis and Hypothesis Testing

Here we present results of the multiple regressions which we used to test our specific three hypotheses.

3.3.1 Age, Preexisting Conditions, Occupational Exposure, and Associations with Heat Illness

Aligned with known risk factors, both age and preexisting conditions significantly increased risk for HRS and HRI+HRS in the multivariate analysis (Table 8). For every five years a slum dweller ages, the odds of experiencing heat-related symptoms increased 21.2% (95% CI 1.16, 1.27) while the odds of experiencing heat-related symptoms and/or heat-related illnesses increased 15.6% (95% CI 1.10, 1.19). Chronic and infectious preexisting conditions (ever had in lifetime) posed risks for all three outcomes; diarrheal only resulted in significant risk for HRI. Chronic conditions increased the odds of HRS 2.49 times the odds of HRS among those without chronic conditions (95% CI 1.82, 3.42), and infectious diseases increased the odds of HRS 1.55 times the odds of HRS among those without infectious diseases (95% CI 1.10, 2.20). The odds of HRI among those who had chronic conditions were 1.66 times higher than the odds for those who did not have chronic conditions (95% CI 1.08, 2.55). The odds of HRI among those who had diarrheal diseases were 3.19 times higher than the odds for those who did not have diarrheal diseases (95% CI 1.68, 6.08). The odds of HRI among those who had infectious diseases were 2.82 times higher than the odds for those who did not have infectious diseases (95% CI 1.86, 4.27). There was a 97.8% increase in the odds of heat-related illnesses and/or symptoms for those who had chronic conditions versus those who did not (95% CI 1.45, 2.70); and a 73.2% increase in the odds of HRI+HRS for those who had infectious diseases versus those who did not (95% CI 1.27, 2.36). Diarrheal diseases were significantly associated with HRI+HRS prior to adding occupation categories to test Hypothesis 1.

Occupation category was only associated with the combined outcome of HRI+HRS. Jobs considered to be “service or office or teaching” appeared to be protective since there was a 46.7%

decrease in the odds of HRI+HRS for those who worked in “service or office or teaching” jobs versus those who were homemakers or were unemployed (95% CI 0.36, 0.79) (Table 8). The unadjusted odds ratio for HRI+HRS and occupation group was insignificant, whereas the adjusted OR was significant. While occupation category was not significantly associated with HRS, location of work actually posed a risk within the sampled slum population. Working in the sun increased the odds of HRS 1.95 times the odds of HRS among those who work in the shade (95% CI 1.10, 3.46).

3.3.2 Access to Heat-Related Information and Heat Illness

Among the five measures of access to information, two were significant. Previously seeking information on heat-related illnesses was protective whereas worrying about getting sick from heat increased risk (Table 9). The odds of HRI+HRS among those who had not sought heat-related information was 2.62 times the odds of HRI+HRS among those who had (95% CI 1.17, 5.86). Similarly, not seeking information on HRI increased the odds of HRI 11.18 times the odds of HRI among those who sought information on HRI (95% CI 2.75, 45.38). *Not* worrying about getting sick from heat was also protective as there was a 56.5% decrease in the odds of HRI+HRS among those who were *not* worried about getting sick versus those who did (95% CI 0.20, 0.95). There was also a 69.2% decrease in the odds of HRS among those who were *not* worried about getting sick versus those who did (95% CI 0.14, 0.68).

3.3.3 Social Connectedness and Heat Illness

Higher degrees of social connectedness appeared to be protective for two outcomes (Tables 2, 8, 9). The odds of HRS among those who had scores of 0 or 1 was 3.27 times the odds of HRS among those who had scores of 3 (95% CI 1.55, 6.93) (Table 2). Similarly, the odds of HRI+HRS among those who had scores of 0 or 1 was 2.18 times the odds of HRI+HRS among those who had scores of 3 (95% CI 1.14, 4.16). The adjusted ORs for these two outcomes shifted

away from the null, in a positive direction while the unadjusted ORs shifted away from the null in a negative direction. The OR comparing social connectedness scores of 0 or 1 and 3 was also insignificant in the unadjusted model whereas the OR comparing scores of 2 and 3 was significant. This association remained true in the association between social connectedness score and HRI (Table 2). The odds of HRI among those who had a score of 2 was 0.42 times lower than the odds of HRI among those who had a score of 3 (95% CI 0.21, 0.85). Results were thus mixed between higher degrees of social connectedness being protective and increasing risk.

3.3.4 Additional Risk and Protective Factors

The prevalence of HRS was additionally associated with monthly household income and main sources of drinking water while the prevalence of HRI+HRS was associated with previous visits to a doctor for heat-related illnesses (Table 2). For every 100 INR increase in household income, there was a 1% reduction in the odds of HRS (95% CI 0.99, 0.99). Some main sources of drinking water were protective against HRS. The odds of HRS among those who used an in-home tap for drinking water was 0.45 times lower than the odds among those who purchased their drinking water (bottled/50 liter jugs) (95% CI 0.21, 0.94). Similarly, the odds of HRS among those who used a public source (tap or borehole) for drinking water was 0.35 times lower than the odds among those who purchased their drinking water (95% CI 0.15, 0.82). Previously seeing a doctor for heat-related illnesses appeared to increase risk for HRI+HRS as there was a 66% decrease in the odds of HRI+HRS among those who had *not* seen a doctor for heat-related illness before versus those who had (95% CI 0.25, 0.44).

4 Discussion

Vulnerability was characterized within this population by the following demographic, exposure, and susceptibility factors and adaptive behaviors: age, household income, work location, preexisting conditions, main sources of drinking water, previous visit to a doctor for

heat-related illness, two measures of access to information and the social connectedness score. There were proportional differences in certain covariates and outcomes, associations identified that coincided with known in literature, and some unexpected findings. We will explain these findings here as well as discuss the limitations of this study and recommendations for future heat-related interventions and research.

4.1 Differences Among the Zones

Even though demographic characteristics were nearly homogenous across all zones, there were several regional differences among the vulnerability factors. In particular, respondents from the New West zone had different working and cooking conditions, reported the least health conditions, sought heat-related illness information the least, and were the least socially connected to their neighborhood community. Approximately 23% *did not* work outdoors during the summer among New West respondents and 36% cooked outdoors. In all the other zones, 90% or more did work outdoors in the summer (except South) and 80% or more cooked indoors, suggesting New West residents were exposed to less exogenous heat than those in other zones. Fewer people possibly worked outdoors because they worked in sales or were artisans in the New West. More people cooked outdoors perhaps due to personal preference or they had more space to do so since many had open space in front of their homes. Those in the New West zone also reported the fewest number of individuals with preexisting conditions. Because of certain exposure and susceptibility differences, New West residents could have been a healthier sub-population overall and thus heat-related illnesses and symptoms occurred less frequently. Consequently, residents might have felt less desire to seek information regarding heat-related illness and prevention tips since fewer people within the neighborhoods experienced heat-related morbidity. The New West zone was also the most recently established zone, possibly attracting more recent migrants. Residents, thus, possibly were less familiar with one another and sought help from their neighbors less.

While certain vulnerability characteristics defined the New West zone, regional differences were the most prominent in the self-reported health outcomes. Relatively large gaps existed between the minimum and maximum numbers of people with reported outcomes. For example, the New West and Central zones had approximately 50% less reported heat-related illnesses and/or symptoms compared to that of the North and East zones. Differential proportions were especially regionally distinct for self-reporting of heat-related illnesses. The North zone accounted for about 26% of all HRI whereas the New West zone accounted for only about 3%. Response bias, population characteristics, and changes in interviewing methods among the research assistants possibly accounted for these differential proportions (interviewer was not controlled for in descriptive analyses and study sites came from the North and East zones in the latter part of field work). Additionally, zones with greater numbers of reported HRS and HRI might be due to the lack of trees in certain slums, less space in between homes for ventilation in certain slums, and less frequent visits from community health workers.

4.2 Associations Between Outcomes and Covariates

Associations observed between independent variables were not quite consistent among the different analyses even though the outcomes were interrelated. Heat-related symptoms were likely reported more frequently than illnesses because the illness had to be *diagnosed*. The prevalence of heat-related illnesses was possibly higher but illnesses were unrecognized because they were mild and undiagnosed; thus, unreported in this study. The magnitude of effect of the significant independent variables and slight differences in type of variables consequently varied among the three outcomes. The distribution and variability of the covariates relative to the outcomes likely influenced power to detect associations that might have existed or were stronger.

Several risk and protective factors identified within this study coincided with those described in literature for heat-related morbidity. Age, chronic and diarrheal diseases, and working conditions all increased the odds of the outcomes. Age was also a likely confounder of

chronic and diarrheal diseases since diarrheal diseases were reported for children more than chronic diseases while chronic diseases were reported more among the elderly than diarrheal. As expected, working outdoors directly under the sun also increased individuals' exposures, putting them at greater risk for developing heat-related symptoms. In addition, previously seeking heat-related illness information and having a higher degree of social connectedness reduced the odds of the outcomes. Respondents possibly took more preventative measures if they were previously exposed to health information related to heat. Having good relations with neighbors was also possibly conducive to lower odds because neighbors exchanged information on heat warnings and health issues as well as more frequently visited each other on a regular basis, which might have helped during heat waves.

The association between social connectedness and the heat-related outcomes posed some anomalies. Multiple regression suggested a different relationship between the two outcomes and social connectedness. Only people with *moderate* social connectivity had *lower risk* in the univariate models whereas only people with *low* social connectivity had *higher risk* in the multivariate models, as expected (Tables 1-2). Overall, lower scores (0-1, 2) did not always confer higher risk for heat-related symptoms and illnesses when compared to high scores (3). These anomalies were likely due to interaction between the social connectedness score and, perhaps, not being worried about getting sick from heat, since confounding was examined and not found. The worried variable was also the only covariate common between those two outcomes (HRS and HRI+HRI) and insignificant for HRI.

Although several vulnerability characteristics and behaviors agreed with literature, there were also some unexpected findings. An association between infectious diseases (non-diarrheal) and heat-related outcomes had not been previously shown in literature. Infectious diseases might not have been examined since they are less relevant in developed countries and most vulnerability studies related to heat have been studied solely in developed settings. More likely, temperature was a confounder, not accounted for here, for heat-related outcomes and infectious diseases since

the prevalence of both are related to temperature patterns. Therefore, a false association between infectious diseases and heat-related outcomes might have existed in this study. Other unexpected findings include the insignificance of occupation and mixed results of the social connectedness score. The former is likely related to statistical power: because the variations between the occupational groups relative to the outcomes were too sparse, an association was likely undetectable even when certain categories were merged. One occupational category, "service/office/teaching," likely gained a significant association with HRI+HRS because of age, which was found to be a confounder, and interactions with other covariates. These interactions also possibly lead to the insignificance of diarrheal diseases in that same model to test Hypothesis 1. Again, this study was not designed to identify interactions and this could be an objective for future research.

4.3 Limitations

This study had several limitations that may threaten internal and external validity, ranging from its cross-sectional design, possible bias from interviewers, methods of survey development, and focus on the slum populations of Ahmedabad. We discuss each in turn.

4.3.1 Potential Threats to Internal Validity – Cross-Sectional Design

As a cross-sectional study, only patterns of exposures and outcomes can be deduced from the data. A prior exposure assessment would have provided a more in depth understanding of heat exposure sources specific to the slum population. Our findings captured patterns from one point in time, July 2011, which was the beginning of monsoon season in Ahmedabad. Although summer had just passed, the summer of 2011 was not as hot as previous summers in recent years. As a result, behavioral patterns and prevalence of heat-related symptoms and illnesses could have differed in 2011 from that of previous years; temporal associations are not clear. Additionally, selection bias may have influenced the results. Because many women were homemakers and

large family sizes existed, with average household sizes of 5 and maximum of 13, most homes were occupied by at least one household member at all times. However, respondents served as proxy for their household members and, thus, possibly provided inaccurate information regarding member's occupational activities and current and previous health conditions. Household level responses may not have applied to all household members as well. Therefore, depending on the independent variable, estimates were possibly skewed away or towards the null due to selection and recall biases. For example, if outdoor sun exposure was underreported because wives did not know whether their husbands or children worked mainly in the sun, risk for heat-related outcomes would show a smaller effect and the odds would be closer to the null when it should be farther away and reflect much greater risk among those who worked in the sun than the study detected.

4.3.2 Potential Threats to Internal Validity - Interviewer Bias

Most RAs were not academically trained in the field of health or social sciences and lacked research experience. Consequently, they likely did not completely understand all terminology within the survey questions and possibly unintentionally biased certain responses by their manners of asking questions. Some differences in response patterns were detected among different RAs. For example, one RA who worked as a pharmacist captured more health conditions among his respondents than the other four RAs who were academically trained in engineering; perhaps they were unable to provide sufficient examples of particular health conditions that they did not understand well. This possibly led to underreporting of health issues, reducing power to detect associations between outcomes and independent variables. They also did not fully comprehend certain questions, such as one regarding indicators of extreme temperatures, and were unable to obtain true responses that would have been given if questions were explained differently. In such cases, responses were not analyzed due to the possibility that RAs recorded responses as they saw fit.

In addition, the RAs recognized that they lacked knowledge of common slang and/or local terminology used among slum dwellers whose social class and cultural background, in several study sites, differed from that of the RAs. Therefore, the RAs likely did not easily build rapport with respondents due to inexperience and language and cultural barriers. Respondents, then, possibly did not provide honest responses to all questions leading to under- or over-reporting of their true behaviors. Again, this could have reduced the power to detect true associations and introduced a bias away from or towards the null.

4.3.3 Potential Threats to Internal Validity – Survey Development

Although the survey was developed with input from IIPHG staff members and piloted on two occasions, some questions and responses might have not been easily understood and/or incorrectly translated. IIPHG staff members who assisted in this project were not familiar with slang or layman's terms that residents of the slums might have been more familiar with. As a result, technical medical terms such as "nervous system disorder," "fatigue" and "heat exhaustion" were likely poorly understood unless well translated and explained by the RAs. Respondents potentially underreported their own and household members' medical history (preexisting and heat-related), which prevented us from seeing stronger associations between these health conditions and the outcomes. Other terms, such as "convenience (of seeing a doctor)," even if translated correctly, were likely not at the proper literacy level. "Convenience" might have been better understood if "easy" was used. In this example, most respondents had stated it was convenient for them to see a doctor or health care provider. However, anecdotally, many respondents had stated they did not get sick and/or needed to see a doctor because gods they worshipped would protect them. Additionally, certain behaviors and health conditions were not captured because some terms got lost in translation, which was not determined until the data entry phase even though the translated survey had been cross-checked for errors and word choice before piloting. For example, "hallucinations or confusion" had been translated as "dizziness."

Relatively different from each other, dizziness did not capture the essence of hallucinations or confusion and prevented us from understanding patterns in those conditions and possible associations with the heat-related outcomes.

4.4 Possible Threats to External Validity

The findings and conclusions from this study only apply to the sampled population due to the limitations of the sampling procedures and analysis. Although clustered multistage sampling was conducted for this study, weights could not be assigned for the strata (zones) and sampling units (ward, slum, household). Lists of the total numbers of slums, households, and household sizes were unavailable at the time the study was conducted. Additionally, selected households may not represent a truly systematically randomized sample but, rather, a convenience sample because RAs were not monitored for systematic and consistent selection of households across all study sites and between RAs despite guidance for systematic random selection. Varying layouts of the slums also made it difficult to maintain consistency since some were more organized into rows while others sprawled in all directions. Consequently, without weights for the strata and sampling units to account for clustering and incomplete randomization of all sampling units, the results cannot be generalized for all Ahmedabad urban slums. However, GEE provided a sufficient mechanism to estimate adjusted ORs for the sampled population given the limited information about the sampling units.

4.5 Implications for Reducing Vulnerability to Extreme Heat in Ahmedabad

The findings of this study have informed several avenues for reducing vulnerability to extreme heat and preventing heat-related morbidity and mortality among residents of urban slums in Ahmedabad for the near future.

1. ***Work closely with community health workers and community leaders and/or gatekeepers to disseminate warnings and information:*** Although doctors might be

accessible to slum dwellers, as observed in this study, they do not necessarily go to the doctor for everything. Since mild heat-related illnesses may go unrecognized, it is easier for community health workers who conduct regular site visits to prevent heat-related illnesses than physicians in urban health centers. From observations, many community members appeared to trust and have good relationships with community health workers. Each slum community also had gatekeepers or key community members whom slum dwellers all knew and trusted. Therefore, public health officials can work with these community leaders invested within each slum to promote ways to raise awareness and reduce heat vulnerability such as drinking water often and reducing outdoor activities during the daytime as well as to provide heat warnings at the beginning of each summer. Community health workers can also distribute and convey key health information in simple terms to help slum dwellers recognize signs and symptoms to prevent those symptoms from advancing to severe heat illnesses. Community health workers and other community leaders might also target specific households with individuals working in occupations where their heat exposure could potentially be higher if they work outdoors in the sun, as this study found.

2. ***Increase awareness of heat-related illnesses among physicians working with the slum population to help them recognize signs and symptoms in order to prevent severe morbidity and mortality:*** Physicians working at the local urban health centers might post heat illness prevention tips at the centers as well as caution all patients they see about the potential health effects of high temperatures at the start of and during summer. Physicians could also look out for signs and symptoms of heat-related illnesses when they treat patients to prevent those symptoms from advancing to severe heat illnesses and discuss potential barriers to protective behaviors. A workshop might also be set up by public health officials to educate physicians on the significance of recognizing the signs and symptoms, how to recognize them, and how to raise awareness regarding health issues

related to heat among their patients. As a long term goal, a system to report and record heat-related diagnoses and mortality could be established to help the city track morbidity and mortality related to heat. This information will be useful in understanding the prevalence and incidence of heat-related illnesses as well as evaluations of interventions.

3. ***Plant trees in and around slum settlements:*** While many slum dwellers already have access to at least an electric fan, planting trees is beneficial in multiple ways including providing shade, reducing the urban heat island effect, and reducing air pollution. Establishing cooling centers in or near slums might not be feasible as it can be costly. Trees would be more cost-effective and require less maintenance while providing shade (additional studies might provide a cost-benefit analysis). Tress can also prevent or reduce the urban heat island effect because they would prevent heat from being trapped in impervious surfaces as well as reduce air pollution, which also accelerates the urban heat island effect. Plants facilitate dry deposition of particulate matter and remove gaseous pollutants. Planting trees would thus benefit the city as a whole in the long run.
4. ***Deliver heat-related illnesses prevention campaigns and extreme heat advisories through television:*** Among heat warning sources, 78% of respondents had reported television as their primary warning source. As it appears that many residents within slums own televisions, it can be an effective means to distribute tips on how to prevent getting sick from heat as well as alert residents of extreme heat at the beginning of summer and right before and while heat waves occur.
5. ***Encourage neighbors to check on each other during heat waves:*** Those in living in slums could be encouraged to check on their neighbors more frequently during heat waves through prevention campaigns since higher social connectivity appeared to have a protective effect. Community health workers, physicians, and community leaders could also promote this protective behavior in their discussions with patients, friends and community members about the health effects of heat and prevention strategies.

6. ***Target interventions towards specific occupations where employees are frequently exposed to heat or specific areas where particular occupational clusters might exist:*** Certain occupations require employees to spend more time outdoors directly in the sun and to perform more strenuous tasks in the sun and/or near heat sources such as furnaces. Only working in the sun increased risk for heat-related symptoms in this study. Public health officials might speak directly with employees in occupations such as masonry and construction work to discuss ways of practicing preventive behaviors while working to reduce heat exposure and/or prevent heat illness. Officials might also work directly with employers to change certain practices to reduce exposure or provide employees with tips to protect themselves from overexertion and heat-related illnesses, especially during heat waves. Because certain trades or occupations might also be clustered in specific areas of the city, interventions might be more effective if public health officials focus intervention efforts by region. A larger population with similar occupational heat exposure levels could then be exposed to prevention techniques and advisories simultaneously, and the information might, in effect, be passed along to more people through social networks. Development of specific interventions may require further research to determine the most effective interventions.

4.6 Implications for Future Research

Findings of this study can serve as baseline for patterns of heat-related morbidity among slum dwellers in Ahmedabad, India as well as a starting point for future heat vulnerability assessments in India. Considering this study's limitations, a similar study could be conducted in Ahmedabad to validate findings and conclusions made here. To improve the survey and sampling methodology so results and conclusions can be generalizable, we have developed several recommendations:

1. ***Modify survey language to suit the literacy level of respondents:*** To prevent confusion among interviewers and survey respondents, questions should be rephrased with assistance from urban health center workers or community leaders within the slums to

reflect language internally used by slum dwellers. In particular, focus should be given to health-related questions since they were likely the most poorly understood by both interviewers and respondents. Because people with varying cultural backgrounds inhabit the slums, such as those with ancestors who were migrants from Rajasthan and Uttar Pradesh, local community leaders could be trained to conduct the surveys within their communities since colloquialisms likely differs from slum to slum and one term may not fit all.

2. ***Modify or remove survey questions and responses that are not socially and/or culturally appropriate:*** Certain questions and/or responses may not apply to those who reside in slums because of lower SES (lack of resources and poor conditions within slums) and particular cultural and/or traditional practices. Thus, questions should be adjusted or eliminated. For example, as mentioned above, many slum dwellers follow traditional practices of worshiping gods to relieve them of their illnesses, especially minor symptoms. Additionally, UHCs may not be centrally located to all slums. Rather than asking whether it is convenient for them to see a medical provider, it might be more useful to ask whether they visit a health center when they or their family get sick. Additionally, asking why they choose to do so, whether they have been visited by a community health worker before, and what services were provided to them would be more insightful because it might allow researchers to understand barriers to recognizing heat-related outcomes. Again, involving local community leaders might make it easier to modify questions and responses appropriate to the study settings.
3. ***Frame heat-related health and behavior questions to reflect those in the past one to two weeks:*** Respondents possibly had a hard time recalling heat-related conditions and behaviors, especially symptoms, if they occurred more than a month prior to the survey. Events that occurred more than one month before could also easily get mixed up with those even further back in time. Therefore, the phrase “in the past two weeks,” or other

shorter time frame, could be added to all questions on the survey pertaining to heat-related symptoms and illnesses, access to information, and other adaptive behaviors.

4. ***Acquire lists with number of slums and households within each ward to account for clustering effects:*** Although lists at the ward level containing numbers of slums and households could not be obtained for this study, UHCs do have these lists. It is advisable to recruit UHC workers early in the process for assistance in collecting these lists. These lists are likely not complete since more recently established slums probably have not been counted by AMC officials and population counts depend on how often the list is updated. Knowledge of the total number of slums and households will allow for randomized sampling at those levels as well as calculating weights to adjust for clustering effects at those levels. More complex analyses can then be done to improve generalizability of results and conclusions.
5. ***Recruit research assistants with health backgrounds and survey experience:*** Regardless of background or experience, RAs should be trained for several days and pilot the survey in mock interviews with professionals for quality control as well as in the field on several occasions. This will give them the opportunity to firmly understand the nature of the research and interviewing techniques, and become comfortable with interviewing. Backgrounds in health and/or surveying experience are advantages since they will be able to better explain health-related questions through examples and clarifications, and might better understand the concepts of bias. With such knowledge, it would be easier for them to avoid interviewing in ways that can potentially discourage or encourage particular responses.

In addition, conducting a focus group with slum dwellers before doing a similar assessment with this survey can provide context and explanations to patterns found here and inform adjustments that can be made to survey questions and responses. Rather than assuming

how people might be exposed, susceptible to heat, and coping with heat through close-ended questions and responses, open-ended focus group questions would allow participants to impart their perceptions on how they might be exposed and susceptible to heat, and share methods they personally use to adapt to high temperatures. Focus groups also provide researchers more time to build rapport among participants, which might encourage them give more honest and informative responses. Focus groups are also beneficial to participants because certain individuals may raise issues or offer examples and/or solutions that other individuals may have never considered, which might help them change or develop behaviors that protect against heat-related illnesses.

Furthermore, an evaluation of the effectiveness of current coping behaviors and responsiveness to future interventions can inform the development of effective interventions. Certain traditional practices thought to reduce heat exposure might have an opposite effect and increase exposure, or have no effect. An evaluation of how effective adaptive behaviors currently being implemented would thus allow public health officials to promote and, possibly, discourage particular behaviors that are applicable to the slum population for reducing heat-related morbidity and mortality. Additionally, as Wilhelmi and Hayden[7] had suggested, it is unclear how successful and effective public health interventions intended to reduce vulnerability and heat-related mortality and morbidity have been. Therefore, integrating an evaluation component to future interventions (e.g. a cohort study where health records are collected of baseline and incident cases of heat-related illnesses to compare before and after effects of interventions) will allow public health officials to measure the effectiveness of their interventions and make improvements.

Lastly, temperature can be monitored in specific slum settlements to compare ambient temperatures from central monitors to regional monitors as well as compare morbidity and mortality data. Temperatures slum dwellers personally are exposed to likely differ by region as well as from temperatures recorded by the central monitor at the Ahmedabad airport. Calibrated monitors, such as the temperature/dew point logger system (HOBOs) used by Harlan et al.[23], could be set to record temperature and humidity in specific time intervals at certain sites for a

year. Regular temperatures and heat wave temperatures could then be compared. Temperatures between sites and that recorded by the central monitor can also be compared. If sufficient heat-related morbidity and mortality data recorded at approximate times of diagnosis or death and/or dates of occurrence are available, daily temporal and annual patterns could be established.

5 Conclusion

This study of factors affecting vulnerability in Ahmedabad indicated that age, income, preexisting conditions, work location, drinking water sources, access to doctors and information, and social connectedness influence the occurrence of heat-related symptoms and illnesses among slum dwellers. The findings suggest several potentially worthwhile interventions targeting slum dwellers including: working with community health workers, community leaders and physicians to disseminate information and prevent heat illnesses by recognizing signs and symptoms; planting trees; delivering important health and heat information through television campaigns; and promoting increased social connectedness. Future research studies might include conducting other vulnerability assessments with improvements to the survey used here, conducting focus groups with the slum community, evaluating the effectiveness of currently applied adaptive behaviors and future interventions e.g. cohort study using health records, and collecting information on temperature at different locations to compare ambient and personal temperature exposures.

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Figure 1[40]. Climatic regions of India.

As classified by the Köppen classification system, India is divided into six major climatic regions including: alpine (or montane), humid subtropical, tropical wet and dry, tropical wet, semi-arid, and arid regions.

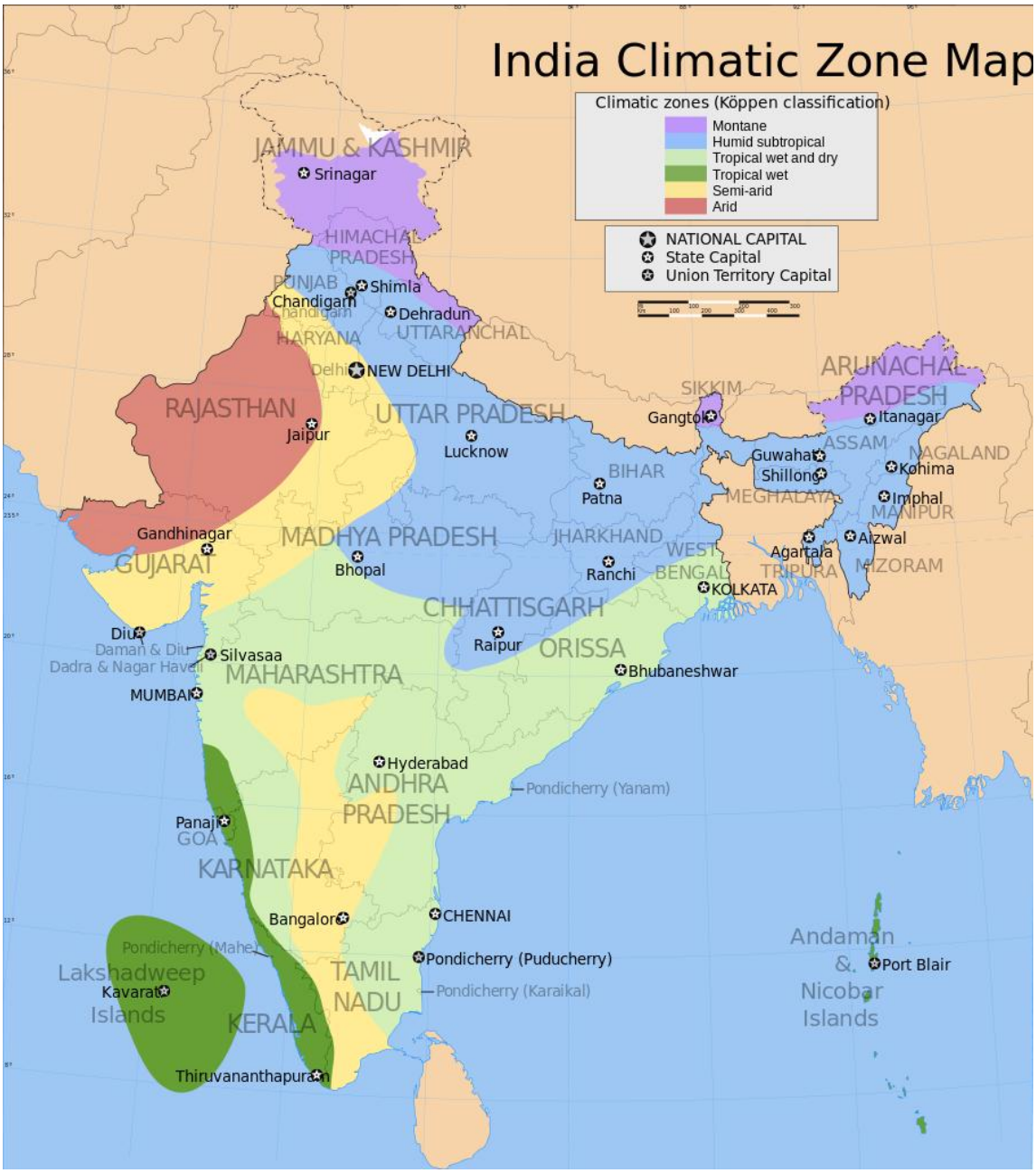


Figure 2[8,12]. Seven homogeneous regions defined by topology and climatic conditions. The homogenous regions include the Western Himalayan, North West, North Central, North East, Interior Peninsula, West Coast and East Coast. The setting of this study is Ahmedabad, India. Located in Gujarat state and the North West homogenous region, the climate is generally very arid year-round, with summer temperatures rising to a maximum average of 45°C and minimum average of 23°C.

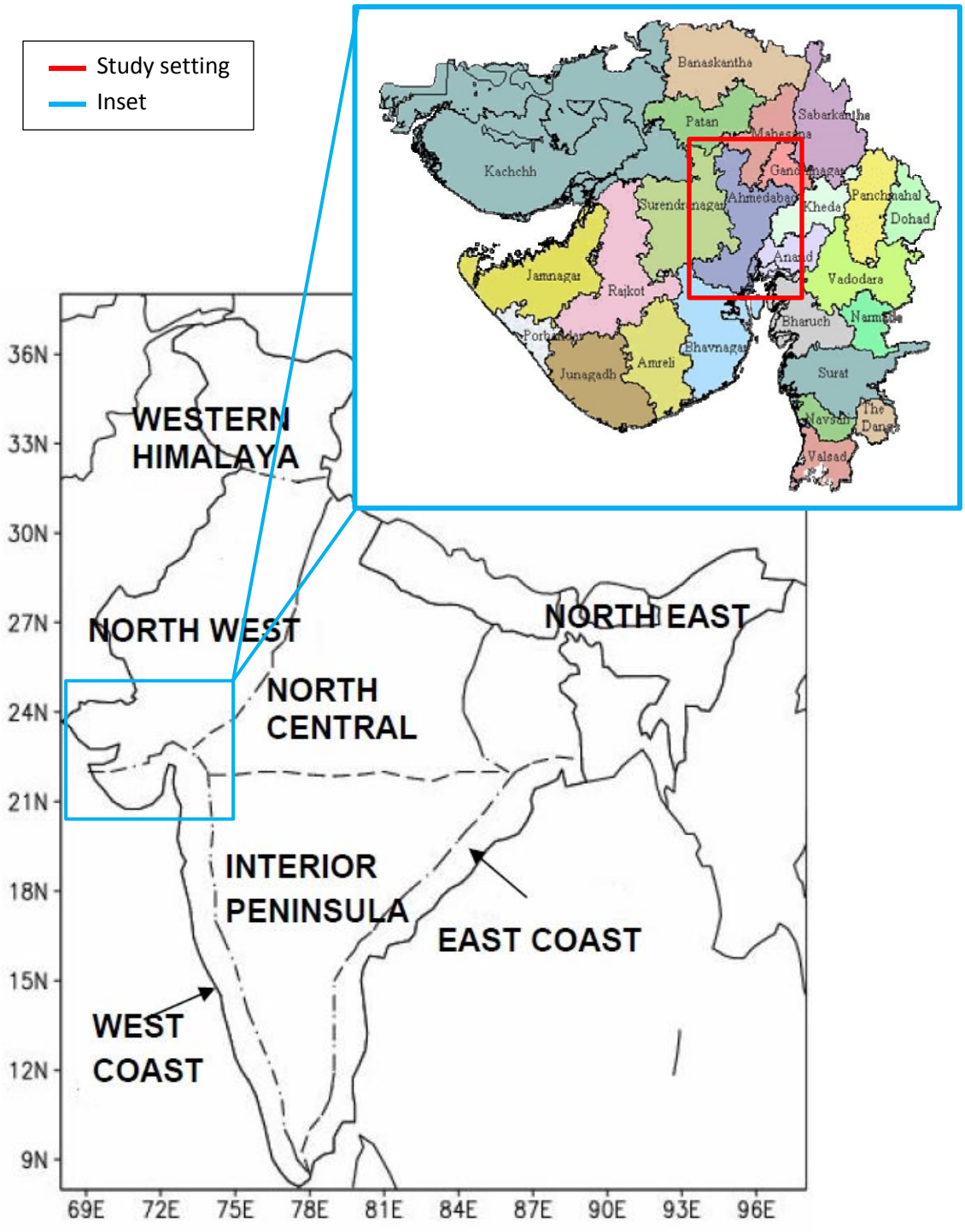


Figure 3[8]. Annual mean temperature anomalies across India from 190-2009 (based on 1961-1990 average). The blue solid curve shows sub-decadal time scale variations smoothed with a binomial filter.

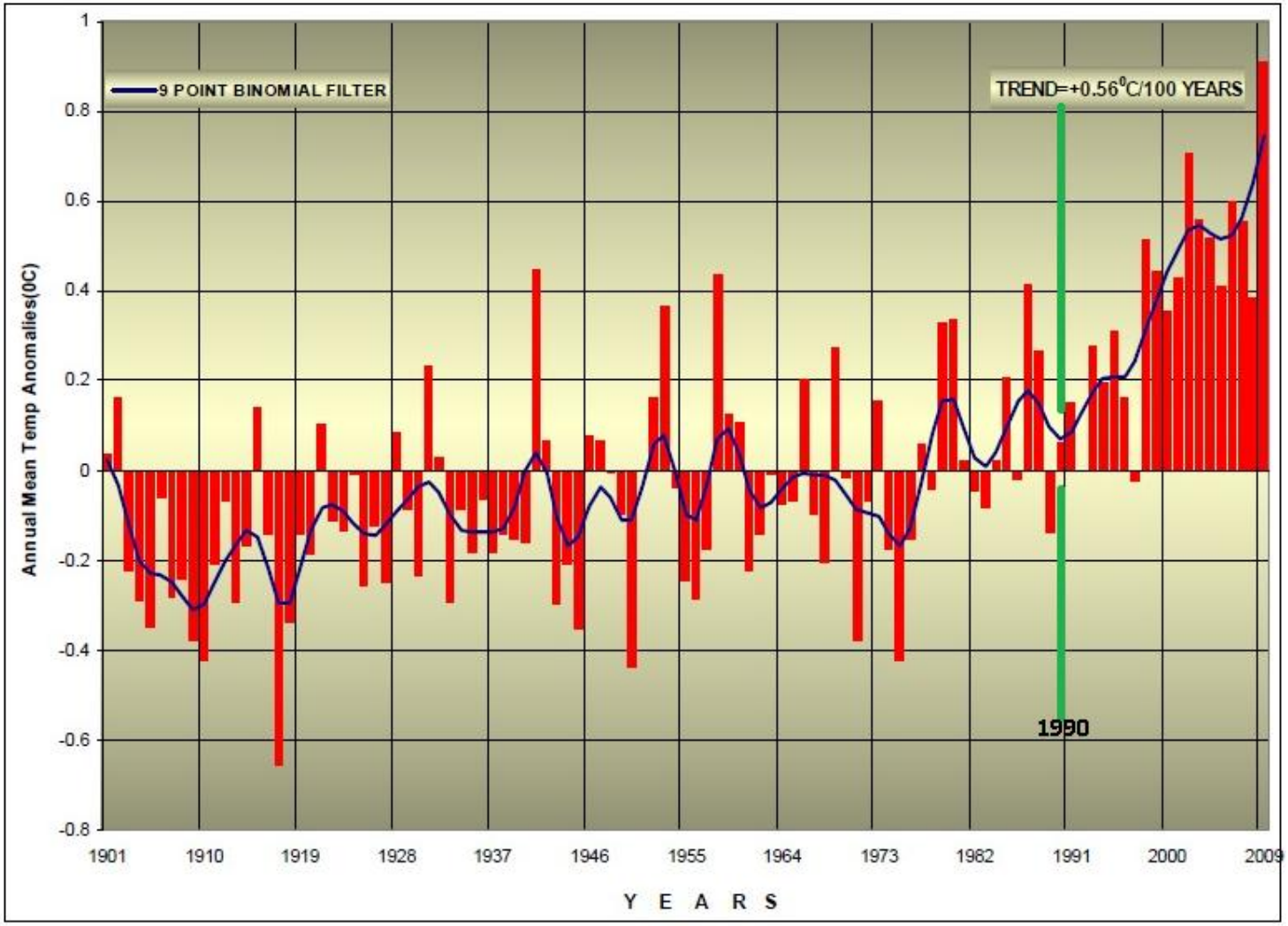
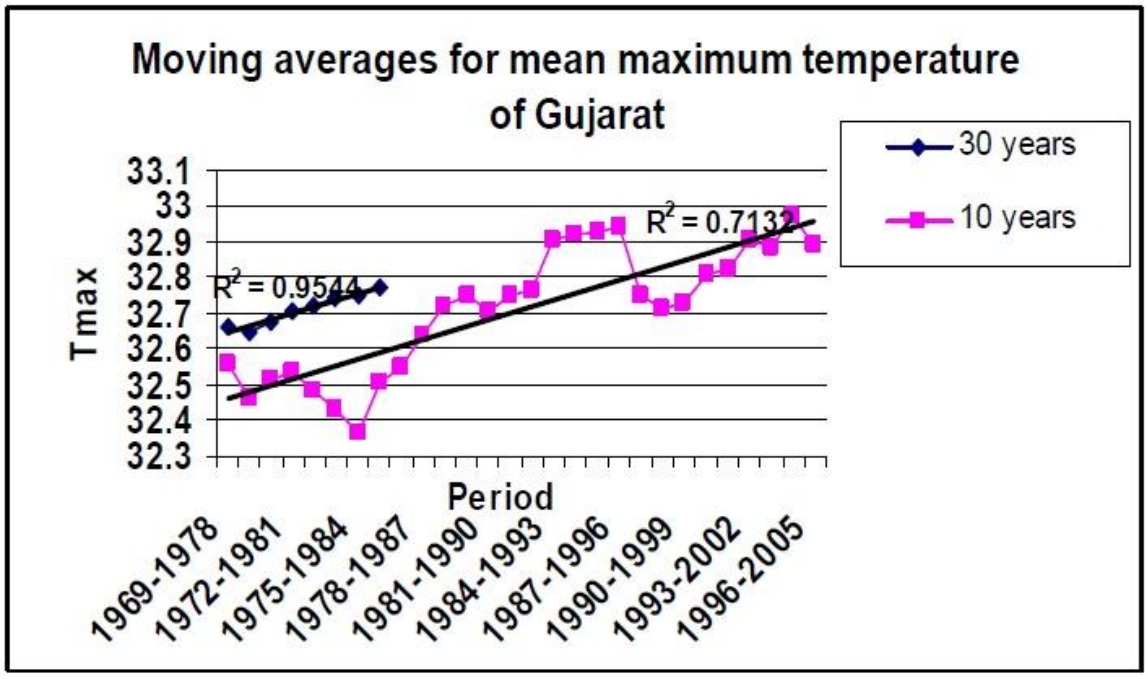


Figure 4[12] A&B. 10 and 30 Year moving averages of maximum and minimum temperatures in Gujarat.

A



B

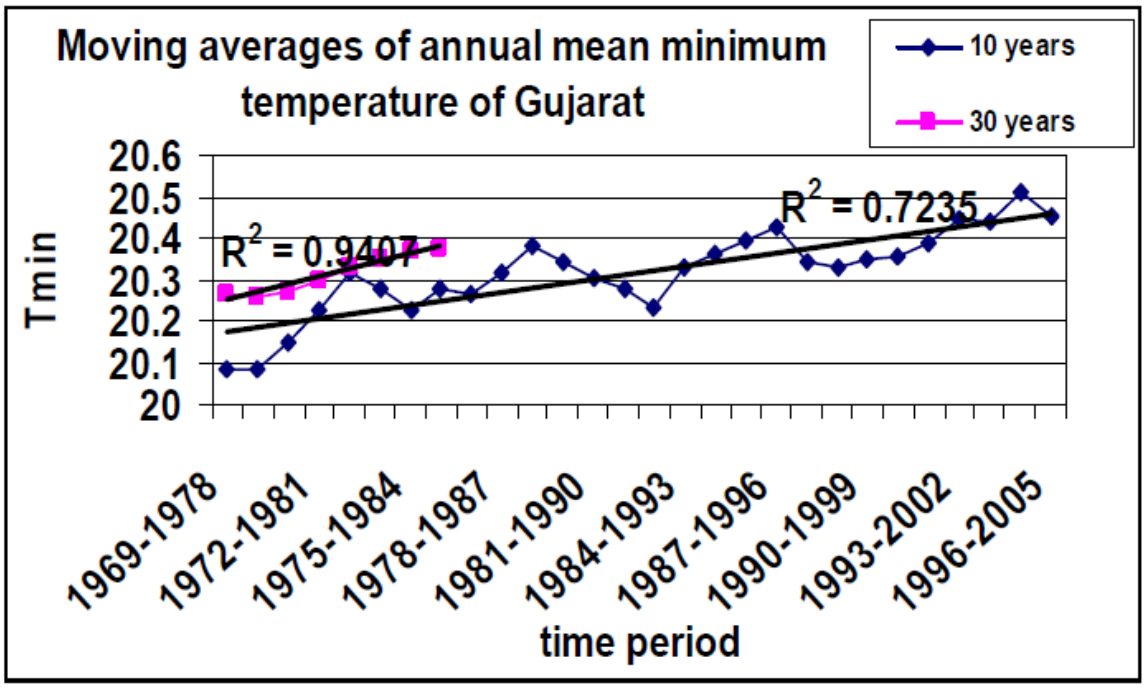


Figure 5. Daily 2010 average maximum and minimum temperatures in Ahmedabad, Gujarat, India. Temperature data courtesy of the Ahmedabad Meteorological Department retrieved August 2011.

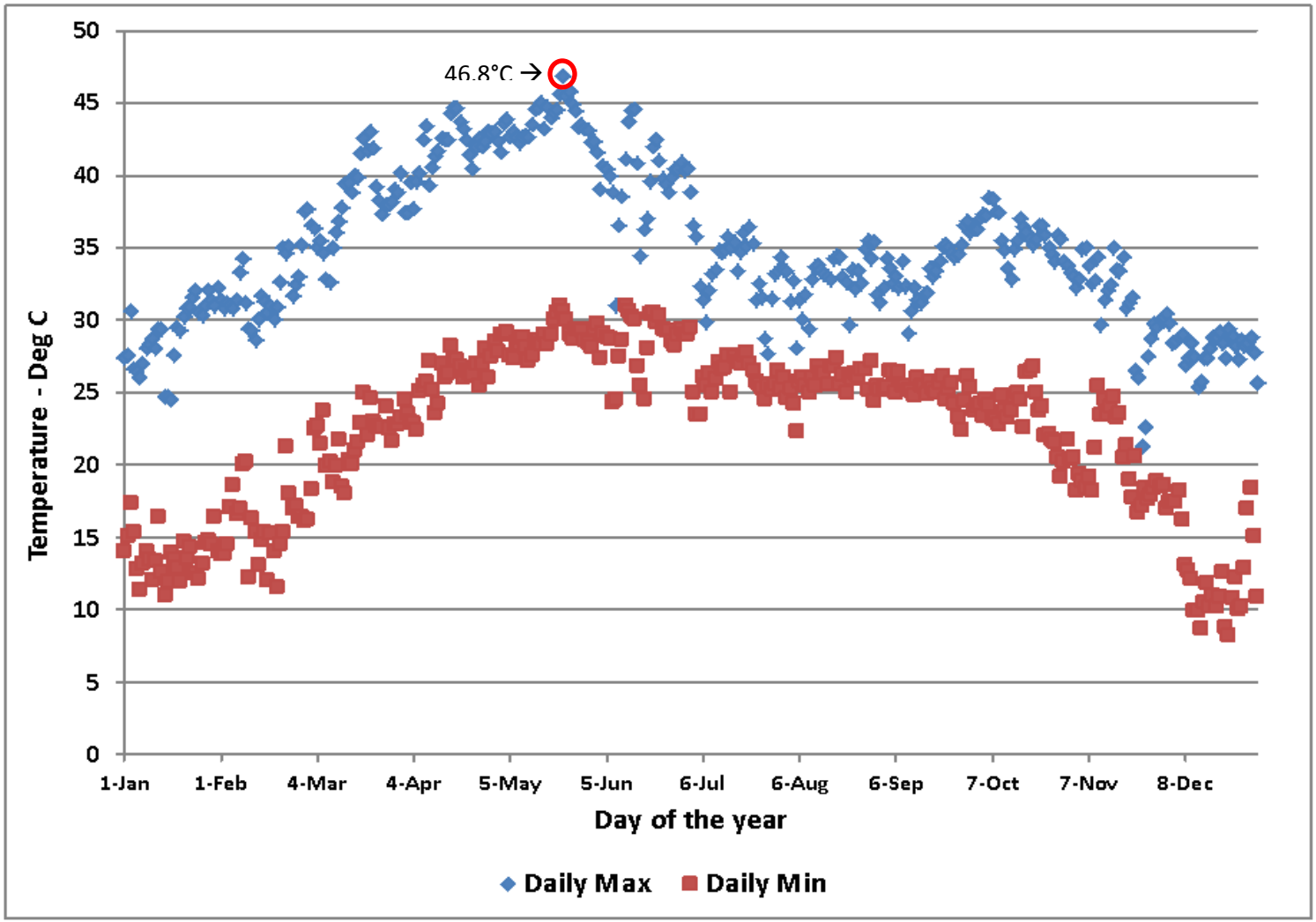
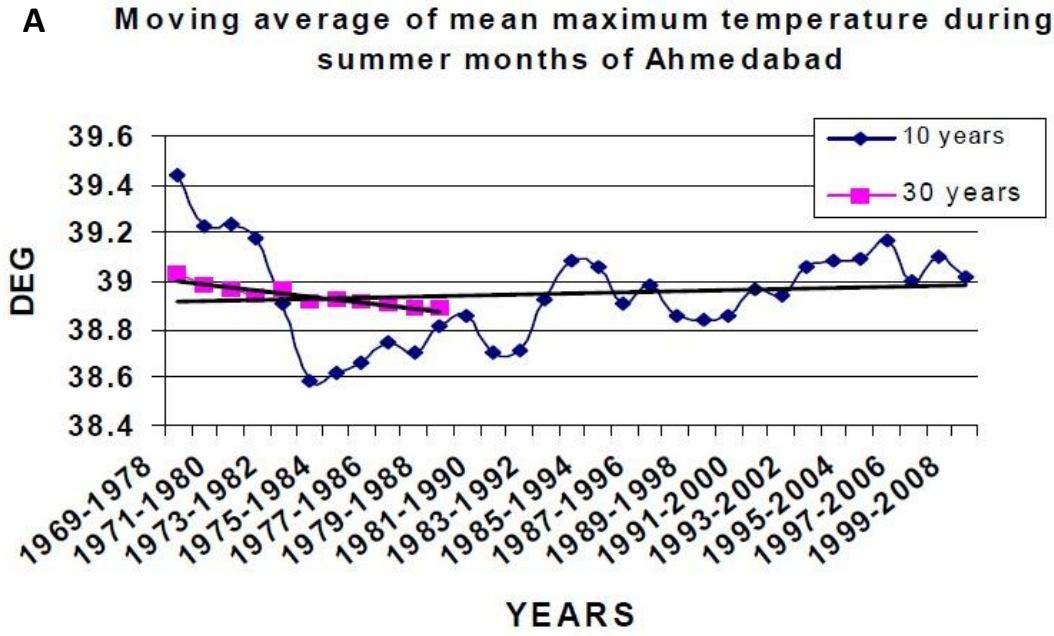


Figure 6[12] A&B. 10 and 30 Year Moving Averages of Maximum Summer and Minimum Winter Temperatures in Ahmedabad, India. Although there were some major fluctuations between 1969 and 2008, the overall trends only show slight decrease in average maximum temperatures in the summer and slight increase in average minimum temperature in the winter. Overall, temperatures have remained relatively stable throughout those 40 years.



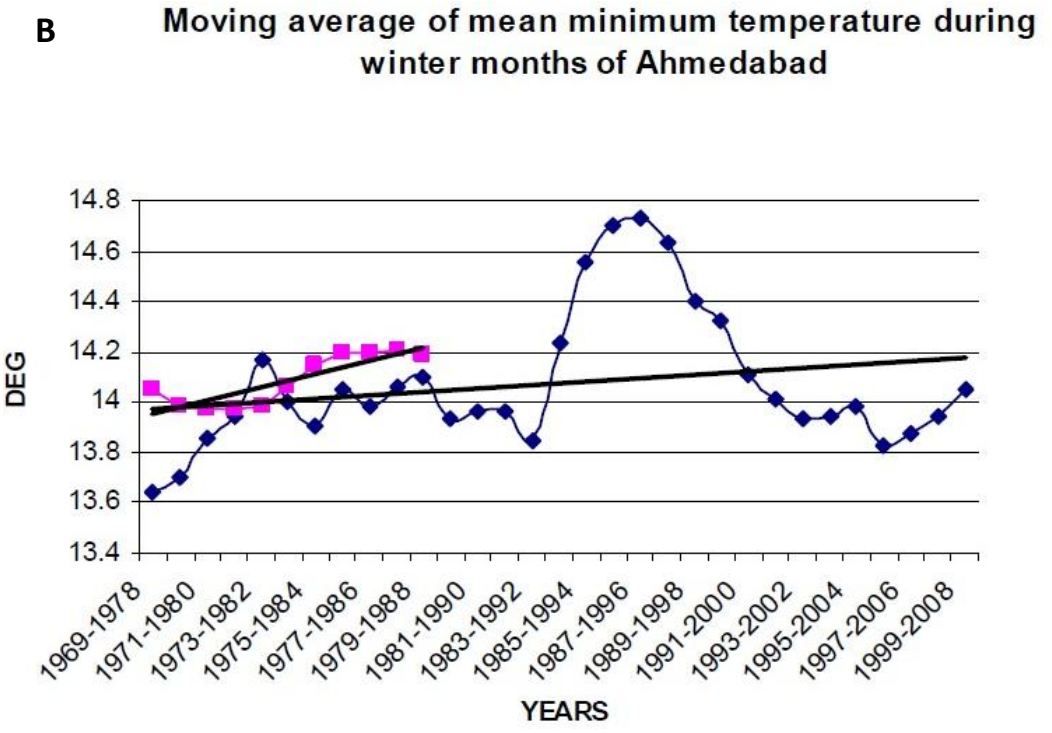


Figure 7. Sampling Design and Household Selection Method. A. Ahmedabad is composed of 6 zones: West, New West, South, Central and East. The zones were further broken down into wards. Two wards were randomly selected per zone out of a total of 57 wards. Within each selected ward, the largest slum was selected for sampling for a total of 12 study sites. Within these study sites, 25 households were surveyed for a total of 50 households per slum and 300 total surveys. B. The neighborhood layout varied among slums. An example of a slum organized by parallel lanes is shown here. Research assistants (5) were instructed to randomly select one household to begin at in their assigned area. Here, they were assigned two lanes each. After the initial household, they proceeded to the fourth house, either left or right of the first, and then every fourth thereafter. RAs selected directions intuitively.

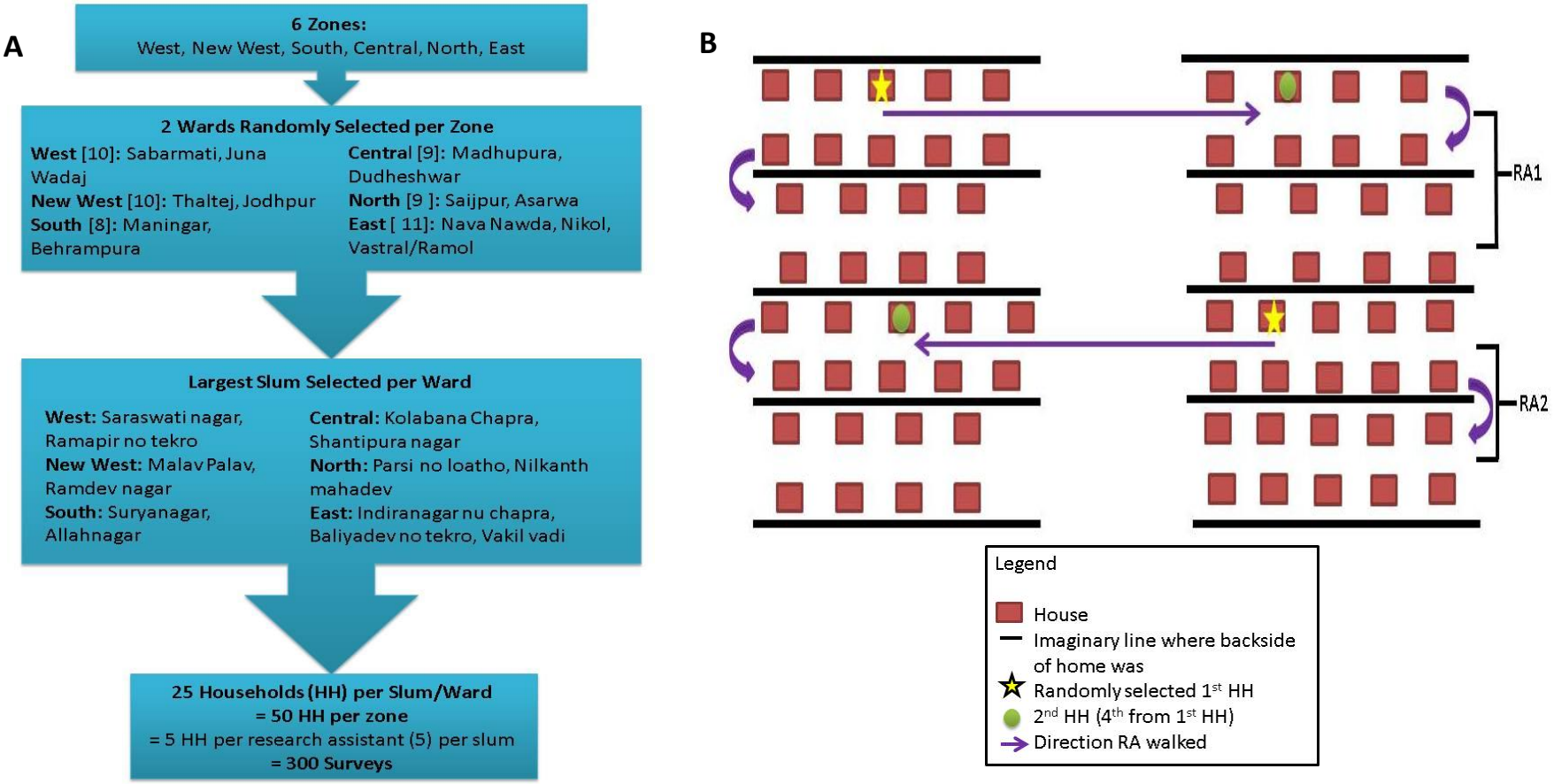


Figure 8. Map of location of all 13 wards where sampling occurred. Markers do not indicated exact location of slum as a GPS was not accessible to record coordinates; they represent the general location of the ward. Wards included: Sabarmati, and Juna Vadaj in the West zone; Thaltej and Johdpur in the New West zone; Maninagar and Behrampura in the South zone; Madhupura and Dudeshwar in the Central zone; Saijpur and Asarwa in the North zone; and Nicol, New Naroda, and Ramol in the East zone.

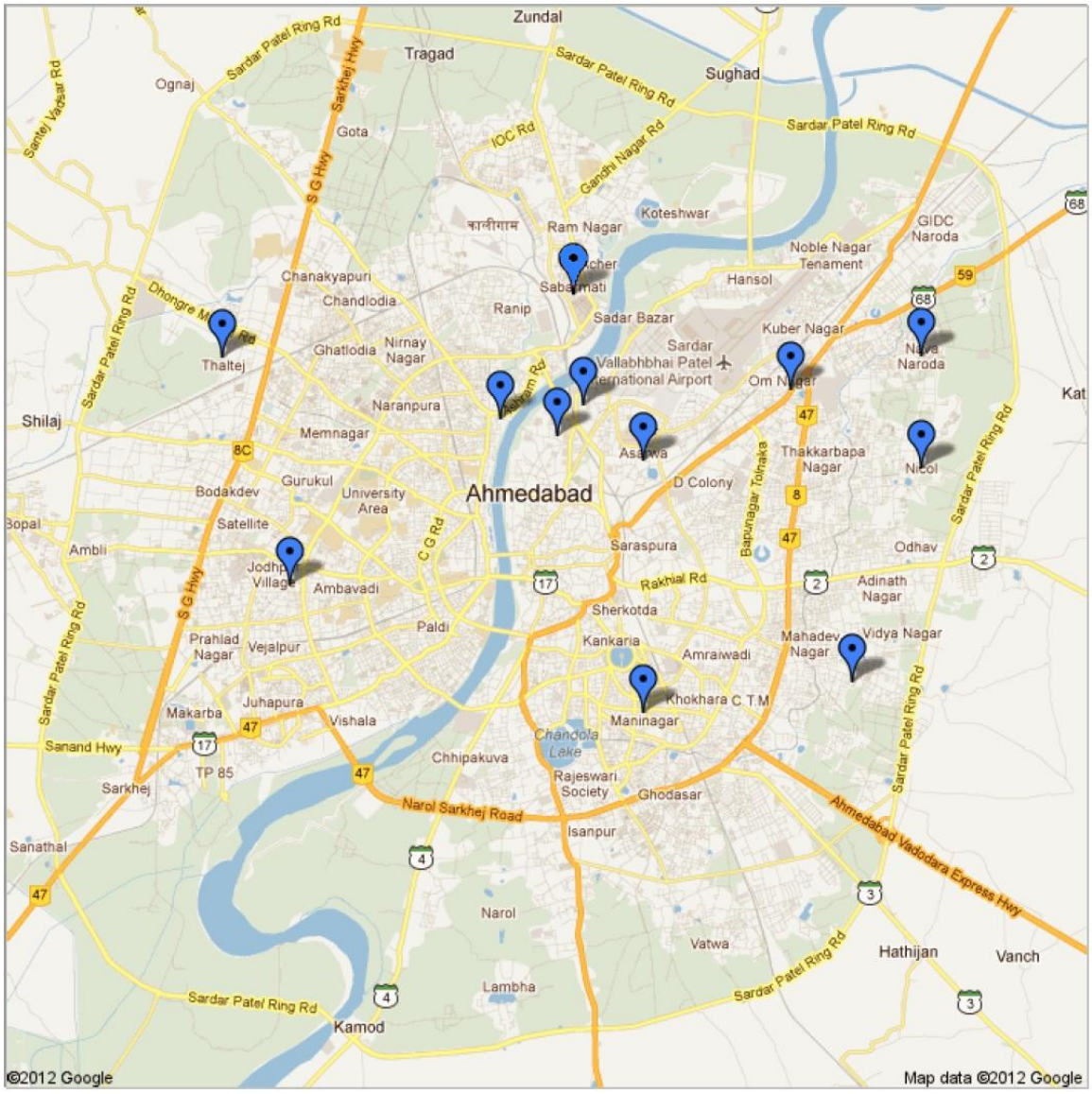


Figure 9. Slums of Ahmedabad across six city zones.


Saraswati nagar, Sabarmati ward, West zone


Millatnagar, Maninagar ward, South zone


Malav Palav, Thaltej ward, New West zone


Parsi no loatho, Saijpur ward, North zone

Table 1. Associations between heat-related outcomes and candidate covariates (odds ratios and 95% confidence intervals. Results bolded when confidence intervals excluded 1. (Italicized header indicate a following group of variables of related measures)

	HRI	**HRS**	**HRI+HRS**
Demographics			
Age (Increase in 5 years)	1.00 (0.99, 1.01)	**1.041** (1.03, 1.05)	**1.03** (1.02, 1.03)
Monthly HH income (increase in 100 INR)	1.00 (0.99, 1.00)	**1.00** (0.99, 1.00)	1.00 (0.99, 1.00)
Bi-monthly electricity bill (increase in 100 INR)	0.98 (0.95, 1.02)	**0.96** (0.94, 0.99)	**0.96** (0.94, 0.99)
Exposure factors			
Occupational category			
Manual labor	0.69 (0.44, 1.10)	1.40 (0.99, 1.96)	1.16 (0.86, 1.56)
Service/Office/teacher	0.82 (0.45, 1.48)	1.18 (0.79, 1.77)	0.89 (0.62, 1.29)
Sales/Artisan	0.80 (0.46, 1.38)	1.09 (0.72, 1.65)	1.01 (0.69, 1.47)
Homemaker/none (ref)			
Work outdoor in summer	0.71 (0.34, 1.47)	0.85 (0.44, 1.66)	0.78 (0.44, 1.38)
Location of work			
Sun	1.01 (0.49, 2.06)	**2.67** (1.65, 4.31)	**1.95** (1.26, 3.02)
Mixed	0.61 (0.33, 1.15)	1.02 (0.64, 1.63)	0.89 (0.59, 1.35)
Shade (ref)			
Kitchen located inside	2.09 (0.92, 4.74)	**2.55** (1.61, 4.06)	**2.71** (1.71, 4.29)
Transit: Walking vs. Auto rickshaw	1.98 (0.48, 8.05)	**2.49** (1.58, 3.92)	**2.59** (1.36, 4.95)
Cooling method			
A/C or air cooler	--	**0.15** (0.053, 0.44)	**0.11** (0.034, 0.36)
Electric fan	--	**0.54** (0.34, 0.86)	0.69 (0.37, 1.27)
Other	--	0.88 (0.19, 4.04)	0.82 (0.15, 4.36)
None (ref)			
Susceptibility factors			
Chronic preexisting condition	**1.52** (1.02, 2.26)	**3.37** (2.57, 4.43)	**2.52** (1.95, 3.26)
Diarrheal preexisting condition	**3.25** (1.78, 5.93)	1.19 (0.69, 2.07)	**2.05** (1.34, 3.13)

Infectious preexisting condition	**2.75** (1.88, 4.02)	**1.51** (1.12, 2.03)	**2.05** (1.58, 2.67)
Barrier to A/C vs Nothing/Don't want to	**2.40** (1.65, 3.51)	**1.42** (1.07, 1.89)	**1.90** (1.43, 2.53)
Main source of drinking water			
In-home tap	0.71 (0.35, 1.42)	**0.51** (0.28, 0.92)	**0.41** (0.20, 0.84)
Public	0.85 (0.30, 2.42)	**0.43** (0.21, 0.89)	**0.42** (0.18, 0.97)
Purchased (bottled/50L jugs) (ref)			
Time of day get water			
Morning	--	0.94 (0.44, 2.03)	1.52 (0.71, 3.26)
Noon	--	1.58 (0.67, 3.75)	**3.49** (1.37, 8.88)
Evening (ref)			
Adaptive Behaviors			
Had NOT visited a Dr. for heat-related illness	--	**0.61** (0.46, 0.80)	**0.26** (0.20, 0.35)
Access to info:			
Heat warning source this past summer: people vs media	0.91 (0.61, 1.36)	**2.10** (1.56, 2.81)	**1.59** (1.19, 2.13)
Heat-related morbidity source where they have looked/would look			
Media	1.61 (0.85, 3.05)	0.76 (0.46, 1.25)	1.10 (0.67, 1.81)
Don't Know	0.81 (0.10, 6.40)	0.77 (0.25, 2.32)	0.95 (0.23, 4.01)
Community (ref)			
Person talked to about heat-related morbidity			
No one vs Professional	0.67 (0.38, 1.18)	**0.59** (0.41, 0.83)	**0.57** (0.40, 0.82)
Community vs Professional	0.93 (0.37, 2.33)	1.12 (0.58, 2.16)	1.13 (0.57, 2.22)
Professional (ref)			
NOT worried or unsure about getting sick from heat	--	**0.38** (0.15, 0.97)	**0.34** (0.12, 0.98)
Have sought heat-related morbidity info before	**6.31** (2.20, 18.12)	**2.01** (1.36, 2.97)	**2.88** (1.95, 4.26)

Coping methods frequency: Most of the time vs. Sometimes/Rarely			
Stay indoors	0.72 (0.28, 1.87)	1.31 (0.76, 2.25)	0.95 (0.53, 1.71)
Drink plenty of water	1.46 (0.62, 3.41)	1.62 (0.94, 2.79)	**1.76** (1.03, 3.01)
Seek shade/tree	0.74 (0.50, 1.09)	0.80 (0.61, 1.06)	**0.71** (0.54, 0.94)
Wear light clothing	1.10 (0.75, 1.61)	**0.56** (0.43, 0.72)	**0.68** (0.52, 0.89)
Wear hat/cover head	0.92 (0.59, 1.44)	**0.72** (0.53, 0.96)	0.78 (0.57, 1.05)
Go to A/C location	--	0.39 (0.05, 2.85)	0.25 (0.035, 1.80)
Reduce activity	0.72 (0.38, 1.35)	1.25 (0.86, 1.83)	1.03 (0.67, 1.57)
Take cool showers	**5.28** (1.82, 15.29)	**2.09** (1.31, 3.34)	**2.86** (1.79, 4.56)
Avoid outdoor activity	0.59 (0.14, 2.44)	0.54 (0.28, 1.02)	**0.50** (0.27, 0.93)
Coping Score (2-13) - continuous	0.98 (0.89, 1.07)	1.03 (0.96, 1.10)	1.00 (0.94, 1.08)
Coping score level			
Low (0-5)	0.95 (0.31, 2.95)	0.74 (0.40, 1.38)	0.80 (0.40, 1.61)
Moderate (6-9)	1.23 (0.84, 1.81)	1.16 (0.88, 1.53)	1.25 (0.95, 1.66)
High (10-16) (ref)			
Social connectedness:			
Did NOT feel safe in neighborhood because of positive/neutral relations within neighborhood	0.55 (0.080, 3.79)	0.69 (0.35, 1.35)	0.62 (0.28, 1.37)
Did NOT Know most of their neighbors and talk to them often	0.70 (0.40, 1.23)	1.15 (0.81, 1.62)	0.96 (0.67, 1.38)
Nearest person they would call in an emergency			
No one	--	0.54 (0.22, 1.32)	0.75 (0.21, 2.77)
Outside of neighborhood	--	0.66 (0.40, 1.08)	**0.42** (0.25, 0.68)
In the neighborhood (ref)			
Respondent/neighbor have NOT checked on each other during heat wave and/or called on each other in an emergency	**0.19** (0.087, 0.42)	**0.51** (0.34, 0.76)	**0.36** (0.24, 0.54)

Social connectedness score - 0-3 (ref=3)			
0-1 vs 3	0.44 (0.19, 1.06)	1.15 (0.70, 1.87)	0.84 (0.51, 1.39)
2 vs 3	**0.26** (0.13, 0.49)	**0.41** (0.28, 0.59)	**0.31** (0.21, 0.46)

Table 2. Covariates included in final model for each heat-related outcome (heat-related symptoms, heat-related illnesses, and combined outcomes).

	HRS	**HRI**	**HRI+HRS**
Age (increase by 5 yrs)	1.21 (1.16, 1.26)	--	1.13 (1.09, 1.18)
HH monthly income (increase by 100 INR)	0.99 (0.99, 0.99)	--	--
Work location:			
Sun	1.86 (1.08, 3.20)	--	--
Mixed	0.94 (0.54, 1.61)	--	--
Shade (ref)			
Chronic preexisting condition	2.45 (1.79, 3.36)	1.67 (1.11, 2.52)	1.96 (1.43, 2.67)
Diarrheal preexisting condition		3.31 (1.73, 6.32)	1.70 (1.04, 2.78)
Infectious preexisting condition	1.53 (1.09, 2.16)	2.84 (1.88, 4.31)	1.73 (1.27, 2.35)
Main drinking water source:			
In-home tap	0.45 (0.21, 0.94)	--	--
Public (tap/borehole)	0.35 (0.15, 0.82)	--	--
From neighbor	0.78 (0.25, 2.4)	--	--
Purchased (bottled or 50 L jugs) (ref)			
Had NOT seen a doctor before for heat-related illness	--	--	0.33 (0.25, 0.44)
Had NOT sought heat-related morbidity info before	--	4.58 (1.41, 14.88)	--
NOT worried about getting sick from heat	0.33 (0.15, 0.72)	--	0.47 (0.22, 0.99)
Social Connectedness Score (1-4)*:*			
0-1	3.27 (1.55, 6.93)	0.82 (0.31, 2.15)	2.18 (1.14, 4.16)
2	0.69 (0.43, 1.12)	0.42 (0.21, 0.85)	0.67 (0.43, 1.03)
3 (ref)			

Table 3. Demographics of the sampled population residing in the Ahmedabad slums across six city zones (household N=300, individual N=1650).

	West	**New West**	**South**	**Central**	**North**	**East**	**Entire Sample**
# HH sampled	50	50	50	50	50	50	300
% F respondent	88	78	94	90	88	90	88
N individuals reported	280	269	283	269	287	262	1650
Avg. HH size (stnd dev)	5.6 (2.3)	5.4 (1.6)	5.7 (2.8)	5.4 (2.0)	5.7 (1.9)	5.2 (1.7)	5.5 (2.1)
Avg. age (stnd dev)*****	26.4 (17.9)	26.1 (18.6)	24.2 (17.1)	26.6 (17.2)	27.0 (17.7)	26.4 (17.5)	26.1 (17.7)
% (n) HH with young children and/or elderly	50 (25)	46 (23)	48 (24)	46 (23)	54 (27)	32 (16)	48 (144)
Avg. HH monthly income (stnd dev)	6180 (3634)	6626 (5902)	5716 (4547)	5686 (3919)	6362 (4570)	7755 (6887)	6389 (4913)
Avg. proportion of HH members employed (stnd dev)	0.36 (0.17)	0.39 (0.25)	0.35 (0.15)	0.41 (0.21)	0.40 (0.21)	0.35 (0.16)	0.38 (0.20)
Avg. proportion of HH members of working age (16-50) employed	0.55 (0.22)	0.57 (0.25)	0.58 (0.23)	0.56 (0.22)	0.55 (0.19)	0.53 (0.20)	0.56 (0.22)
% (n) elderly (>60) employed among elderly*	8 (1)	20 (3)	18 (2)	30 (3)	25 (3)	10 (1)	19 (13)
% own home	82	80	84	76	88	74	81
Avg. time at current residence (stnd dev) (yrs)	23.3 (15.3)	28.9 (20.1)	22.9 (28.7)	25.1 (16.9)	32.6 (19.5)	15.8 (12.3)	24.8 (20.0)
% pay for electricity	96	92	86	88	100	88	92
Avg. bi-monthly electric bill (stnd dev) (INR)	639.9 (526.9)	576.4 (357.5)	433.8 (355.0)	576.1 (407.9)	762.8 (630.8)	522.6 (533.0)	585.3 (486.2)

*Among individuals

Table 4. Prevalence of self-reported outcomes within individuals (N=1650) residing in Ahmedabad slums across six city zones within the sampled population.

	West	New West	South	Central	North	East	Entire Sample
Avg. # of HH members with heat-related symptoms (stnd dev)	1.2 (1.11)	0.92 (1.08)	0.92 (1.23)	0.80 (0.83)	1.44 (1.01)	1.36 (0.94)	1.11 (1.06)
Avg. # of HH members with heat-related illnesses (stnd dev)	0.88 (1.08)	0.20 (0.46)	0.86 (1.81)	0.38 (0.70)	1.02 (0.92)	0.85 (0.85)	0.69 (1.09)
% (n) who ever previously experienced a heat-related symptom	21.4 (60)	17.1 (46)	16.3 (46)	14.9 (40)	25.1 (72)	26.0 (68)	20.1 (332)
% (n) who was ever previously diagnosed with:							
Heat stroke	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.38 (1)	0.06 (1)
Hyperthermia	1.4 (4)	0.0 (0)	2.5 (7)	0.74 (2)	1.7 (5)	0.38 (1)	1.2 (19)
Heat rash/adema/exhaustion	12.5 (35)	2.2 (6)	12.4 (35)	5.6 (15)	15.7 (45)	14.9 (39)	10.6 (175)
None	86.1 (241)	97.8 (263)	85.2 (241)	93.7 (252)	82.6 (237)	84.6 (221)	88.2 (1455)
% (n) who ever previously had a heat-related symptom or diagnosed illness	30.0 (84)	19.0 (51)	27.9 (79)	19.3 (52)	38.0 (109)	38.9 (102)	28.9 (477)

Table 5. Individual (N=1650) and household (N=300) exposure factors among residents of Ahmedabad slums across six city zones.

% (n)	**West**	**New West**	**South**	**Central**	**North**	**East**	**Entire Sample**
			N=1650 reported individuals				
Occupation groups - N	N=280	N=269	N=283	N=269	N=287	N=262	N=1650
Homemaker/None	65.7 (184)	61.0 (164)	66.4 (188)	59.9 (161)	62.4 (179)	64.9 (170)	63.4 (1046)
Physical labor	11.4 (32)	11.2 (30)	7.8 (22)	13.0 (35)	13.2 (38)	9.9 (26)	11.1 (183)
Service	13.2 (37)	10.8 (29)	7.4 (21)	11.2 (30)	7.0 (20)	6.1 (16)	9.3 (153)
Office/Teacher	2.5 (7)	1.1 (3)	0.4 (1)	1.9 (5)	0.7 (2)	4.6 (12)	1.8 (30)
Factory/Manufacturing	0.7 (2)	0.7 (2)	3.2 (9)	6.0 (16)	9.4 (27)	9.9 (26)	4.9 (82)
Sales	5.0 (14)	8.6 (23)	3.5 (10)	6.3 (17)	5.9 (17)	1.9 (5)	5.2 (86)
Artisan	1.4 (4)	6.7 (18)	11.3 (32)	1.9 (5)	1.4 (4)	2.7 (7)	4.2 (70)
Work hrs not dependent on season	81.3 (78)	90.7 (88)	89.0 (81)	97.2 (105)	95.4 (104)	89.1 (82)	90.7 (538)
Work outdoors in summer	92.7 (89)	77.3 (75)	72.8 (67)	98.2 (106)	97.3 (106)	97.8 (90)	89.7 (533)
Workplace has indoor fan	61.5 (59)	70.1 (68)	70.7 (65)	61.1 (66)	73.4 (80)	64.1 (59)	66.8 (397)
Wear medium (thickness) work clothing	97.9 (94)	92.7 (89)	94.6 (87)	97.2 (105)	100 (109)	98.9 (91)	97.0 (575)
Work in the daytime	97.9 (94)	96.9 (94)	97.8 (90)	99.1 (107)	99.1 (108)	100 (92)	98.5 (585)
Location of work -							
Sun	22.9 (22)	16.5 (16)	14.1 (13)	20.3 (22)	6.4 (7)	10.9 (10)	15.2 (90)
Shade	33.3 (32)	41.2 (40)	62.0 (57)	36.1 (39)	54.1 (59)	53.3 (59)	46.5 (276)
Mix	43.8 (42)	42.3 (41)	23.9 (22)	43.5 (47)	39.5 (43)	35.9 (33)	38.4 (228)
			N=300				
Modes of transit							
Walking	68.0 (34)	74.0 (37)	76.0 (38)	74.0 (37)	78.0 (39)	76.0 (38)	74.3 (223)
Bus	14.0 (7)	16.0 (8)	6.0 (3)	18.0 (9)	14.0 (7)	8.0 (4)	12.7 (38)
Home warmer inside than outside during summer[#]	87.8 (43)	94.0 (47)	100 (50)	98.0 (49)	100 (50)	100 (50)	96.7 (289)

Feel too hot inside home during summer	100 (50)	100 (50)	100 (50)	100 (50)	100 (50)	100 (50)	100 (300)
Does not change cooking schedule during summer[#]	75.6 (34)	81.3 (39)	93.8 (45)	100 (49)	93.9 (46)	93.8 (45)	89.9 (258)
Avg. # of times cook in a day (stnd dev)	2.12 (0.33)	2.02 (0.25)	2.02 (0.14)	2.04 (0.29)	2.10 (0.31)	2.02 (0.15)	2.05 (0.26)
Time of day when cooking							
Time 1 - morning[#]	86.0 (43)	89.6 (43)	87.5 (42)	87.8 (43)	85.7 (42)	89.4 (42)	87.6 (255)
Time 2 - evening[#]	88.0 (44)	95.7 (45)	97.9 (47)	93.8 (45)	89.8 (44)	97.9 (46)	93.8 (271)
Indoor kitchen	100 (50)	64.0 (32)	86.0 (43)	92.0 (46)	100 (50)	94.0 (47)	89.3 (268)
Inside home warmer when cooking[#]	84.0 (42)	78.8 (26)	100 (43)	97.8 (45)	100 (50)	100 (47)	94.1 (253)
Open window when cooking[#]	92.7 (38)	92.9 (26)	91.4 (32)	100 (38)	100 (44)	100 (43)	96.5 (221)
Frequency of keeping windows open throughout year:							
Always	35.4 (17)	57.1 (24)	35.6 (16)	40.9 (18)	37.5 (18)	42.9 (21)	41.3 (114)
Depends on the season	41.7 (20)	23.8 (10)	46.7 (21)	45.5 (20)	47.9 (23)	49.0 (24)	42.8 (118)
Rarely/never	22.9 (11)	19.1 (8)	17.8 (8)	13.6 (6)	14.6 (7)	8.1 (4)	15.9 (44)
No window	2	8	5	6	2	1	24
Keep window open in summer[#]	81.3 (39)	83.3 (35)	82.2 (37)	88.6 (39)	85.4 (41)	91.8 (45)	85.5 (236)
Primary cooling method: electric fan	90.0 (45)	84.0 (42)	98.0 (49)	96.0 (48)	100 (50)	94.0 (47)	93.7 (281)
Don't go to place with A/C	78.0 (39)	90.0 (45)	94.0 (47)	98.0 (94)	90.0 (45)	84.0 (42)	89.0 (267)

#missing data

Table 6. Individual (N=1650) and household (N=300) susceptibility factors among residents of Ahmedabad slums across six city zones.

% (n)	**West**	**New West**	**South**	**Central**	**North**	**East**	**Entire Sample**
Preexisting chronic condition(s)*	20.0 (56)	7.8 (21)	15.9 (45)	10.8 (29)	27.8 (78)	24.8 (65)	17.8 (294)
Preexisting infectious disease(s)*	24.6 (69)	1.5 (4)	17.3 (49)	18.2 (49)	30.3 (87)	44.7 (117)	22.7 (375)
Preexisting diarrheal disease(s)*	6.1 (17)	2.2 (6)	5.3 (15)	4.1 (11)	8.4 (24)	8.0 (21)	5.7 (94)
Avg. # (stnd dev) of HH members with preexisting conditions*	2.84 (2.21)	1.14 (1.40)	2.38 (1.23)	2.00 (1.65)	3.54 (1.85)	3.58 (1.67)	2.58 (1.89)
Young children with chronic preexisting condition(s) among young children (n=148)*	6.7 (2)	0.0 (0)	7.7 (2)	0.0 (0)	7.7 (2)	10.0 (2)	5.4 (8)
Young children with diarrheal preexisting condition(s) among young children (n=148)*	16.7 (5)	12.0 (3)	7.7 (2)	0.0 (0)	30.8 (8)	15.0 (3)	14.2 (21)
Elderly with chronic preexisting condition(s) among elderly (n=70)*	50.0 (6)	33.3 (5)	63.6 (7)	30.0 (3)	91.7 (11)	70.0 (7)	55.7 (39)
Elderly with diarrheal preexisting condition(s) among elderly (n=70)*	8.3 (1)	0.0 (0)	18.2 (2)	20.0 (2)	0.0 (0)	10.0 (1)	8.6 (6)
A/C access prevented by:							
Nothing/Don't want to go	54.0 (27)	82.0 (41)	78.0 (39)	92.0 (46)	68.0 (34)	68.0 (34)	73.7 (221)
Time of day	8.0 (4)	8.0 (4)	4.0 (2)	0.0 (0)	6.0 (3)	8.0 (4)	5.7 (17)
Disability or Elderly/young at home	10.0 (5)	0.0 (0)	4.0 (2)	2.0 (1)	20.0 (10)	12.0 (6)	8.0 (24)
Distance	20.0 (10)	8.0 (4)	2.0 (1)	0.0 (0)	6.0 (3)	8.0 (4)	7.3 (22)
Safety	8.0 (4)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	2.0 (1)	1.7 (5)

Financial problem	0.0 (0)	2.0 (1)	12.0 (6)	6.0 (3)	0.0 (0)	2.0 (1)	3.7 (11)
Main water source is in-home tap	70.0 (35)	90.0 (45)	80.0 (40)	92.0 (46)	94.0 (47)	94.0 (47)	86.7 (260)
Have a specific time when water is provided to their homes	92.0 (46)	84.0 (42)	100 (50)	100 (50)	98.0 (49)	92.0 (46)	94.3 (283)
Only provided with water in the morning	100 (46)	97.6 (41)	94.0 (47)	100 (50)	100 (50)	65.2 (30)	93.0 (264)

*Among individuals

Table 7. Household (N=300) adaptive behaviors among residents of Ahmedabad slums across six city zones.

% (n)	West	New West	South	Central	North	East	Entire Sample
Seeing a Dr. is convenient	98.0 (49)	98.0 (49)	98.0 (49)	100 (50)	100 (50)	100 (50)	99.0 (297)
Have seen a Dr. for heat-related morbidity	56.0 (28)	20.0 (10)	42.0 (21)	28.0 (14)	74.0 (37)	58.0 (29)	46.3 (139)
Coping Methods and frequency of application:							
Stay indoors **MOST OF THE TIME**	98.0 (49)	86.0 (43)	90.0 (45)	96.0 (48)	90.0 (45)	92.0 (46)	92.0 (276)
Drink lots of water **MOST OF THE TIME**	94.0 (47)	96.0 (48)	92.0 (46)	88.0 (44)	88.0 (44)	84.0 (42)	90.3 (271)
Seek shade **MOST OF THE TIME**	44.0 (22)	74.0 (37)	50.0 (25)	58.0 (29)	50.0 (25)	50.0 (25)	54.3 (163)
Wear light clothing **MOST OF THE TIME**	58.0 (29)	42.0 (21)	40.0 (20)	42.0 (21)	34.0 (17)	44.0 (22)	43.3 (130)
Take cool showers **MOST OF THE TIME**	92.0 (46)	82.0 (41)	82.0 (41)	86.0 (43)	90.0 (45)	86.0 (43)	86.3 (259)
SOMETIMES wear hat/cover head	38.0 (19)	36.0 (18)	42.0 (21)	44.0 (22)	44.0 (22)	38.0 (19)	40.3 (121)
RARELY go to place with A/C	80.0 (40)	88.0 (44)	94.0 (47)	98.0 (49)	92.0 (46)	90.0 (45)	90.3 (271)
RARELY reduce activity	68.0 (34)	90.0 (45)	100 (50)	96.0 (48)	80.0 (40)	74.0 (37)	84.7 (254)
RARELY avoid outdoor activity	80.0 (40)	84.0 (42)	100 (50)	100 (50)	98.0 (49)	98.0 (49)	93.3 (280)
Change sleeping pattern in the summer to: go to sleep later/wake up earlier	62.0 (31)	58.0 (29)	74.0 (37)	46.0 (23)	64.0 (32)	52.0 (26)	59.3 (178)

Drink more fluids (H_2O+other drinks) in summer	62.0 (31)	60.0 (30)	46.0 (23)	58.0 (29)	64.0 (32)	70.0 (35)	60.0 (180)
Protect themselves in-transit	100 (49)	94.0 (47)	92.0 (46)	92.0 (46)	98.0 (49)	100 (50)	96.0 (287)
Heard an excess heat warning this summer thru[#]:							
People	54.2 (26)	62.5 (25)	48.9 (23)	44.9 (22)	50.0 (23)	60.9 (28)	53.3 (147)
Media Sources	45.8 (22)	37.5 (15)	51.1 (24)	55.1 (27)	50.0 (23)	39.1 (18)	46.7 (129)
Sought heat-related illness info if they were worried about getting sick from exposure[#]	82.0 (41)	54.0 (27)	84.0 (42)	96.0 (48)	98.0 (49)	92.0 (42)	84.3 (253)
Sought or would look for heat-related illness info thru media sources	95.7 (45)	86.5 (32)	88.9 (40)	95.8 (46)	89.6 (43)	87.5 (42)	90.8 (248)
Previously talked about preventing heat-related illness with:							
Healthcare professional	70.0 (35)	64.0 (32)	84.0 (42)	88.0 (44)	78.0 (39)	80.0 (40)	77.3 (232)
Commmunity	14.0 (7)	4.0 (2)	0.0 (0)	0.0 (0)	4.0 (2)	2.0 (1)	4.0 (12)
No one	16.0 (8)	32.0 (16)	16.0 (8)	12.0 (6)	18.0 (9)	18.0 (9)	18.7 (56)
Feel safe in neighborhood and have positive/neutral relations with neighbors	96.0 (48)	90.0 (45)	100 (50)	100 (50)	98.0 (49)	100 (50)	97.3 (292)
Know most neighbors and talk to them often	86.0 (43)	74.0 (37)	98.0 (49)	98.0 (49)	78.0 (39)	82.0 (41)	86.0 (258)
Would call on someone in their neighborhood for an emergency	94.0 (47)	96.0 (48)	100 (50)	100 (50)	100 (50)	100 (50)	98.3 (295)
They/their neighbors have helped each other during an emergency and/or heat wave	76.0 (38)	74.0 (37)	76.0 (38)	78.0 (39)	82.0 (41)	86.0 (43)	78.7 (236)

#missing data

Table 8. The association between the heat-related outcomes and age, occupation, and preexisting conditions (multivariate regression odds ratios and 95% confidence intervals).Result bolded when confidence interval excluded 1.Covariates tested for hypotheses were italicized.

	HRS	**HRI**	**HRI+HRS**
Age (increase by 5 yrs)	**1.21** (1.16, 1.27)	1.01 (0.96, 1.07)	**1.15** (1.10, 1.19)
HH monthly income (increase by 100 INR)	**0.99** (0.99, 0.99)	--	--
Occupation:			
Manual labor	0.85 (0.42, 1.72)	0.68 (0.42, 1.11)	0.88 (0.62, 1.23)
Service/Office/teacher	0.72 (0.35, 1.50)	0.77 (0.41, 1.45)	**0.53** (0.36, 0.79)
Sales/Artisan	1.14 (0.57, 2.31)	0.93 (0.53, 1.63)	1.04 (0.67, 1.62)
None (ref)			
Work location:			
Sun	**1.95** (1.10, 3.46)	--	--
Mixed	0.99 (0.58, 1.71)	--	--
Shade (ref)			
Chronic preexisting condition	**2.49** (1.82, 3.42)	**1.66** (1.08, 2.55)	**1.98** (1.45, 2.70)
Diarrheal preexisting condition	0.93 (0.55, 1.58)	**3.19** (1.68, 6.08)	1.62 (0.98, 2.66)
Infectious preexisting condition	**1.55** (1.10, 2.20)	**2.82** (1.86, 4.27)	**1.73** (1.27, 2.36)
Main drinking water source:			
In-home tap	**0.46** (0.22, 0.96)	--	--
Public (tap/bore hole)	**0.35** (0.15, 0.83)	--	--
From neighbor	**0.76** (0.24, 2.44)	--	--
Purchased (bottled/50 L jug) (ref)			
Had NOT visited a Dr. for heat-related illness before	--	--	**0.32** (0.24, 0.42)
Had NOT sought heat-related morbidity info: N vs Y	--	**4.74** (1.46, 15.38)	--
NOT worried about getting sick from heat: N/Don't Know vs. Y	**0.33** (0.15, 0.71)	--	**0.46** (0.22, 0.99)

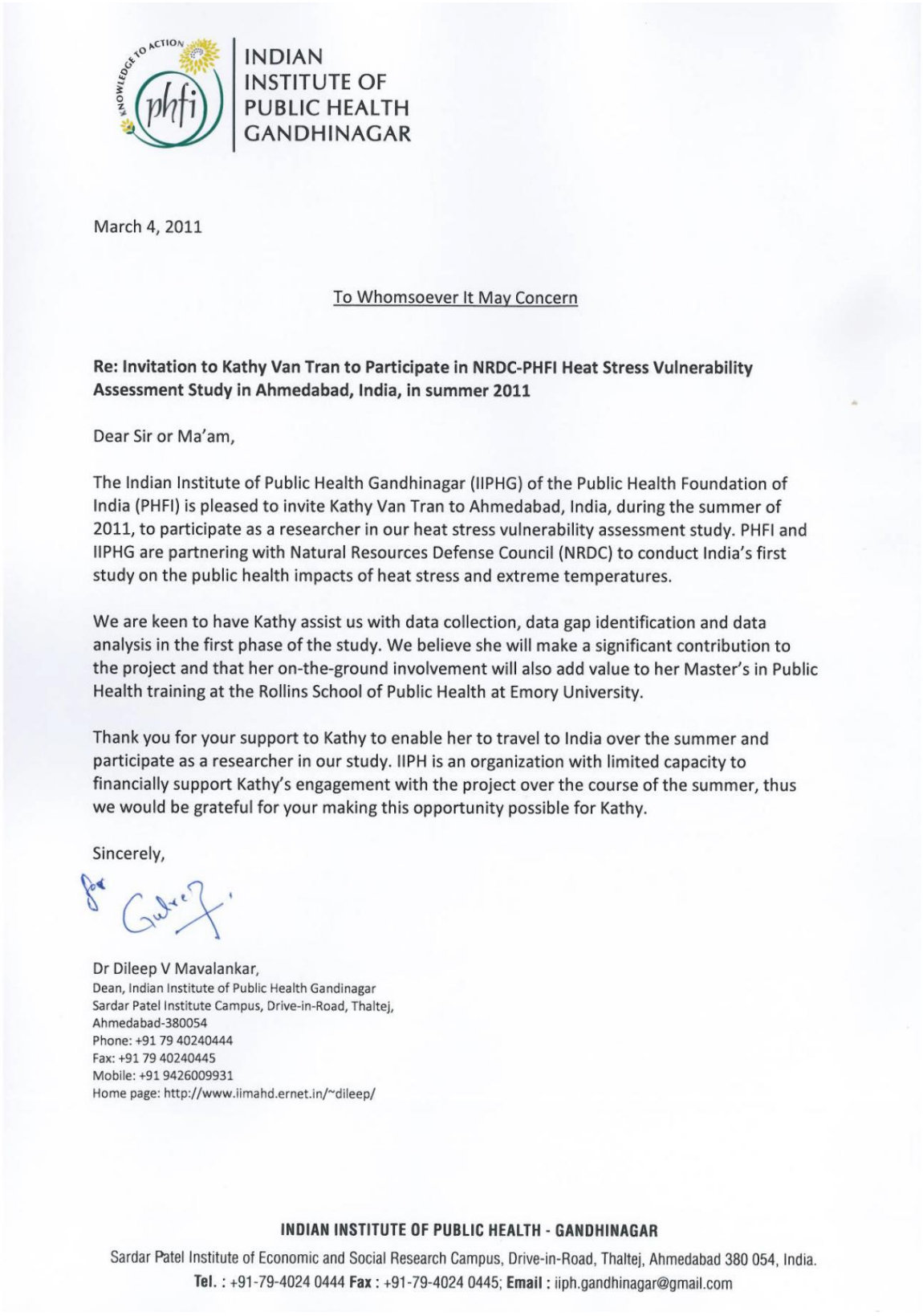
Social Connectedness Score			
0-1 vs. 3	**3.37** (1.58, 7.20)	0.84 (0.32, 2.20)	**2.30** (1.21, 4.36)
2 vs. 3	0.69 (0.43, 1.12)	**0.43** (0.21, 0.86)	0.67 (0.43, 1.04)

Table 9. The association between the heat-related outcomes and measures of access to information (multivariate regression odds ratios and 95% confidence intervals).Result bolded when confidence interval excluded 1.Covariates tested for hypotheses were italicized.

	HRS	**HRI**	**HRI+HRS**
Age (increase by 5 yrs)	**1.21** (1.16, 1.27)	--	**1.14** (1.09, 1.18)
HH monthly income (increase by 100 INR)	**0.99** (0.99, 0.99)	--	--
Work location:			
Sun	**1.83** (1.06, 3.16)	--	--
Mixed	0.93 (0.54, 1.61)	--	--
Shade			
Chronic preexisting condition	**2.42** (1.76, 3.33)	**1.66** (1.09, 2.51)	**1.92** (1.40, 2.63)
Diarrheal preexisting condition		**3.42** (1.78, 6.57)	**1.72** (1.07, 2.77)
Infectious preexisting condition	**1.54** (1.09, 2.18)	**2.90** (1.91, 4.43)	**1.73** (1.26, 2.36)
Main drinking water source:			
In-home tap	**0.48** (0.24, 0.97)	--	--
Public (tap/bore hole)	**0.37** (0.17, 0.84)	--	--
From neighbor	0.78 (0.25, 2.46)		
Purchased (bottled/50L jug) (ref)			
Has NOT visited a Dr. for heat-related illness	--	--	**0.3491** (0.26, 0.46)
Access to Information:			
Heat warning source this past summer: People vs Media	0.88 (0.60, 1.31)	0.82 (0.44, 1.52)	0.89 (0.62, 1.28)
Heat-related morbidity source where they have looked/would look			
Media	1.48 (0.82, 2.67)	1.54 (0.68, 3.54)	1.66 (0.93, 2.96)
Don't Know	1.15 (0.34, 3.84)	1.64 (0.23, 11.89)	1.26 (0.28, 5.72)
Community (ref)			

Person previously talked to about heat-related morbidity			
No one	0.86 (0.48, 1.54)	0.71 (0.36, 1.40)	0.72 (0.44, 1.16)
Community	1.58 (0.78, 3.22)	2.17 (0.87, 5.45)	1.98 (0.97, 4.03)
Professional (ref)			
NOT Worried about getting sick from heat	**0.31** (0.14, 0.68)	--	**0.44** (0.20, 0.95)
Had NOT sought heat-related morbidity info before	1.63 (0.67, 3.97)	**11.18** (2.75, 45.38)	**2.62** (1.17, 5.86)
Social Connectedness Score (1-4):			
0-1 vs. 3	**3.54** (1.65, 7.60)	0.86 (0.31, 2.41)	**2.42** (1.26, 4.61)
2 vs. 3	0.69 (0.43, 1.11)	**0.40** (0.21, 0.75)	0.68 (0.45, 1.04)

Appendix A. Indian Institute of Public Health, Gandhinagar Letter of Invitation



INDIAN INSTITUTE OF PUBLIC HEALTH GANDHINAGAR

March 4, 2011

To Whomsoever It May Concern

Re: Invitation to Kathy Van Tran to Participate in NRDC-PHFI Heat Stress Vulnerability Assessment Study in Ahmedabad, India, in summer 2011

Dear Sir or Ma'am,

The Indian Institute of Public Health Gandhinagar (IIPHG) of the Public Health Foundation of India (PHFI) is pleased to invite Kathy Van Tran to Ahmedabad, India, during the summer of 2011, to participate as a researcher in our heat stress vulnerability assessment study. PHFI and IIPHG are partnering with Natural Resources Defense Council (NRDC) to conduct India's first study on the public health impacts of heat stress and extreme temperatures.

We are keen to have Kathy assist us with data collection, data gap identification and data analysis in the first phase of the study. We believe she will make a significant contribution to the project and that her on-the-ground involvement will also add value to her Master's in Public Health training at the Rollins School of Public Health at Emory University.

Thank you for your support to Kathy to enable her to travel to India over the summer and participate as a researcher in our study. IIPH is an organization with limited capacity to financially support Kathy's engagement with the project over the course of the summer, thus we would be grateful for your making this opportunity possible for Kathy.

Sincerely,

Dr Dileep V Mavalankar,
Dean, Indian Institute of Public Health Gandinagar
Sardar Patel Institute Campus, Drive-in-Road, Thaltej,
Ahmedabad-380054
Phone: +91 79 40240444
Fax: +91 79 40240445
Mobile: +91 9426009931
Home page: http://www.iimahd.ernet.in/~dileep/

INDIAN INSTITUTE OF PUBLIC HEALTH - GANDHINAGAR
Sardar Patel Institute of Economic and Social Research Campus, Drive-in-Road, Thaltej, Ahmedabad 380 054, India.
Tel. : +91-79-4024 0444 **Fax :** +91-79-4024 0445; **Email :** iiph.gandhinagar@gmail.com

Appendix B. Natural Resources Defense Council Letter of Invitation

NRDC
THE EARTH'S BEST DEFENSE

NATURAL RESOURCES DEFENSE COUNCIL

March 3, 2011

To Whomsoever It May Concern

Re: Invitation to Kathy Van Tran to Participate in NRDC-PHFI Heat Stress Vulnerability Assessment Study in Ahmedabad, India, in summer 2011

Dear Sir or Ma'am,

The Natural Resources Defense Council (NRDC) is pleased to invite Kathy Van Tran to Ahmedabad, India, during the summer of 2011, to participate as a researcher in our heat stress vulnerability assessment study. NRDC is partnering with the Public Health Foundation of India (PHFI) to conduct India's first study on the public health impacts of heat stress and extreme temperatures.

We are keen to have Kathy assist us with data collection, data gap identification and data analysis in the first phase of the study. We believe she will make a significant contribution to the project and that her on-the-ground involvement will also add value to her Master's in Public Health training at the Rollins School of Public Health at Emory University.

Thank you for your support to Kathy to enable her to travel to India over the summer and participate as a researcher in our study. NRDC is a 501(c)(3) nonprofit organization with limited capacity to financially support Kathy's engagement with the project over the course of the summer, thus we would be grateful for your making this opportunity possible for Kathy.

Sincerely,

Anjali Jaiswal
Director, India Initiative
Natural Resources Defense Council
111 Sutter Street, 20th Floor
San Francisco, CA 94104-4540
Phone: 415 875-6141, ajaiswal@nrdc.org

Appendix C. Emory IRB Exemption Letter

EMORY UNIVERSITY

Institutional Review Board

Kathy Tran
Principal Investigator
Public Health

DATE: July 5, 2011

RE: **Exemption of Human Subjects Research**
IRB00051015
Developing Adaptation Strategies to Combat Climate Change: Heat Vulnerability Assessment in Ahmedabad, India

Dear Principal Investigator:

Thank you for submitting an application to the Emory IRB for the above-referenced project. Based on the information you have provided, we have determined on **07/01/2011** that although it is human subjects research, it is exempt from further IRB review and approval.

This determination is good indefinitely unless substantive revisions to the study design (e.g., population or type of data to be obtained) occur which alter our analysis. Please consult the Emory IRB for clarification in case of such a change. Exempt projects do not require continuing renewal applications.

This project meets the criteria for exemption under 45 CFR 46.101(b)(3). Specifically, you will be conducting research using survey and interview procedures with de-identifiable data.

Please note that the Belmont Report principles apply to this research: respect for persons, beneficence, and justice. You should use the informed consent materials reviewed by the IRB unless a waiver of consent was granted. Similarly, if HIPAA applies to this project, you should use the HIPAA patient authorization and revocation materials reviewed by the IRB unless a waiver was granted. CITI certification is required of all personnel conducting this research.

Unanticipated problems involving risk to subjects or others or violations of the HIPAA Privacy Rule must be reported promptly to the Emory IRB and the sponsoring agency (if any).

In future correspondence about this matter, please refer to the study ID shown above. Thank you.

Sincerely,

Olga Dashevskaya, JD
Research Protocol Analyst
This letter has been digitally signed

Appendix D: Ahmedabad Municipal Corporation Letter of Support

Dr. S. P. Kulkarni
Medical Officer Of Health,
M.B.B.S., D.P.H., M.D.,

AHMEDABAD MUNICIPAL CORPORATION
Sardar Patel Bhavan, Sardar Patel Marg,
Ahmedabad - 380 001
Tel. (o) **25350858, 25391811,** Ext - **670 / 705**
Fax - **079 - 25350858, 25350926**

Dr. S P Kulkarni
MOH – Ahmedabad Municipal Corporation
Ahmedabad

HEALTH CENTRAL OFFICE
Inward / Outward No. 1165
Date : 9 / 7 /2011

9th July 2011

Kathy Van Tran
Emory University
1518 Clifton Road.
Atlanta, Georgia 30322
Local Phone: 94-09-173688

Dear Ms. Kathy Tran

Sub: Partner Organisation Letter of Support

On behalf of the Ahmedabad Municipal Corporation (AMC), we wish to express our support for the heat health vulnerability assessment, a collaborative project between Natural Resources Defence Council (NRCD) and IIPH-PHFI.

As one component of the assessment, the household questionnaire being conducted this summer will increase the body of shared knowledge on preparedness for heat health and stress related to temperature increases. Understanding the patterns of excessive heat exposure experienced by the most vulnerable urban population, the slums, and prevalence of heat related illnesses will help us develop targeted interventions to reduce heat exposure and associated morbidities.

AMC will gladly assist you in identifying slums and establishing contacts within each to facilitate access to the households. We will provide additional support throughout the duration of the questionnaire if necessary.

We look forward to this highly productive collaboration with NRDC and IIPH-PHFI.

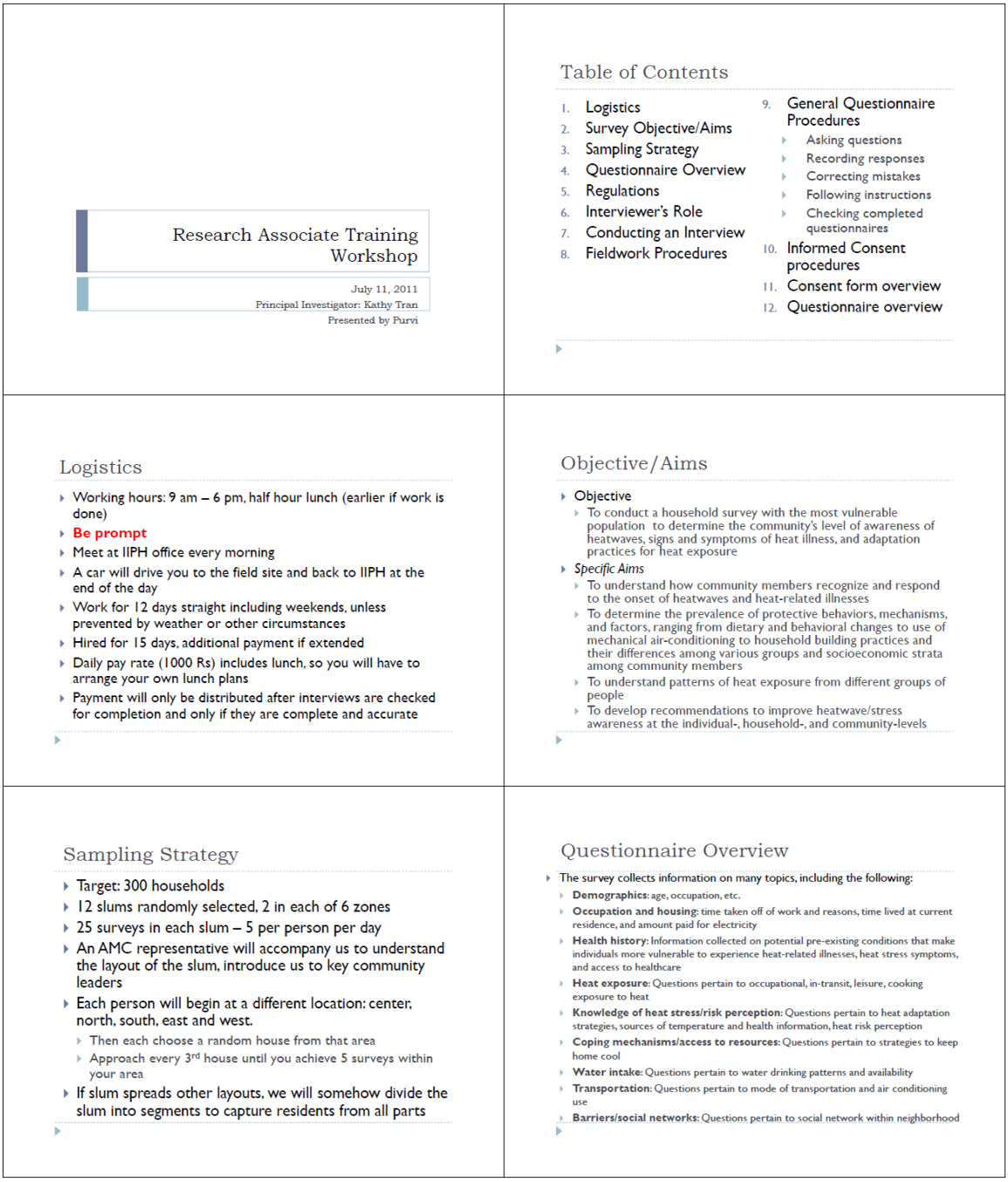
Sincerely,

9/7/11

Dr. S P Kulkarni
AMC

Ahmedabad Municipal Corporation
HEALTH DEPT.
Ahmedabad

Appendix E. Research assistant training workshop (July 12, 2011): PowerPoint presentation



Research Associate Training Workshop

July 11, 2011
Principal Investigator: Kathy Tran
Presented by Purvi

Table of Contents

Logistics

- Working hours: 9 am – 6 pm, half hour lunch (earlier if work is done)
- **Be prompt**
- Meet at IIPH office every morning
- A car will drive you to the field site and back to IIPH at the end of the day
- Work for 12 days straight including weekends, unless prevented by weather or other circumstances
- Hired for 15 days, additional payment if extended
- Daily pay rate (1000 Rs) includes lunch, so you will have to arrange your own lunch plans
- Payment will only be distributed after interviews are checked for completion and only if they are complete and accurate

Objective/Aims

- Objective
  - To conduct a household survey with the most vulnerable population to determine the community's level of awareness of heatwaves, signs and symptoms of heat illness, and adaptation practices for heat exposure
- *Specific Aims*
  - To understand how community members recognize and respond to the onset of heatwaves and heat-related illnesses
  - To determine the prevalence of protective behaviors, mechanisms, and factors, ranging from dietary and behavioral changes to use of mechanical air-conditioning to household building practices and their differences among various groups and socioeconomic strata among community members
  - To understand patterns of heat exposure from different groups of people
  - To develop recommendations to improve heatwave/stress awareness at the individual-, household-, and community-levels

Sampling Strategy

- Target: 300 households
- 12 slums randomly selected, 2 in each of 6 zones
- 25 surveys in each slum – 5 per person per day
- An AMC representative will accompany us to understand the layout of the slum, introduce us to key community leaders
- Each person will begin at a different location: center, north, south, east and west.
  - Then each choose a random house from that area
  - Approach every 3rd house until you achieve 5 surveys within your area
- If slum spreads other layouts, we will somehow divide the slum into segments to capture residents from all parts

Questionnaire Overview

- The survey collects information on many topics, including the following:
  - **Demographics**: age, occupation, etc.
  - **Occupation and housing**: time taken off of work and reasons, time lived at current residence, and amount paid for electricity
  - **Health history**: Information collected on potential pre-existing conditions that make individuals more vulnerable to experience heat-related illnesses, heat stress symptoms, and access to healthcare
  - **Heat exposure**: Questions pertain to occupational, in-transit, leisure, cooking exposure to heat
  - **Knowledge of heat stress/risk perception**: Questions pertain to heat adaptation strategies, sources of temperature and health information, heat risk perception
  - **Coping mechanisms/access to resources**: Questions pertain to strategies to keep home cool
  - **Water intake**: Questions pertain to water drinking patterns and availability
  - **Transportation**: Questions pertain to mode of transportation and air conditioning use
  - **Barriers/social networks**: Questions pertain to social network within neighborhood

Regulations

1. Except for illnesses, **absences must be approved prior to absence**
2. Throughout the survey training and the fieldwork period, you are representing Emory University and IIPH. Your **conduct must be professional** and your behavior must be congenial in dealing with the public.
3. For the survey to succeed, you must **work together**, sharing in difficulties and cooperating and supporting each other. You may not create a disruptive influence on the team.
4. It is critical that the data gathered during the fieldwork be both accurate and valid.
5. You must follow all rules and processes indicated in this presentation and those that have been discussed with you by the principal investigator, whether you agree with them or not. While you are in the field, if you think that changes should be made in the process you must follow, you are required to get approval from the field advisor before executing those changes, no matter how small those changes may seem to you.
6. All data collected are confidential. **They should not be discussed with anyone outside your study team. Under no circumstances should confidential information be passed on to third parties.** You should not break these rules and the confidence placed in you by the respondents.

Interviewer's Role

- The interviewer occupies the central position in this project because he collects information from respondents. Therefore, the success of this project depends on the quality of each interviewer's work.
- In general, the responsibilities of an interviewer include the following:
  - Locating the structures and households in the sample, and completing the Heat Vulnerability Assessment Survey
  - Interviewing only HoHs, preferably female
  - Checking completed interviews to be sure that all questions were asked and the responses are neatly and legibly recorded
  - Returning to households to interview respondents who could not be interviewed during the initial visit, whether it be requested by the respondent or the HoH was unavailable

Conducting an Interview

- Building rapport, or a friendly relationship
  1. Make a good first impression

     Open the interview with a smile and greeting, then proceed with your introduction, which is the consent form.
  2. Always have a positive approach

     Never adopt an apologetic manner, and do not say things like "Are you too busy." Such questions invite refusal right from the start.
  3. Stress confidentiality of responses
  4. Answer any questions from the respondent frankly
  5. Interview the respondent alone, if possible

     Avoid recall bias from multiple people by requesting to interview the respondent alone.

Conducting an Interview

- Tips for conducting the interview
  1. Be **neutral** throughout the interview
  2. Never suggest answers to a respondent
  3. Do not change the wording or sequence of a question or answer choices
  4. Handle hesitant respondents tactfully
  5. Do not form expectations
  6. Do not hurry the interview

Fieldwork Procedures

- Items to bring everyday to the field:
  - 8 surveys each
  - 8 consent forms each
  - 80 pamphlets
  - Digital Thermometer
  - Clip board
  - Pens
  - Bag to carry all materials
  - AMC support letter
- Locating Sample Households
  - Locate central water spigot
  - Select house in front of water spigot
  - Next homes will begin to the left of the first and make way around slum until reach target of 25

Fieldwork Procedures

- Contacting a household
  - Ask to speak with the female head-of-household (HoH), middle-aged member who would know everything about the elderly, children and spouse of their homes
  - Emphasize the need to speak to someone who would know everything about their family members, including health history
  - If the female HoH is not present, ask when she will be available and plan to come back
  - If an elder female family member prefers to respond, agree to conduct the survey with her
  - If the female HoH requests you to speak with her husband, agree to conduct the survey with him
  - If more than one household lives in one home, conduct the survey with the female HoH from each of those other families
  - If no one is present at a house, move to next home

Fieldwork Procedures

- Obtaining Informed Consent
  - You **MUST obtain verbal oral consent** from the respondent agreeing to respond to the questionnaire and that they understand what is being asked of them **before** beginning the questionnaire
- Checking completed questionnaires
  - Review questionnaire for completion before leaving the respondent's home
  - Answers should be clear and legible
  - Any notes should be made in margin or space at the end of the questionnaire
- Returning work assignments
  - Check that you have completed the cover sheet of the individual questionnaire of each respondent identified, whether you were able to interview them or not
  - Make sure the subject number and survey number align with each other on the consent form and questionnaire
  - Return all material to the PI at the end of the day

General Questionnaire procedures

- Asking Questions
  - **Ask questions as they are written and in the order they are written**
  - Speak slowly and clearly, repeating the question until the respondent understands if you need to
  - You may have to restate the question if the respondent still doesn't understand after repeating; choose words carefully as not to alter the meaning of the question
- Recording Responses
  - Questions with precoded responses
  - Questions with responses not precoded
  - Health history lists

Recording Responses

- Mark all responses with blue pens, never use pencil
- Questions with precoded responses examples:
  1. Circle response from listed responses – make circles large and obvious

૮. આ તમારૂ કુટુંબ / તમારા કુટુંબનું ઘર છે? ભાડે છે? બિનકાયદેસર છે?

અ. પોતાનું
બ. ભાડાથી
ક. રહેણાંક બિનકાયદેસર છે

Recording Responses

2. Write in code within provided boxes
   - EXAMPLE 1

૩. હવે હું તમને ક્રમવાર પ્રશ્નો પુછીશ (તમારા ઘરના માણસોને લગતા)
અ. તમારા ઘરમાં રહેતા બધા માણસોના નામ આપો. (જો કોઇ ના આપેલો હોય તો અલગથી પ્રતિભાવ લખવો.)

i. S – પતિ / પત્નિ
ii. C – બાળકો
iii. M – માતા
iv. F – પિતા
v. MI – સાસુ
vi. FI – સસરા
vii. B – ભાઈ
viii. SS – બહેન

જવાબ આપનાર સાથેનો સંબંધ	વર્ષ	ભણ
S		
C1		
C2		

Recording Responses

- EXAMPLE 2

૧૭. તમારા ઘરમાંથી કોઈને ગયા ઉનાળામાં તાપથી ઉલટીનો થઈ છે? જો હ તો કોને? તમને યાદ છે ક્યારે અને ક્યા?

કોને (તમારા કુટુંબ સભ્યમાંથી)	સ્થાન (ઘર(O), બહાર(I), બંધ નથી (DK))	સમય (શરૂઆતિક પહેલા(D), મધ્યમગાળામાં(W), ચાર મહિને(M), ૨–૩મહીના પહેલા(2-3), ૩ થી મહિના કરતા વધારે(3+),
S	O	M
M	DK	2-3

Recording Responses

- Questions with responses not precoded examples:
  1. Write responses on the line

૯. છેલ્લા કેટલા સમયથી તમે અને તમારૂ કુટુંબ હાલના રહેણાંકમાં રહો છો?

_____ મહીના _____ વર્ષ

૨૪. જો ના, તો તમને કઈ વસ્તુ તબીબ / તબીબી સારવાર લેતા રોકે છે?

a. અંતર
b. રથળાતંરની સમસ્યા
c. જવા માટેની કિંમત
d. લાંબો સમય વાર જોવી / વધારે માણસો
e. બીજું (વિવરણ આપો) _____

Recording Responses

2. Write responses in the box

d. અત્યારે તે શું ધંધો કરે છે?
e. તેઓની માસિક આવક કેટલી છે?

૧૨	વર્ષ	ભણતર	ધંધા	વાર્ષિક આવક
			farmer	

Recording Responses

- Health history lists:
  - Put an "X" within the box if respondent said yes to an disease/condition
  - For "other" types of diseases, like other respiratory diseases, write in what the person has such as lung disease

૧૨. બધાને ચેક કરો અને બધાને પુછો. હુ તમને વિવિધ આરોગ્યલક્ષી પ્રશ્નોત્તર કરીશ. હુ તમારો થોડો વધારે સમય લઈશ. જો તમે તમારા પતિ/પત્ની કે ઘરના કોઈ બાલકને કયારેય નીચેની પરિસ્થિતિથી તપાસ થયેલ હોય તો મને જણાવો.

બીમારી	જાતે	પતિ / પત્ની	(નાંય કરો)				
દમ	x						
ન્યુમોનિયા							
બીજી કોઇપણ કે શ્વસનતંત્રના રોગ (lung diseases, specify)							
ઠાયાબીટીસ – મધુપ્રમેહ		x					
કેન્સર (any)							
થાયરોઇડ							

General Questionnaire procedures

- Correcting Mistakes
  - **Keep responses as neat as possible, avoid mistakes**
  - Should you make a mistake recording the response or the respondent changes her/his mind,
    1. Cross out the entire mistaken response and circle the correct response

૮. આ તમારૂ કુટુંબ / તમારા કુટુંબનું ઘર છે? ભાડે છે? બિનકાયદેસર છે?
અ. પોતાનું
~~બ. ભાડાની~~
ક. રહેણાંક બિનકાયદેસર છે

Correcting mistakes

2. Cross out the response and write the new one next to it for responses written on lines

૯. છેલ્લાં કેટલા સમયથી તમે અને તમારું કુટુંબ હાલના રહેણાંકમાં રહો છો?
~~2~~ 10 મહીના _____ વર્ષ

Correcting mistakes

3. Move to the next box and cross out the one with the mistake for responses written within boxes

૧૩. તમારા ઘરમાંથી કોઈને બચ્ચા ઉનાળામાં તાપથી ઉલટીઓ થઈછે? જો હા તો કોને? તમને યાદ છે કયારે અને કયાં?

કોને (તમારા શું સબંધ થાય છે)	થયા (ઘરે (0), બહાર (1), બધા નથી (DK))	સમય (થોડો હિસ્સ રહ્યો (D), ગયા અઠવાડિયે (W), ગયા મહિને (M), ૨-૩ મહીના પહેલા (2-3), વર્ષ મહિના કરતા વધારે (3+),
S	0	M
~~M~~	~~DK~~	~~2-3~~
F	DK	2-3

Correcting mistakes

4. Cross out the "X"

૧૨. બધાને ચેક કરો અને બધાને પુછો. હુ તમને વિવિધ આરોગ્યલક્ષી પ્રશ્નોત્તર કરીશ. હુ તમારો થોડો વધારે સમય લઈશ. જો તમે તમારા પતિ/પત્ની કે ઘરના કોઈ બાલકને કયારેય નીચેની પરિસ્થિતિથી તપાસ થયેલ હોય તો મને જણાવો.

બીમારી	જાતે	પતિ / પત્ની	(નાંય કરો)				
દમ	x						
ન્યુમોનિયા		X					
બીજી કોઇપણ કે શ્વસનતંત્રના રોગ (lung diseases, specify)							
ઠાયાબીટીસ – મધુપ્રમેહ		~~X~~					
કેન્સર (any)							
થાયરોઇડ							

General Questionnaire procedures

- Following instructions – in parentheses ( ), or brackets [ ]
- It is extremely important you read carefully and follow all instructions provided so that you fill in the responses correctly and skip questions only when necessary
  1. Skip questions
  2. Instructions
  3. Check/circle all that apply
  4. Fill in
  5. Explain "other"

General Questionnaire procedures

1. Skip questions
2. Instructions

૩૨. [માત્ર પુરુષ ઉમેદવાર માટે] તમને તમારી પત્નિ / માતાનું રસોઈ બનાવવાનું સમયપત્રક ખબર છે?

a. હા

b. ના [Q37 પર જાઓ]

[Q32-Q35 માટે જ, પુરુષ જવાબ આપતો હોય તો શબ્દો બદલી શકાય]

૩૩. તમે તમારા રસોઈ બનાવવાના સમયપત્રકને બદલાવો છો? ઉનાળામાં જમવાનું બનાવવાનો સમય કયો છે?

a. હા

b. ના [Q35 પર જાઓ]

General Questionnaire procedures

3. Fill in

૧૨. બધાને ચેક કરો અને બધાને પુછો. હું તમને વિવિધ આરોગ્યલક્ષી પ્રશ્નોત્તર કરીશ. હું તમારો થોડો વધારે સમય લઈશ. જો તમે તમારા પતિ/પત્ની કે ઘરના કોઈ માણસને ક્યારેય નીચેની પરિસ્થિતિથી તપાસ થયેલ હોય તો મને જણાવો.

બીમારી	પોતે	પતિ / પત્ની	(બાંધ કરો)				
દમ	X						
ન્યુમોનિયા							
બીજી કોઇપણ							

General Questionnaire procedures

4. Check/circle all that apply

૪૧. [Circle all that apply] તમારા તાપમાં તમારી જાતને બચાવવા તમે કયાં પગલાં લો છો? અને કેટલી વાર?

a. ઘરમાં રહો છો?

I. દિવસમાં ઘણી વખત
II. રોજ
III. અઠવાડિયામાં ઘણા દિવસ
IV. અઠવાડિયામાં એક વખત
V. એક કરતા ઓછી વખત
VI. મહિનામાં એક વખત
VII. કદિ નહી

General Questionnaire procedures

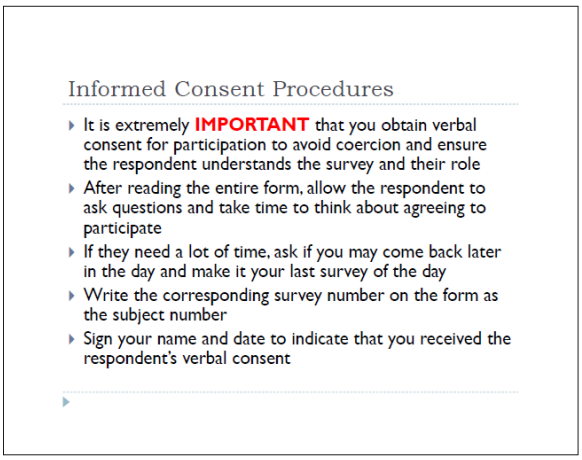
5. Explain "other"

૨૪. જો ના, તો તમને કંઈ વસ્તુ તબીબ / તબીબી સારવાર લેતા રોકે છે?

a. અંતર
b. સ્થળાંતરની સમસ્યા
c. જવા માટેની કિંમત
d. લાંબો સમય વાર જોવી / વધારે માણસો
e. બીજું (વિવરણ આપો) _____

General Questionnaire procedures

- Checking completed questionnaires
  - Review questionnaire for completion immediately after conducting the interview, BEFORE leaving the residence
  - Check that you have followed all important skip patterns and that you have not omitted any sections
  - Check that answers are all clearly legible, especially where you made corrections


Informed Consent Procedures
It is extremely IMPORTANT that you obtain verbal consent for participation to avoid coercion and ensure the respondent understands the survey and their role
After reading the entire form, allow the respondent to ask questions and take time to think about agreeing to participate
If they need a lot of time, ask if you may come back later in the day and make it your last survey of the day
Write the corresponding survey number on the form as the subject number
Sign your name and date to indicate that you received the respondent's verbal consent

Appendix F. English/Gujarati consent form (cover sheet to survey)

Emory University
Consent to be a Research Subject

Title: Developing Adaptation Strategies to Combat Climate Change: Heat Vulnerability Assessment in Ahmedabad, India

Principal Investigator: Kathy Tran, MPH Candidate 2012, Emory University

Introduction
You are being asked to be in a research study. Your household was randomly selected within your neighborhood to participate in a survey that will take approximately 1.5 hours to complete. Ten neighborhoods within Ahmedabad have been chosen for this survey, including yours.

This study is being conducted by a student from the US. The purpose of this study is to understand the public's knowledge of heat waves, symptoms of heat illnesses, and adaptation practices for heat exposure. The questionnaire will gather data on household information such as number of family members, ages, and occupations; behavioral and dietary adaptations; health history; and how households obtain and act on information relating to dangerously high temperatures.

Your name and address will not appear on any document. You will be given a subject number and location code. All of your answers will be kept confidential and will only be discussed among the research team (5 research assistants and 1 field advisor). The results of this study will be reported in a paper written in the US.

This study is not designed to benefit you and your family directly. However, the results may be used to help others in the future. You will also not be offered payment for being in this study.

Now I will ask for your verbal consent to be a survey respondent for this study. You will be given a subject number. **It is voluntary, entirely your choice. If you decide to take part, you can change your mind later on and withdraw from the research study. Again, your answers will be kept completely confidential. You can skip any questions that you do not wish to answer. You may ask any questions before you provide consent.**

You can take a copy of this consent form, to keep. Feel free to take your time thinking about whether you would like to participate. By verbally consenting to participate you will not give up any legal rights.

Contact Information
Contact Kathy Tran at 94-09-173688 or kathy.tran@emory.edu:

- if you have any questions about this study or your part in it or
- if you have questions, concerns or complaints about the research

Consent

The foregoing information has been read to me. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate as a subject in this study and understand that I have the right to withdraw from the study at any time without in any way it affecting me in any way.

_____

Subject number

_____ _____

Signature of Person Conducting Informed Consent Discussion Date

Time

ઈમોરી યુનિવર્સીટી
સંશોધન કાર્યમાં ભાગ લેવા માટે સંમત્તિ પત્રક

મથાળુ : આબોહવામાં થઈ રહેલા અસામાન્ય ફેરફારોનો સામનો કરવા માટે વ્યુહ રચના બનાવવીઃ અમદાવાદ, ભારતમાં ગરમીની ભેદ્યતાનું મુલ્યાંકન

પ્રસ્તાવના : તમોને સંશોધન કાર્યમાં ભાગ લેવા વિનંતી કરવામાં આવે છે. તમારા વિસ્તારમાંથી તમારા ઘરની પસંદગી કોઈ પણ પ્રકારના ભેદભાવ વગર સમાનતાના સિધ્ધાંત પર કરી છે અને લગભગ ૧.૩૦ (દોઢ કલાક) આ સર્વેનું પત્રક ભરવા માટે લાવશે. આ સર્વે માટે આપના વિસ્તાર સાથે અમદાવાદમાંથી ૧૦ બીજા વિસ્તાર પસંદ કરવામાં આવ્યા છે.

આ અભ્યાસ યુ. એસ.ના વિદ્યાર્થી દ્વારા કરવામાં આવી રહેલ છે. આ અભ્યાસનો હેતુ લોકોમાં રહેલી ગરમીના મોજા વીશેની જાણકારી, ગરમીના કારણે થતી બીમારીઓના લક્ષણોની જાણકારી અને ગરમીથી ઉત્પન્ન થતી પરિસ્થીતીને પહોંચી વળવા અનુકુલન સાધવાની જાણકારી પ્રાપ્ત કરવાનો છે. આ અભ્યાસમાં વિવિધ પ્રકારની માહિતી જેવીકે કુટુંબમાં કુલ સભ્યોની સંખ્યા,ઉમંર, રોજગાર, વર્તણૂંક અને આહાર સંબંધીત, આરોગ્ય સંબંધીત અને ઘરના લોકો ગરમી (ઊંચા તાપમાન) બાબતની જાણકારી કેવી રીતે મેળવે છે અને તેના માટે જરૂરી અનુકુલન કેવી રીતે પ્રાપ્ત કરે છે તે મેળવવામાં આવશે.

તમારું નામ કે સરનામું કયાંય દર્શાવવામાં આવશે નહીં. તમારા ઘર તથા વ્યકિતને એ સંકેત કોડ આપવામાં આવશે. તમારા બધાજ જવાબો ખાનગી રાખવામાં આવશે અને માત્ર સંશોધન કર્તાઓના જૂથને જ તેની ખબર હશે (૫ સંશોધન મદદનીશ તથા એક ક્ષેત્રીય સલાહકાર). આ અભ્યાસના તારણોનો અહેવાલ યુ. એસ.માં બનાવવામાં આવનાર સંશોધનપત્રમાં રજૂ કરવામાં આવશે.

આ અભ્યાસ તમને કે તમારા કુટુંબીજનોને સીધો ફાયદો નહી કરાવે, પરંતુ, તેના તારણો ભવિષ્યમાં સહુ કોઈને ઉપયોગી નીવડશે. આ અભ્યાસના અંતે તમને પણ કોઈ નાણાકીય લાભ મળશે નહી.

હવે હું આપને આ અભ્યાસ સાથે આપની મૌખિક સંમત્તિની અપેક્ષા રાખું છું. તમને એક વ્યકિત નંબર આપવામાં આવશે. આ સ્વૈચ્છિક અભ્યાસ છે અને તમારી અંગત પસંદગી પર સમગ્ર અભ્યસનો આધાર છે. જો આપને આ અભ્યાસમાં ભાગ લીધા પછી પણ, તમારું મન વચ્ચેથી બદલાયતો પછી પણ અભ્યાસમાંથી બહાર થઈ શકાશે. ફરીથી આપને વિશ્વાસ આપીએ છીએ કે, આપના જવાબોને સંપૂર્ણપણે ગુપ્ત રાખવામાં આવશે.
જો કોઈ પ્રશ્નનો ઉત્તર આપવાની ઇચ્છા આપને ન હોયતો તમે તેમ કરી શકો છો. આ અભ્યાસમાં ભાગ લેવા સંમત્તિ આપતા પહેલા આપને કોઈ પ્રશ્ન હોયતો પૂછી શકો છો.

આપને આ સંમત્તિપત્રની નકલ જોઈએ તો તે મળી શકશે. સર્વેક્ષણમાં ભાગ લેવા તમે શાંતિથી વિચાર કર્યા પછી નિર્ણય લેવા માટે આઝાદ છો. માત્ર મૌખિક સંમત્તિ આપવાથી તમે તમારા કોઈ કાયદાકીય અધિકારથી વંચિત થતા નથી.

સંપર્ક કરવા માટે માહિતીઃ

સંપર્ક માટે : કેથી ટ્રાન :– ૯૪–૦૯–૧૭૩૬૮૮ અથવા kathy.tran@emory.edu

- જો તમારે આ અભ્યાસ કે તેના કોઈ ભાગ માટે પ્રશ્ન હોય તો
- જો તમને આ અભ્યાસ બાબતે કોઈ પ્રશ્ન, તેના તાત્પર્ય બાબતે કે અભ્યાસ વીશે કોઈ ફરીયાદ હોયતો

સંમત્તિ :–

ઉપરોકત માહિતી મને વાંચી સંભળાવવામાં આવી છે. મને તેના વિશે પ્રશ્નો પુછવાની તક આપવામાં આવી છે. મે જે કોઈ પ્રશ્ન પુછયો છે તેનો જવાબ મને સંતોષકારક આપવામાં આવ્યો છે. હું સ્વૈચ્છિક રીતે આ અભ્યાસમાં સામેલ થવા સંમત્તિ આપું છું અને જો તે મને કોઈ પણ રીતે અપેક્ષીત અસર કરનાર નહીં હોય તો તેમ લાગતા સર્વેમાંથી છૂટા થઈ જવાની સમજ મને છે.

_____

વ્યકિતનો નંબર

_____ _____

સુમાહિતગાર સંમત્તિ માટે ચર્ચા કરનાર વ્યકિતની સહી તારીખ સમય

Appendix G. English/Gujarati Heat Vulnerability Assessment Survey

Survey #____

ગરમીની ભેદ્યતા મુલ્યાંકન સર્વેક્ષણ

Heat Vulnerability Assessment Survey

પ્રશ્નોત્તરી કરનાર માટે :–

સુચનો :–

૧. મૌખિક સંમતિ, સંમતિપત્રકથી લો અને સંમતિપત્રકની એક નકલ સર્વેમાં ભાગ લેનાર વ્યકિતને આપો.

૨. બધાજ પ્રશ્નો અને વિકલ્પો સર્વેમાં ભાગ લેનાર વ્યકિતને વાંચી સંભળાવવા.

૩. ભાગલેનાર તેની અનુકુળતા પ્રમાણે સર્વેના જવાબ માટે દિવસ/ ટાઈમ આપશે.

૪. સર્વે માટે, શરૂઆતમાં નીચેનો ભાગ ભરી લેવો.

૫. ઘાટા અક્ષરોને જવાબના કોડ ગણી અને તેની નોંધ કરવી.

૬. કૌંસમાં સુચનો બતાવેલ છે. ([ ])

પ્રશ્નોત્તરી કરનાર : _____

કયાં વિભાગમાં રહે છે. : _____

વિભાગનું સ્થાન (શેરી / પોળ) : _____

રહેણાંકની મુલાકાતની તારીખ : _____

ઘરના માલિક પ્રશ્નોત્તરી માટે સહમત થયા હતા ? હા ના (કારણ)

પ્રશ્નોત્તરી કરવાની તારીખ: _____

રહેણાંકનો પ્રકાર ઝોપડપટ્ટી ચાલી

છત પ્રકાર: ટીન/મેટલ/ પ્તરા એસ્બેસ્ટોસ પ્લાસ્ટિક શીટ્સ માટી લાકડાના સિમેન્ટ બીજુ કાંઈ (વિતરણ આપો):

For Interviewer:

Instructions:

1. Obtain oral consent with consent form and provide a copy of consent form to participant
2. All questions and options will be read to participants
3. Participants may reschedule day/time most convenient for them to respond to the survey
4. Fill out portion below before beginning to conduct survey
5. For responses you need to fill in, use the **bolded letters** as your code for the response if provided
6. Instructions indicated by brackets ([ ])

Interviewer:

Residence Ward:

Location of residence (street OR coordinates):

Date(s) approached residence:

Did head-of-household agree to do the interview? Yes No (**Reason**:)

Date interview conducted:

Residence type: Slum Chawl

Roof type: tin/metal asbestos plastic sheets clay wood cement other:

A. ઘરમાં રહેતા લોકો વિષે માહિતી :

જનસંખ્યા તથા વ્યકિત વીશેની માહિતી

1. ભાગ લેનારની ઊંમર : _____
1. Participant Age: _____

2. જાતિ : સ્ત્રી (F) પુઢષ (M)
2. Gender: M F

3. હવે હું તમને ક્રમવાર પ્રશ્નો પુછીશ (તમારા ઘરના માણસોને લગતા)
    a. તમારા ઘરમાં રહેતા બધા માણસોના નામ આપો. (જો કોડ ના આપેલો હોય તો અલગથી પ્રતિભાવ લખવો.)
        i. S – પતિ / પત્નિ
        ii. C – બાળકો
        iii. M – માતા
        iv. F – પિતા
        v. MI – સાસુ
        vi. FI – સસરા
        vii. B – ભાઈ
        viii. SS – બહેન
    b. એ બધાની ઊંમર ?
    c. આ બધામાંથી સૌથી વધારે ભણતર કોનું છે ?

i. N – કોઈ નહી
ii. P – standard 0-5
iii. M – standard 6-8
iv. S – standard 9-10
v. I – standard 11-12
vi. G – સ્નાતક (બી.એસ., બી.એક., એમ.ડી., પીએચડી, માસ્ટર્સ વગેરે)
vii. F – બિન-ઔપચારિક શિક્ષણ (ઘર અને શાળા, પુખ્ત શિક્ષણ)

d. અત્યારે તે શું ધંધો કરે છે ?
e. તેઓની માસિક આવક કેટલી છે ?

3. I am now going to ask you a series of questions relating to your household members.
   a. Please tell me all the members of your household. [if coding not listed, please write in response]
      i. S – spouse
      ii. C – child
      iii. M – mother
      iv. F – father
      v. MI – mother-in-law
      vi. FI – father-in-law
      vii. B – brother
      viii. SS - sister
   b. How old is each of them?
   c. What is the highest level of education each of them has achieved or currently in?
      i. N – none
      ii. P – primary (grade 0-5)
      iii. M – middle (grade 6-8)
      iv. S – secondary (grade 9-10)
      v. I – intermediate/senior-secondary (grade 11-12)
      vi. G – graduate (B.S., B.A., MD, PhD, master's, etc.)
      vii. F – non-formal education (home school, adult learning, etc.)
   d. What is their current occupation, if any?
   e. How much is their monthly income (Rs)?

જવાબ આપનાર સાથેનો સંબધ	ઉંમર (વર્ષ)	ભણતર	ધંધો	માસિક આવક
Relation to Respondent	***Age***	***Education level***	***Occupation***	***Annual income***

4. ભણવા જતા બાળકો કેટલાં છે ? (#): _____
4. How many children are in school? (#): _____

5. જો તમારા બાળકો નિશાળે નથી જતા, તો દિવસ દરમ્યાન શું કરે છે ? (જો લાગુ પડતું ન હોય તો આગળના પ્રશ્ન પર જાઓ)
    a. ઘરની બહાર કામ કરે છે.
    b. ઘરમાં લોકોને કામમાં મદદ કરે છે. (રસોઈ બનાવવી, કચરા પોતા કરવા)
    c. ઘરની બહાર લોકોને મદદ કરે છે. (ખેતરમાં કામ કરવું લાકડા અને પાણી એકઠા કરવા)
    d. રમત.
    e. બીજુ કાંઈ (વિતરણ આપો): _____
5. If your children are not in school, what do your children primarily do during the day?
    a. Work outside of the home
    b. Help with chores indoors (cooking, sweeping, etc.)
    c. Help with chores outdoors (field work, gathering wood and water, etc.)
    d. Play
    e. Other (explain): _____

ધંધો

6. તમારા ઘરમાં કોઈ માણસે છેલ્લાં બાર મહીનામાં સતત કામ ધંધો કરેલો છે ?
    a. હા **[Q8 ને ભરવું]**
    b. ના
6. Have the members in your household who have a job worked continuously in the past 12 months?
    a. Yes [skip to Q8]
    b. No

7. જો નહી તો શાના કારણે ? (એક મહીનો / તેથી વધારે) કયારે ? શું કારણે ?
    a. L – રજા (ઘરમાંથી કોઈ *વ્યક્તિ* ની બીમારીના કારણે)
    b. I – તમારી માંદગીના કારણે
    c. V – રજાઓના ગાળામાં
    d. M – ગર્ભાધારણ / પ્રસુતિના કારણે
    e. બીજુ કારણ (વિવરણ આપો)

વ્યક્તિ	***કયારે (છેલ્લાં માસમાં, બે મહિના પહેલા વિગેરે)***	**કારણે**
Person	***When (last month, 2 months ago, etc.)***	***Reason***

7. If not, who took time off (one month or more)? When? And for what reason? Possible reasons may include:
    a. L - Leave (bereavement, attend to own or family health needs, etc.)
    b. I - Illness
    c. V - Vacation
    d. M - Maternity leave
    e. Other (explain)

ઘર વિષે માહિતી

8. આ તમારૂ કુટુંબ / તમારા કુટુંબનું ઘર છે ? ભાડે છે ? બિનકાયદેસર છે ?
    a. પોતાનું
    b. ભાડાથી
    c. રહેણાંક બિનકાયદેસર છે

8. Do you or your family own this residence, rent or squat?
    a. Own
    b. Rent
    c. Squat

9. છેલ્લાં કેટલા સમયથી તમે અને તમારું કુટુંબ હાલના રહેંણાંકમાં રહો છો ?
    _____મહીના _____ વર્ષ

9. Do you or your family own this residence, rent or squat?
    a. Own
    b. Rent
    c. Squat

10. વિજળીનું બીલ કોણ ચુકવે છે ?
    a. હું ચુકવું છું.
    b. મારો મકાન માલીક ચુકવે છે **[Q.12 ઉપર જાઓ]**
    c. વિજ ચોરી કરવામાં આવે છે. **[Q.12 ઉપર જાઓ]**
    d. વિજળીનું જોડાણ નથી **[Q.12 ઉપર જાઓ]**

10. Who pays for your electricity?
    a. I pay
    b. My landlord pays (skip to Q12)
    c. We tap into the wires (skip to Q12)
    d. No electricity (skip to Q12)

11. તમારે વિજળી માટે કેટલું ભાડું આપવું પડે છે. બે મહિને, આશરે, ઉનાળાના દિવસોમાં (માર્ચ – જુલાઈ)
રકમ (રૂપિયા) _____ [છેલ્લા મહીનાનું બીલ જણાવવું]

11. How much do you pay for electricity bi-monthly, on average, during the summer months (Mar-Jul)?
Amount (Rs): _____

B. આરોગ્ય

આરોગ્યનો ઈતિહાસ

12. **[Check all that apply]** બધાને ચેક કરો અને બધાને પુછો. હું તમને વિવિધ આરોગ્યલક્ષી પ્રશ્નોત્તર કરીશ. હું તમારો થોડો વધારે સમય લઈશ. જો તમેને કે તમારા પતિ/પત્ની કે ઘરના કોઈ માણસને કયારેય નીચેની પરિસ્થિતિની તપાસ થયેલ હોય તો મને જણાવો.
12.[Check all that apply for each person] I am going to go through a list of various health conditions. It is a little long so bear with me. If you, your spouse, or any other household member has ever been diagnosed with one of these conditions, please let me know:

બીમારી	*પોતે*	*પતિ / પત્ની*	*(નોંધ કરો)*				
દમ	Asthma						
ન્યુમોનિયા	Pneumonia						
બીજી ફેફસાની કે શ્વસનતંત્રના રોગ (lung diseases, specify)	Other Respiratory Diseases						
ડાયાબીટીસ – મધુપ્રમેહ	Diabetes						
કેન્સર (any)	Cancer						
થાયરોઈડ ગ્રંથીના રોગો	Thyroid Disorder						
સ્થૂળતાપણું – મેદસ્વીતા	Obesity						
લોહીના ટકા ઓછા થવા (પાંડુરોગ)	Anemia						
માનસિક બિમારી (specify)	Mental disorder						
લકવો	Paralysis						
બીજું (ચેતાતંત્રની બીમારી) (specify)	Other nervous system disorder						
રૂધિરના દબાણની	High blood						

બીમારી	pressure						
હ્રદય રોગનો હુમલો	Heart attack						
હ્રદયના ધબકારા અનિયમિત થવા	Cardiac dysrhythmia						
રકતજ મૂર્છાનો હુમલો (Stroke)	Stroke						
બીજી હ્રદયની બીમારી (specify)	Other heart disease						
લીવર ના રોગ (પીળીયો, કમળો)	Liver disease (hepatitis, etc.)						
કીડનીનું કામ કરતું બંધ થવું	Kidney failure						
કુપોષણ	Malnutrition						
મલેરીયા	Malaria						
ડેન્ગ્યુ	Dengue						
સંધિવા , ચિકનગુનિયા	Chikungunya						
બીજા કૃમિના રોગો (specify)	Other parasitic disease (s)						
ઝાડા	Diarrheal disease						
બીજું (specify)	Other						

13. તમને / તમારા ઘરના કોઈને આગળ ચર્ચા કર્યા મુજબ કોઈ દર્દની છેલ્લા બે મહિનામાં તપાસ થઈ છે ?
    a. હા
       સમજાવો _____ (શું થયું હતું અને કોને થયું હતું તે જણાવો)
    b. ના

13. Were you or any of your household members diagnosed with any of these diseases in the past 2 months?
    a. Yes
       Explain: _____
    b. No

14. તમને / તમારા ઘરના કોઈને ગયા બે મહિનામાં તાવ આવેલ છે ?
    a. હા
    b. ના

14. Have you or anyone else in your household had a fever in the past 2 months?
    a. Yes
    b. No

15. તમને / તમારા ઘરના કોઈને ગયા બે મહિનામાં ઝાડા થયેલ છે ?
    a. હા
    b. ના

15. Have you or anyone else in your household had diarrhea (more than 3 loose stools a day) in the past 2 months?
    a. Yes
    b. No

16. **[Check all that apply]** બધા માણસોની તપાસ કરો. હું આરોગ્યને લગતી બાબતોનું પુછપરછ કરું છું. તમને / તમારા પતિ / પત્નિ કે ઘરના કોઈને નીચેની પરિસ્થિતિનો અનુભવ થયો હોય તો મહેરબાની કરી મને જણાવો. [Check all that apply for each person] I am going to go through another list of various health conditions. If you, your spouse, or any other household member has ever experienced one of these conditions related to heat, please let me know:

લક્ષણ	**પોતે**	**પતિ / પત્ની**				
નાની ફોડોલી અથવા ખીલ	Small blisters or pimples					
સુકું મોઢું	Dry mouth					
થાકી જવું	Fatigue					
પગનો દુઃખાવો	Leg cramps					
ભારે પસિનો થવો	Heavy sweating					
ખુબ જ તરસ લાગવી	Intense thirst					
હ્રદયના ધબકારા વધી જવા	Rapid heartbeat					
માથું દુઃખવું	Headache					
પગમાં સોજા આવવા	Leg swelling					

17. તમારા ઘરમાંથી કોઈને ગયા ઉનાળામાં તાપથી ઉલટીઓ થઈ છે ? જો હ તો કોને ? તમને યાદ છે કયારે અને કયાં ? Has anyone in your household vomited from the heat in the last year? If so, who? Do you remember when and where?

કોને (તમારા શું સગા થાય છે)	સ્થાન (ઘરે (O), બહાર (I), ખબર નથી. (DK))	સમય (થોડો દિવસ પહેલા (D), ગયા અઠવાડિયએ (W), ગયા મહિને (M), ૨–૩ મહીના પહેલા (2-3), ત્રણ મહિના કરતા વધારે (3+),
Person	**When (last month, 2 months ago, etc.)**	**Reason**

18. તમારા ઘરમાંથી ગયા વર્ષે કોઈ મુછીલ થયું છે ? જો હા તો કોને ? કયારે અને કયાં ?
Has anyone in your household fainted from the heat in the last year? If so, who? Do you remember when and where?

કોને (તમારા શું સગા થાય છે)	સ્થાન (ઘરે (O), બહાર (I), ખબર નથી. (DK))	સમય (થોડો દિવસ પહેલા (D), ગયા અઠવાડિયએ (W), ગયા મહિને (M), ૨–૩ મહીના પહેલા (2-3), ત્રણ મહિના કરતા વધારે (3+)
Person	**When (last month, 2 months ago, etc.)**	**Reason**

19. શું ગરમીના કારણે ગયા વર્ષે તમારા ઘરમાં કોઈને ચકકર અથવા મુંઝવણ કે આભાસ થાય છે ? જો એમ હોય તો, કોને આવું થાય છે ? તમને યાદ છે કયારે અને કયાં ?
Has anyone in your household developed hallucinations or confusion from the heat in the last year? If so, who? Do you remember when and where?

કોને (તમારા શું સગા થાય છે)	સ્થાન (ઘરે (O), બહાર (I), ખબર નથી. (DK))	સમય (થોડો દિવસ પહેલા (D), ગયા અઠવાડિયએ (W), ગયા મહિને (M), ૨–૩ મહીના પહેલા (2-3), ત્રણ મહિના કરતા વધારે (3+),
Person	**When (last month, 2 months ago, etc.)**	**Reason**

20. તમે / તમારા ઘરમાંથી કોઈ હોસ્પિટલે, દવાખાને કે એવી કોઈ જગ્યા તાપથી થતી બીમારીના કારણે ગયેલ છે ?
    a. હા
    b. ના **[Q23 પર જાઓ]**
    c. ખબર નથી. **[Q23 પર જાઓ]**

20. Have you or anyone in your family ever visited a hospital, clinic or healthcare facility for heat-related illness?
    a. Yes

b. No
c. Don't know

21. **[નીચેના ખાનાનું વિવરણ કરો, with code]** તમને / તમારા ઘરના વ્યકિતીને આમાંથી શું થયું હતું ?
[Explain other in box below person] What were you or your household members diagnosed with?
[Explain other in box below person] What were you or your household members diagnosed with?

નિદાન	**વ્યકિતની માહિતી ભરો**					
તાપથી ચાઠા પડવા	Heat rash					
તાપથી સોજા આવવા	Heat adema					
તાપથી અશકિત કે ઉલ્ટી કે માથાનો દુ:ખાવો વગેરે	Heat exhaustion					
તાપથી ગંભીર સ્ટ્રોક	Heat stroke					
શરીરનુ તાપમાન વધી જવું	Hyperthermia					
કીડની કામ કરતી બંધ થવી.	Acute renal failure					
બીજું	Other:					

22. જે સારવાર સંસ્થાને તમે ગયા ત્યાં
    a. બહાર કરતાં ઠંડી હતી.
    b. બહાર જેટલી ગરમ હતી.
    c. બહાર કરતા વધારે ગરમ હતી.

22. Was the medical facility you went to:
    a. Cooler than the outside
    b. As hot as the outside (about the same temperature)
    c. Warmer than the outside

23. તમારા માટે તબીબી કે તબીબી સેવા આપનાર આરામદાયક છે ?
    a. હા **[Q25 પર જાઓ]**
    b. ના

23. Is it convenient for you to see a doctor or medical practitioner?
    a. Yes [skip to Q25]

b. No

24. જો ના, તો તમને કંઈ વસ્તુ તબીબ / તબીબી સારવાર લેતા રોકે છે ?
   a. અંતર
   b. સ્થળાતંરની સમસ્યા
   c. જવા માટેની કિંમત
   d. લાંબો સમય વાર જોવી / વધારે માણસો
   e. બીજું (વિવરણ આપો) _____

24. If not, what prevents you from seeing a doctor or medical practitioner?
   a. Distance
   b. No transportation
   c. Cost of visit
   d. Long wait/overcrowded
   e. Other (explain): _____

C. અનુકૂલન સંબંધિત

ગરમીનો પ્રભાવ

25. હું તમને ક્રમબધ્ધ સવાલ પુછવા જઈ રહયો છું તમારા ઘરના લોકોની કામ કરવાની પરિસ્થિતિ વિષે.
   a. તમારા ઘરના લોકોના કામ કરવાના કલાકો વાતાવરણ પર નિર્ભર છે.
   b. ઉનાળામાં ઘરની બહાર કોણ કામે જાય છે ?
   c. તમે / તમારા ઘરના, ઘરમાં કામ કરો, તો AC / પંખો છે ? (હા / ના)
   d. નોકરી વખતે તમે / તમારા ઘરના લોકો કયા પ્રકારના કપડા પહેરે છે. ઉનાળામાં ?
      i. પાતળા
      ii. મધ્યમ
      iii. ઝાડા
   e તમે / તેઓ દિવસ / રાત કામ કરો છો ?
   f. તમે / તેઓ ઘરની બહાર કમ કરો ત્યારે , કયાં કામ કરો છો ?
      i. સુર્યતાપમાં
      ii. છાયડામાં
      iii. બન્નેમાં

25. I am now going to ask you a series of questions about your household members' working conditions.
   a. Are your or your household member's working hours dependent on the season?
   b. Who works outdoors during the summer months (Mar-Jul)?
   c. If you or they work indoors, is there air conditioning or fans available? (Y/N)
   d. What kind of clothing or uniform do you or they wear on the job during the summer months (Mar-Jul)?
      i. Thin
      ii. Medium
      iii. Thick
   e. Do you or they work during the day or during the night?
   f. If you or they work outdoors during the day, do you or they primarily work:

i. In the sun
ii. In the shade
iii. A mix

માણસ *(તમારા શું સગા થાય છે)*	***ઋતુ પ્રમાણે*** *હા* ***(Y)****/ના* ***(N)***	***ઘરની બહાર ઉનાળામાં*** *હા* ***(Y)****/ના* ***(N)***	***AC / પંખો*** *હા* ***(Y)****/ના* ***(N)***	***કપડાનો પ્રકાર*** *(પાતળા* ***(TN)****,* *મધ્યમ* ***(M)****,* *જાડા* ***(TK)****)*	***દિવસનો સમય*** *(દિવસ* ***(D)****,* *રાત* ***(N)****)*	***સ્થાનિક*** *(સુર્યતાપ* ***(S)****,* *છાયડો* ***(SH)****,* *મિશ્રણ* ***(M)****)*
Person (relative to resondent)	***Seasonality*** (**Y/N**)	***Outdoors in the summer*** (**Y/N**)	***Air conditioning or fans available*** (**Y/N**)	***Clothing type*** (thin (**TN**), medium (**M**), thick(**TK**))	***Time of day*** (**D**ay, **N**ight)	***Location*** (**S**un, **SH**ade, **M**ix)

26. આશરે, ઉનાળામાં તમે / તમારા ઘરના ઘરની બહાર કેટલા કલાકો કામ કરો છે ? (માર્ચ થી જુલાઈ દરમ્યાન)
On average, how many hours a day do you and your household members spend outdoors during the summer months (Mar-Jul):

વ્યક્તિ (તમારા શું સગા થાય છે)	***ઘરની બહાર (કલાકો)***	***કામના સ્થળે જતી વખતે (કલાકો)***	***કામના સ્થળની બાજુમાં બીજે (ખરીદી, રમતગમત વગેરે) (કલાકો)***
Person (relative to respondent)	***Working outdoors (hrs)***	***In-transit to work (hrs)***	***Besides work/in-transit (shopping, playing sports, etc.) (hrs)***

27. તમારા ઘરમાં અંદર બહાર કરતા વધારે ગરમ છે ? (માર્ચથી જુલાઈ)
a. હા
b. ના

27. Is the inside of your home warmer than the outside in the summer months (Mar-Jul)?
a. Yes
b. No

28. **[માત્ર પુરુષ ઉમેદવાર માટે]** તમને તમારી પત્નિ / માતાનું રસોઈ બનાાવવાનું સમયપત્રક ખબર છે ?
a. હા
b. ના **[Q33 પર જાઓ]**

28. [Only for **male** respondents] Are you familiar with your wife or mother's cooking schedule?
    a. Yes
    b. No [skip to Q33]

[Q29-Q32 માટે જે, પુરુષ જવાબ આપતો હોય તો શબ્દો બદલી શકાય]

[For Q32-Q35, change wording accordingly when asking the **male** respondent]

29. તમે તમારા રસોઈ બનાવવાના સમયપત્રકને બદલાવો છો ? ઉનાળામાં જમવાનું બનાવવાનો સમય કયો છે ?
    a. હા
    b. ના **[Q31 પર જાઓ]**

29. Do you change your cooking schedule, i.e. the times you cook your meals, during the summer?
    a. Yes
    b. No [skip to Q31]

30. **[વર્તુળ કરો]** જો હા, તો કેવી રીતે ?
    a. પુરા દિવસમાં વધારે વખત જમવાનું બનાવો છો ?
    b. પુરા દિવસમાં ઓછી વખત જમવાનું બનાવો છો ?
    c. દિવસના જલ્દી જમવાનું બનાવી લો છો.
    d. એક વખત વધારે જમવાનું બનાવી લો છો.
    e. બીજુ (વિવરણ આપો)_____

30. [Circle all that apply] If so, how do you change it?
    a. Cook more times throughout the day
    b. Cook less times throughout the day
    c. Cook earlier in the day
    d. Cook more at once
    e. Other (explain): _____

31. દિવસમાં કેટલી વાર જમવાનું બનાવો છો ? (૨૪ કલાકમાં, દિવસ/રાતે) ઉનાળામાં ? (માર્ચથી જુલાઈ)
    a. ૧
    b. ૨
    c. ૩
    d. ૪ / વધારે

31. How many times do you cook in a day (i.e. a 24-hour period, both day and night) during the summer months (Mar-Jul)?
    a. 1
    b. 2
    c. 3
    d. 4 or more

32. **[Circle all that apply]** (વર્તુળ કરો) દિવસના કયા સમયે જમવાનું બનાવો છો ?
    a. વહેલી સવારે
    b. સવારે
    c. બપોરે
    d. બપોરપછી
    e. વહેલી સાંજે
    f. સાંજે

32. [Circle all that apply] What times of the day do you cook?
    a. Early morning
    b. Morning
    c. Noon
    d. Afternoon
    e. Early evening
    f. Evening

[Q33-Q36 પુરુષ જવાબ આપતો હોય તો જવાબ બદલી શકાય]

[For Q33-Q36, change wording accordingly for **male** respondent]

33. તમારું રસોડું ઘરમાં છે કે બહાર ?
    a. ઘરમાં અંદર
    b. બહાર **[Q37 પર જાઓ]**

33. Is your kitchen inside or outside of your home?
    a. Inside
    b. Outside [skip to Q37]

34. તમે જયારે રસોઈ બનાવો છો ત્યારે તમારું ઘર અંદર થી ગરમ થઈ જાય છે ?
    a. હા
    b. ના

34. If inside, is your home warmer inside when you cook?
    a. Yes
    b. No

35. તમારા ઘરમાં બારીઓ છે?
    a. હા
    b. ના

34. Does your kitchen have a window?
    a. Yes
    b. No

36. તમે રસોઈ બનાવો ત્યારે બારીઓ ખુલ્લી રાખો છો ?
    a. હા
    b. ના

36. Do you usually open your window when you cook?
    a. Yes
    b. No

ગરમીના કારણે ઉદભવતી પરિસ્થીતી જાણકારી તથા તેના જોખમોની માહિતી

37. **[લાગું પડતું હોય ત્યાં વર્તુળ કરો]** સખત તાપમાં તમારી જાતને બચાવવા તમે કયાં પગલાં લો છો ? અને કેટલી વાર?
37. What steps do you take to protect yourself from the heat during very hot weather? And how frequently? (circle all that apply)
    a. ઘરમાં રહો છો ? Stay indoors
        I. હંમેશા
        II. મોટા ભાગના સમયે
        III. કયારેક
        IV. ભાગ્યેજ
        V. કયારે નહી
        i. Always
        ii. Most of the time
        iii. Sometimes
        iv. Rarely
        v. Never
    b. પાણી પુષ્કળ પીઓ Drink plenty of water
        i. Always
        ii. Most of the time
        iii. Sometimes
        iv. Rarely
        v. Never
    c. છાયડામાં રહેવું Seek shade
        i. Always
        ii. Most of the time
        iii. Sometimes
        iv. Rarely
        v. Never

    d. હલકા કપડા પહેરો Wear light clothing
        i. Always
        ii. Most of the time
        iii. Sometimes
        iv. Rarely
        v. Never
    e. ટોપી પહેરો / માથું ઢાંકો Wear a hat/cover head

i. Always
ii. Most of the time
iii. Sometimes
iv. Rarely
v. Never

f. AC હોય તેવી જગ્યાએ જાઓ છો ? (ખરીદી કરવાની જગ્યા, પીકચર જોવા, મંદિર મસ્જિદ, બીજા)
Go to a place with air conditioning (mall, movie theater, temple/mosque, etc)
i. Always
ii. Most of the time
iii. Sometimes
iv. Rarely
v. Never

g. પ્રવૃત્તિ ઓછી થઈ જાય છે. Reduce activity
i. Always
ii. Most of the time
iii. Sometimes
iv. Rarely
v. Never

h. ઠંડા પાણીથી નહાવ છો Take cool showers
i. Always
ii. Most of the time
iii. Sometimes
iv. Rarely
v. Never

i. ઘરની બહારની પ્રવૃતિ અવગણો (ટાઈમટેબલ બદલો, બપોરે રજા રાખો, વહેલી સવારે કામ કરો, બપોર પછી કામ કરો)
Avoid outdoor activity (change schedule, take breaks in the afternoon, etc)
i. Always
ii. Most of the time
iii. Sometimes
iv. Rarely
v. Never

j. ખાસ પ્રકારના ખોરાક ખાવ (સમજાવો) Eat certain foods more: _____
i. Always
ii. Most of the time
iii. Sometimes
iv. Rarely
v. Never

k. ખોરાક ઓછો લો (સમજાવો) Eat certain foods less:
_____

i. Always
ii. Most of the time
iii. Sometimes
iv. Rarely
v. Never

l. કઈ પણ અલગ પ્રકારનું નથી કરતા. Do nothing different

m. બીજું (વિવરણથી સમજાવો) Other (explain):_____-

i. Always
ii. Most of the time
iii. Sometimes
iv. Rarely
v. Never

38. તાપ તમારા ઘરના માણસોની સુવાની રીતમાં અસર કરે છે?

a. વહેલા સુવુ, વહેલા ઉઠવું.
b. વહેલા સુવુ, મોડું ઉઠવું.
c. મોડા સુવું, મોડું ઉઠવું
d. મોડા સુવું, વહેલું ઉઠવુ
e. કાંઈ અસર નથી કરતું.

38. Does heat affect your household's sleeping pattern?

a. Sleep earlier, wake up earlier
b. Sleep earlier, wake up later
c. Sleep later, wake up later
d. Sleep later, wake up earlier
e. No affect

39. તમે કયારે બીલ બોર્ડ, બસ, રેડીયો, છાપામાં કયારે આ ઉનાળામાં વધારે તાપ પડે છે એવું સાંભળ્યુ કે યાદ છે ?

a. હા
b. ના **[Q41 અવગણો]**

39. Do you recall hearing about excessive heat this summer from any media source such as a billboard, bus ad, radio, TV, or newspaper?

a. Yes
b. No [skip to Q41]

40. **[જ્યાં લાગું પડતુ હોય ત્યાં વર્તુળ બનાવો]** તમે / તમારા ઘરનાઓએ આ ઉનાળામાં વધારે પડતી ગરમી માટે ચેતવણી કયાં સાંભળી છે ?

a. ટી.વી.
b. ઈન્ટરનેટ
c. છાપામાં
d. રેડીયો
e. કુટુંબ / મિત્ર / પાડોશી
f. ઘરનું તાવ માપવાનું મશીન (થર્મોમીટર)

g. બીલ બોર્ડ / હોર્ડીંગ
h. બીજું કાંઈ (વિવરણ આપો:_____
i. ખબર નથી.

41. [circle all that apply] Where did you or your household members hear weather warnings about excessive heat this summer?
    a. TV
    b. Internet
    c. Newspapers
    d. Radio
    e. Family/friends/neighbors
    f. Home thermometer
    g. Billboard
    h. Other (explain): _____
    i. Don't know

41. તમે વાતાવરણની માહિતી કેટલીવાર મેળવો છો ?
    a. દરરોજ
    b. બે–ત્રણવાર / અઠવાડીયામાં
    c. એકવાર અઠવાડિયામાં
    d. મહિને એકવાર
    e. કયારે નહી.

41. How often do you look for weather information?
    a. Daily
    b. 2-3 times a week
    c. Once a week
    d. Once a month
    e. Never

42. તમે વધારે તાપમાન માટે કયા ઘટકમાપ વાપરો છો ?
    પ્રતિસાદ: _____

42. What indicators do you use to determine high temperatures?
    Response: _____

43. જયારે વધારે તાપમાન આવે છે. ત્યારે તમો કે તમારા કુટુંબીજનો વધારે તાપમાનથી બીમાર પડશો એવી ચિંતા થાય છે ?
    a. હા
    b. ના
    c. ખબર નથી.

43. When it comes to heat and your family, are you worried about anyone getting sick from heat exposure?
    a. Yes

b. No
c. Don't know

44. તમે વધારે તાપમાનથી થતી બીમારી કયારેય જોઈ છે ?
    a. હા
    b. ના

44. Have you ever sought information about heat-related illnesses?
    a. Yes
    b. No

45. **[જ્યાં લાગું પડતુ હોય ત્યાં વર્તુળ બનાવો]** તમને વધારે તાપના લીધે થતી બીમારી કયાં જોઈ છે / કયાંથી માહિતી મળી છે ?
    a. રેડીયો
    b. ટીવી
    c. ઈન્ટરનેટ
    d. છાપું
    e. સામુદાયીક વર્તમાનપત્ર
    f. તબીબી તજજ્ઞ
    g. કુટુંબીજનો
    h. નિશાળના શિક્ષક
    i. મિત્રો
    j. પાડોશી
    k. ધર્મના વડા
    l. બીજું (વિવરણ આપો)_____

45. [Circle all that apply] Where have you found or would you look for information about heat-related illnesses?
    a. Radio
    b. TV
    c. Internet
    d. Newspaper
    e. Community newsletter
    f. Medical professional
    g. Family member
    h. School teachers
    i. Friends
    j. Neighbors
    k. Religious leader
    l. Other (explain): _____

46. **[જ્યાં લાગું પડતુ હોય ત્યાં વર્તુળ બનાવો]** તમે કયારે તાપથી થતી બીમારીથી બચવા વિષે સાંભળ્યું છે ? કોની પાસેથી?

a. ડોકટર
b. દવા આપનાર
c. કુટુંબીજનો
d. શાળાના શિક્ષક
e. મિત્રો
f. પાડોશી
g. ધર્મના વડા
h. Never
i. બીજું (વિવરણ આપો)_____

46. [Circle all that apply] Have you ever talked about steps to prevent heat related illness with your
    a. Doctor
    b. Pharmacist
    c. Family member
    d. School teachers
    e. Friends
    f. Neighbors
    g. Religious leader
    h. Other (explain): _____

પ્રતિસાદની રીત

47. તમે ઉનાળાના અંદરથી વધારે ગરમ હતા ?(માર્ચ–જુલાઈ)
    a. હા
    b. ના

47. Are you ever too hot inside your home during the summer months (Mar-Jul)?
    a. Yes
    b. No

48. તમારું ઘર રાત્રે દિવસ કરતાં વધારે ઠંડું હોય છે ?
    a. હા
    b. ના

48. Is your home cooler at night than during the day time?
    a. Yes
    b. No

49. વર્ષમાં તમે કેટલીવાર બારીઓ ખુલ્લી રાખો છો ?
    a. હંમેશા
    b. વાતાવરણ પર આધાર રાખે છે.
    c. ભાગ્યે જ
    d. કયારે નહી.

49. How often do you keep the windows opened throughout the year?
    a. Always
    b. Depends on the season
    c. Rarely
    d. Never

50. ઉનાળામાં, તમે બારીઓ ખુલ્લી રાખો છો ?
    a. ખુલ્લા રાખો છો
    b. બંધ રાખો છો

50. In the summer, do you usually keep your windows opened or closed?
    a. Opened
    b. Closed

51. **[જ્યાં લાગું પડતુ હોય ત્યાં વર્તુળ બનાવો]** નીચેનામાંથી તમે ઘરને ઉનાળામાં ઠંડું રાખવા શું કરો છો ?
    a. AC
    b. વિજળીનો પંખો
    c. વૃક્ષો અને છોડવાઓ
    d. એર –કુલર
    e. કંઈ નહી.
    f. બીજું (વિવરણ આપો): _____

51. [Circle all that apply] Which of the following are you using to cool your home in this summer?
    a. Air conditioning
    b. Electric fans
    c. Shades and/or shutters
    d. Trees and plants
    e. None
    f. Other (explain): _____

[Q52-53 પર જાઓ જો એર–કુલર જવાબ હોય તો]

[Skip Q56-57 if "Air cooler" was not given as an answer by the respondent]

52. એર – કુલર તમારું છે કે ભાડેથી ?
    a. પોતાનું
    b. ભાડેથી

52. Do you own or rent your air conditioner?
    a. Own
    b. Rent

53. તમને એર– કુલર વાપરવાથી કોણ અટકાવે છે ?
    a. AC નો ભાવ

b. વિજળીનો ભાવ
c. કામ નથી કરવું.
d. સમારકામનો ભાવ
e. અવાજ કરે છે.
f. બીજું (વિવરણ આપો)
g. કંઈ રોકતું નથી.

53. Does anything prevent you from using air-conditioning?
    a. Cost of air conditioner
    b. Cost of electricity
    c. Doesn't work
    d. Cost of repairs
    e. Noise
    f. Other (explain):
    g. Nothing prevents me

54. જ્યારે વાતાવરણ ખુબ ગરમ હોય ત્યારે તમે ઘર છોડીને AC હોય તેવી બીજી ઠંડી જગ્યાએ જાવ છો ?
    a. હા
    b. ના **[Q55 અવગણો]**

54. Do you leave your home and go to an air conditioned place when the weather is very hot?
    a. Yes
    b. No [Skip to Q56]

55. તમે કયાં જાવ છો ?
    a. ખરીદીની જગ્યાએ.
    b. મંદીર / મસ્જિદ
    c. મુવી / થીયેટર
    d. કુટુંબ / મિત્ર / પાડોશી પાસે
    e. બીજે (વિવરણ આપો):

55. Where do you go?
    a. Shopping mall
    b. Temple/mosques
    c. Movie theater
    d. Family/friends/neighbors
    e. Other (explain):

56. **[Circle all that appy]** તમને AC જગ્યાએ જતા કોઈ રોકે છે ?
    a. દિવસનો સમય
    b. કોઈ વિકલાંગતાના કારણે
    c. ઘરથી તેનું અંતર
    d. ત્યાં સુધી જવાની યંત્રનો અભાવ

e. વ્યકિતગત સલામતિ
f. ઘરડા / બાળકો જે ઘરે હોય છે.
g. કોઈ રોકતું નથી.
h. બીજું (વિવરણ આપો):

56. Does anything prevent you from going to an air-conditioned place?
    a. Time of day
    b. Disability
    c. Distance from home
    d. Lack of transportation
    e. Personal safety
    f. Elderly/young children at home
    g. Nothing prevents me
    h. Other (explain):

પાણી પીવા સંબધિત જાણકારી માટે

57. તમે / તમારા કુટુંબીજનો ઉનાળામાં (માર્ચ–જુલાઈ) વધારે પાણી પીઓ છો ?
    a. હા
    b. ના

57. Do you and your family drink more water in the summer months (Mar-Jul)?
    a. Yes
    b. No

58. તમે / તમારા કુટુંબીજનો ઉનાળામાં વધારે બીજું પીણું જયુસ, સોડા કે છાસ પીઓ છો ?
    a. હા
    b. ના

58. If you and your family do not drink more water during the summer months, do you drink more other types of liquids like juice, soda or chhas?
    a. Yes
    b. No

59. તમારું પીવાનું પાણી કયાંથી આવે છે ?
    a. ઘરે – નળમાંથી
    b. ઘરે – ગાળીને
    c. સામુહિક નળમાંથી
    d. સામુહિક ટાંકીમાંથી
    e. બાટલીમાંથી
    f. બીજું (વિવરણ આપો):

59. What is your main source of drinking water?
    a. In home – tap
    b. In home – filtered
    c. Public tap

d. Public tank
e. Bottled
f. Other (explain):

60. કોઈ ચોકકસ સમયે તમને પાણી મળે છે ?
    a. હા
    b. ના

60. Is there a particular time of day that you get your water?
    a. Yes
    b. No

61. જો હા તો કયા સમયે પાણી આવે છે. **[જયાં લાગું પડતુ હોય ત્યાં વર્તુળ બનાવો]**
    a. વહેલી સવારે
    b. સવારે
    c. બપોરે
    d. બપોર પછી
    e. વહેલી સાંજે
    f. સાંજે

61. If yes, what time of day do you get your water?
    a. Early morning
    b. Morning
    c. Noon
    d. Afternoon
    e. Early evening
    f. Evening

62. એક મહિનામાં આશરે , તમે પીવાના પાણી પર કેટલો ખર્ચ કરો છો ?
    રકમ રૂપિયા : _____

62. How much money do you spend for your drinking water per month, on average?
    Amount (Rs): _____

63. તમે અથવા તમારા પતિ / પત્નિ કામ પર હોય તો તમે પાણી કયાંથી લાવો છો ?
    a. કામની જગ્યા પરથી
    b. બાટલીમાંથી
    c. બીજું (વિવરણ આપો):

63. Where do you get your drinking water when you or your spouse are at work?
    a. At work site
    b. Public tank
    c. Bottled
    d. Other (explain):

64. તમને /તમારા / પતિ /પત્નિ કામની જગ્યાએ પીવાનું પાણી કોણ આપે છે ?
    a. કામ કરનાર
    b. AMCના સામુહિક સ્ત્રોતમાંથી
    c. પોતે લઈ જાવ
    d. બીજું (વિવરણ આપો):

64. Who provides you or your spouse with the drinking water at work?
    a. Employer
    b. AMC public source
    c. Self
    d. Other (explain):

65. તમે બહાર માર્કેટ, મંદીર, રમતના મેદાનમાં હોય ત્યારે પાણી કયાંથી લાવો છો ?
    a. જાહેર પાણીના ફુવારામાંથી
    b. ખરીદેલી બાટલીમાંથી
    c. ઘરેથી / નળ / ફીલ્ટરમાંથી / ભરીને લાવો છો
    d. બીજું (વિવરણ આપો):

65. Where do you get your water when you are out for leisure, like going to the market, temple, play sports?
    a. Public water fountain
    b. Public tank
    c. Bottled – purchased
    d. Bottled – from home tap/filter
    e. Other (explain):

સ્થાળાંતર : Transportation

66. જ્યારે તમે કામે, ખરીદી કરવા, મંદીરે, કે બીજી જગ્યાએ કેવી રીતે જાવ છો ?
    a. ચાલીને
    b. સાયકલથી
    c. બસથી
    d. મોટર સાયકલથી
    e. કારથી
    f. ટેક્ષથી
    g. ઓટો રીક્ષાથી
    h. બીજું (વિવરણ આપો):

66. How do you most commonly get from one place to another when you go to work, shopping, temple and other places on a regular basis?
    a. Walk
    b. Bicycle
    c. Bus
    d. Motorcycle
    e. Car

f. Taxi
g. Auto-rickshaw
h. Other (explain):

[જો સર્વેમાં ભાગ લેનાર પાસે ગાડી હોય તો Q67-68 પર જાઓ] [Skip Q73-75 unless respondent owns a car]

67. જ્યારે બહાર ગરમી હોય ત્યારે તમે કેટલી વખત તેમાં AC ચલાવો છો ?
    a. હંમેશા
    b. મોટા ભાગના સમયે
    c. ક્યારેક
    d. ભાગ્યેજ
    e. ક્યારે નહી

67. How often do you use air conditioning in your car when it is hot outside?
    a. Always
    b. Most of the time
    c. Sometimes
    d. Rarely
    e. Never

68. તમે શા કારણે ગાડીમાં AC વાપરતા નથી.
    a. ગેસની કિંમત
    b. કામ નથી કરતું
    c. સમારકામની કિંમત
    d. અવાજ
    e. કાંઈ જ મને રોકતું નથી
    f. બીજું (વિવરણ આપો):

68. Does anything prevent you from using your car air-conditioning?
    a. Cost of gas
    b. Doesn't work
    c. Cost of repairs
    d. Noise
    e. Nothing prevents me
    f. Other (explain):

69. **[Circle all that apply]** જ્યારે તમે / તમારા કુટુંબીજનો બહાર ચાલવા / બાઈક પર હોય ત્યારે ટોપી / ખાસ પ્રકારના કપડાઓ પહેરો છો ?
    a. ટોપી
    b. કપડાઓ
    c. સુર્યપ્રકાશથી બચાવતા ચશ્માં
    d. બીજુ કંઈ

69. Do you or your family wear hats or particular clothing to protect you or them from the sun when you or they walk or bike (bicycle or motorcycle)?
    a. Hats

b. Clothing
c. Sunglasses
d. Other (explain):

Barriers/Social networks

70. તમે તમારા પડોશીથી સુરક્ષીત છો ?
    a. હા
    b. ના
    c. નથી જાણતા

70. Do you feel safe in your neighborhood?
    a. Yes
    b. No
    c. Don't know

71. શા માટે અથવા શા માટે નહિ ?
    કારણ : _____

71. Why or why not?
    Reason:

72. તમે તમારા કેટલા પડોશીઓને જાણો છો ?
    a. બધા
    b. લગભગ બધા
    c. કોઈક
    d. ઓછા
    e. કોઈને નહિ.

72. How many of your neighbors do you know?
    a. All
    b. Most
    c. Some
    d. Few
    e. None

73. કેટલી વાર તમે તેમની જોડે વાત કરો છો ?
    a. રોજ
    b. કોઈકવાર
    c. કારણસર
    d. ભાગ્યેજ
    e. કોઈવાર નહિ

73. How often do you talk to them?
    a. Everyday
    b. Often

c. Occasionally
d. Rarely
e. Never

74. જો તમે તમારા પડોશીની મદદ માંગો તો તમને મદદ કરે છે ? અથવા તમને અનુકુળ છે ?
    a. હા
    b. ના
    c. નથી જાણતા

74. Is there a neighbor you would feel comfortable asking for assistance if you needed help?
    a. Yes
    b. No
    c. Don't know

75. જો તમે તાત્કાલિક બોલાવો તો તરત આવે તેવો માણસ કયાં છે ?
    a. બાજુમાં
    b. પડોશમાં
    c. ગામમાં
    d. બીજે (વર્ણવો)

75. Where is the nearest person whom you could call in an emergency?
    a. Next door
    b. In the neighborhood
    c. Other part of the city
    d. Other (explain):

76. તમે જેને બોલાવો છો તે માણસ કોણ છે ?
    a. ઘરનો સભ્ય કે જે તમારા ઘરમાં નથી
    b. મિત્ર
    c. પડોશી
    d. ધર્મગુરુ
    e. સામાજીક નેતા
    f. બીજા (વર્ણવો)

76. Who is this person you would call?
    a. Family member not in your household
    b. Friend
    c. Neighbor
    d. Religious leader
    e. Community leader (local chief, etc.)
    f. Other (explain):

77. <u>તમે કોઈ વખત</u> તમારા પડોશીને તાત્કાલિક મદદ માટે બોલાવ્યા છે ?
    a. હા
    b. ના

77. Have you ever called a neighbor in an emergency?
    a. Yes

b. No

78. તમે કયારેય વધારે તાપ પડેલ હોય ત્યારે તમારા પાડોશી સાજા છે કે કેમ તે માટે ખાતરી કરી છે.
    a. હા
    b. ના

78. More specifically, have you ever checked in on a neighbor during a heat wave to make sure they were OK?
    a. Yes
    b. No

79. <u>તમારા કોઈ પાડોશીએ</u> તમને તાત્કાલિક મદદ માટે બોલાવ્યા છે ?
    a. હા
    b. ના

79. Have any of your neighbors ever called you in an emergency?
    a. Yes
    b. No

80. તમે સાજા છો કે કેમ તેની ખાતરી તાપ પડે છે ત્યારે તમારા પાડોશીએ કરી છે ?
    a. હા
    b. ના

80. More specifically, have you ever checked in on a neighbor during a heat wave to make sure they were OK?
    a. Yes
    b. No

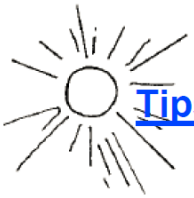
81. તમારે ત્યાં લોકોને તાપથી થતી બીમારીની માહિતી આપવા માટે સામુહિક પ્રોગ્રામ છે ?
    a. હા
    b. ના
    c. ખબર નથી

81. Is there a program in your community that informs people about heat-related illnesses?
    a. Yes
    b. No
    c. Don’t know

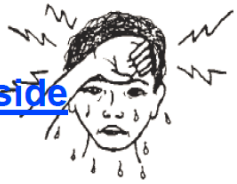
આ પ્રશ્નોના જવાબ આપવા માટે સમય ફાળવવા બદલ તમારો ખુબ ખુબ આભાર !

THANK YOU SO MUCH FOR TAKING THE TIME TO ANSWER OUR QUESTIONS TODAY!

Appendix H. English/Gujarati NRDC Heat illness prevention tip sheet



Keep Cool Ahmedabad
Tips for Keeping Cool When It's Hot Outside



In extreme heat, you are at high risk for serious illness if you are:

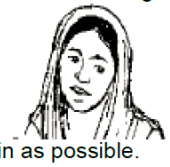
- Older than 65
- Newborns or young children
- suffering a chronic medical condition, such as heart or lung illness
- Work outdoors in highly exposed to heat, for example, factory workers, market vendors, rickshaw pullers, or construction workers
- Unable to leave the house
- Confined to bed
- Overweight

Recognize symptoms of extreme heat – see a doctor immediately if you have:

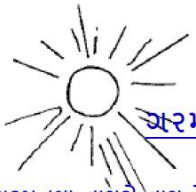
- heart or lung disease and do not feel well
- symptoms of heat illness, such as:
  - Hot, dry skin OR cold, clammy skin
  - Weakness
  - Dizziness
  - Nausea or vomiting
  - Shortness of breath or trouble breathing
  - Confusion, hallucinations, disorientation

Ways to protect yourself from heat

- Go to a cool place like a library, shopping mall, or movie theatre
- Drink water even if you do not feel thirsty
- Avoid drinks with alcohol, caffeine, soft drinks, or lots of sugar
- Check urine colour, dark urine may mean you are not drinking enough water
- Check on neighbours to make sure they are keeping cool
- Keep windows open to let fresh air in and cover the windows with something to prevent sunlight from entering
- Use fans ONLY when the windows are open
- Stay out of the sun and get in the shade, if possible.
- If you must be in the sun, wear:
  - a head covering to protect your face and head
  - Thin, light-colour, loose-fitting clothes to cover as much skin as possible.
  - Sunscreen (at least SPF 15)
- Avoid intense physical activity, but if you must, take a break during peak afternoon heat, and rest in the shade
- Make plans for outdoor activities in the evening, when it's cooler
- Eat sorghum, raw onion and raw sour mangoes
- Drink chhaas and jal jeera to protect against heatstroke



Protect your health to help prevent heat-related illness.



ઠંડક રાખો

ગરમીથી બચવા અને ઠંડક રાખવા માટેનાં કેટલાક સુચનો/ઉપાયો

ગરમ (લૂ) વાયરો વાય તે દરમિયાન તમે માંદગીમાં સપડાવવાનો ભય રહે છે:

- ૬૫ વર્ષ અથવા તેનાથી મોટી ઉંમરના હોવ.
- નવજાત અથવા બાળકો
- લાંબા ગાળાની માંદગી, હૃદય અને ફેફસાની બીમારીઓ
- ગરમીમાં મોટે ભાગે બહાર જ કામ કરતાં વ્યક્તિઓ, નોકરિયાત વર્ગ અથવા ધંધાદારી માણસો જેવાકે, ઓટોરીક્ષા વાળાઓ, ફેરીયાઓ, અથવા બાંધકામ કરનાર કારીગરો, ફેક્ટરી કામદારો
- ઘરની બહાર નથી નીકળી શકતા.
- સંપૂર્ણ રીતે પથારીવશ હોય.
- વધુ પડતાં વજનના કારણે.

વધુ પડતી ગરમીના લક્ષણો ઓળખો - તમારા ડોક્ટરનો સંપર્ક કરી શકો છો આકસ્મીક તાત્કાલીન સારવાર મેળવી શકો છો:

- તમને હૃદય અથવા ફેફસામાં રોગ થયો હોય તો કંઇ જ સારૂ લાગતું નથી.
- તમને ગરમીના કારણે માંદગીના લક્ષણો જણાય ત્યારે :
  - ગરમ, સુકી ચામડી અથવા Clammy Skin (વધુ પડતો પરસેવો થતો હોય તેવી ચામડી).
  - થાક અનુભવવો.
  - ચક્કર આવવાં.
  - ઉલ્ટી આવવી.
  - શ્વાસ લેવામાં તકલીફ થવી.
  - મુંઝવણ, ભ્રમ, આત્મવિસ્મૃતિ.

ગરમીથી પોતાની જાતને બચાવવાના રસ્તાઓ

- તમે ઠંડકવાળા સ્થળો પર જઇ શકો છો. જેવાં કે પુસ્તકાલય, શોપિંગ મોલ, સિનેમા ઘર.
- પાણી પીધા કરો, તરસ્યા હોય તેવું ક્યારેય ન લાગવું જોઇએ.
- તમે તમારા પાડોશીનો પણ ખ્યાલ રાખી શકો છો, અને તમે તેમને ગરમીથી બચવાનાં ઉપાયો સૂચવી શકો છો.
- તમારે પોતાના ઘરની અથવા ઓફિસની બારી ખુલ્લી રાખવી જોઇએ, જેથી તાજી હવા તમને મળી રહે; અને બારીને પડદાથી ઢાંકી રાખો.
- જ્યારે બારી ખુલ્લી હોય ત્યારે માત્ર પંખાનો જ ઉપયોગ કરવાનો રાખો.
- જો શક્ય હોય તો સૂર્યના તાપ નીચે ઉભા રહેવા કરતાં છાંયડામાં ઉભા રહેવાનું પસંદ કરો. જો તમે સૂર્યની સામે રક્ષણ મેળવવા માંગતાં હોવ તો:
  - તમે તમારૂં માથું અને ચહેરો ઢાંકવાનું રાખો.
  - શક્ય હોય તો પાતળા, આછા કલરના અને ઢીલાં કપડા પહેરવા જોઇએ.

- ગરમીથી રાહત મેળવવા માટે જુવાર, છાશ, જલજીરા, કેરી, ડુંગળી વગેરે લેવા જોઇએ.
- બહાર જવાનું રાત્રિનાં ભોજન પછી ગોઠવવાનું રાખો, જેથી ઠંડી હવા મળી રહે.
- અતિશય મહેનતવાળા શારીરિક કાર્યોથી દૂર રહો, પણ જો કાર્યો કરવા જ હોય તો બપોરે ગરમીમાં છાંયડા નીચે આરામ કરવાનું રાખો,

તમારા આરોગ્ય સુરક્ષિત કરવા માટે ગરમી સંબંધિત બિમારી રોકવા મદદ કરે છે

Appendix I. Variables recoded for modeling

Several variables were recoded into categories or categories were combined due to low number of responses for particular categories for analysis.

- Preexisting conditions, ever or currently had in lifetime, were recoded into three dichotomous variables of chronic, diarrheal, and infectious (full list of diseases in codebook in Appendix). Any disease or conditions that fell into each category were coded as a "yes" and "no" if otherwise.
- Occupation (Q3D) was categorized into seven categories including physical labor, service, office/teacher, factory/manufacturing, sales and artisan (full list of occupations by category in Appendix) for the descriptive analysis. For modeling, the categories were further combined based on nature of work and likelihood of work settings (outdoors vs. indoors, etc.) because the low number of individuals per category did not provide enough power to detect associations. The physical labor and factory/manufacturing categories were combined since work in both categories are likely strenuous and labeled as manual labor. The sales and artisan categories were combined into one because many within those categories were observed to work outdoors and artisans also sell their own products. Lastly, the service and office/teacher categories were combined because those with these types of jobs are more likely to work indoors and/or have work tasks that are not physically strenuous.
- For cooling methods (Q51), air conditioning and evaporative air cooler were recategorized into the "A/C" category, and trees/plants, sprinkle water on floor ("other" response), and put wet towel on head ("other" response) were recategorized into the "other" category.
- Factors preventing access to air conditioning (Q56) was dichotomized so any response other than "nothing or did not want to," reference, were considered a barrier; the wide distribution and concentration in the reference group reduced the power to detect associations.
- For main sources of drinking water (Q59), bottled water and 50 liter bottles ("other" response) were recategorized into the "purchased" category, and "from neighbor, no pipe line" and "from neighbor" ("other" responses) were recategorized into the "neighbor" category.
- Time of day respondents got their water (Q61) (piped water only came at a certain time of day) was recoded into 3 categories morning (early morning, morning), noon (noon, afternoon), and evening (early evening, evening).
- Sources of extreme heat that summer (Q40) were recoded into media (TV, internet, newspapers, radio) and person (family/friends/neighbors).
- HRI information sources respondents had used or would use (Q45) were recoded as media (radio, TV, internet, newspaper, community newsletter) and community (medical professional, family member, school teachers, friends, neighbors, religious leader).
- Person respondent has talked to about preventing HRI (Q46) was recoded into professional (doctor, pharmacist) and community (family member, school teachers, friends, neighbors, religious leader).
- For coping methods (Q37A-I), frequencies were recoded as most of the time (always, most of the time), sometimes, and rarely (rarely, never). Sometimes and rarely were then combined into one category.
- Number of neighbors respondent knew (Q72) were recoded into most (all, most), some, and few (few, none). The frequency of talking to neighbors (Q73) were recoded into often (everyday, often), occasionally, and rarely (rarely, never). These two were then

combined into a binary variable of knowing most of their neighbors and talking to them often (yes/no).

- Reasons for feeling safe (Q71) were categorized into three categories including positive, neutral and negative (full list of responses in Appendix). This was then combined with whether the respondent felt safe in their neighborhood (Q70) into a binary variable of feeling safe in neighborhood because of positive/neutral relations within neighborhood (yes/no).
- The nearest person respondent would call in an emergency was recoded into "in the neighborhood" (next door, in the neighborhood) and "outside of neighborhood" (other part of city, other).

Appendix J. List of recoded occupations by category

Homemaker/ none	**physical laborer**	**Service**	**Office/teacher**
housewife/work	laborer	AMC office janitor	AMC water dept worker
retired	mason	AMC road cleaner	AMTS office clerk
student	AEC laborer	auto rickshaw driver	BRTS ticket checker
dropout	animal husbandry	bungalow housekeeper	aaganwadi/preschool worker
handicapped	brick maker	cloth shop janitor	accountant
retired	bicycle shop mechanic	delivery auto driver	call center customer service rep
retired (pension)	car painter	delivery truck driver	clerk in PWD
	car washer	driver	company job
	carpenter	hotel bell boy	computer teacher
	construction worker	hotel waiter	courier service worker
	foundry laborer	housekeeper	doctor's assistant
	house painter	janitor	file binder
	metal laborer	janitor in call center	home teacher
	mill laborer	janitor in mall	insurance office peon
	mill worker	lift repairman	lawyer
	pacca ceiling maker	maid	painter co. clerk
	painter	milkman	pharmacy office clerk
	rag picker	newspaper deliverer	secretary
	transport co. laborer	office janitor	social worker
		pedal rickshaw driver	teacher
		personal driver	temp office clerk
		pipe fitting	typing tutor
		plumber	apprentice
		policeman	
		private driver	
		psychic	
		railway track maintenance man	
		railway worker	
		residential sweeper	
		security guard	
		sewage dept sweeper	
		shoe repairman	
		shoe tailor	
		shop peon	
		street cleaner	
		tailor	
		tailor apprentice	
		watchman	
		water pipeline worker	

Factory/manufacturing	Sales	artisan
Nirma factory worker	balloon vendor	bed sheet maker
cable wire manufacture worker	bangals vendor	broom maker
carbon factory worker	beauty parlor worker	cloth printing
chemical industry	clock shop	cushion covers maker
diamond factory worker	cloth shop salesman	design embroideries for sarees
electrician	cloth shop worker	diamond maker worker
factory apprentice	cloth vendor	diamond polisher
factory cloth maker	clothing vendor	embroidery designer
factory machine operator	cups vendor	embroidery maker
factory worker	cutlery shop owner	embroidery work/study
iron factory machine operator	door to door salesman	fabric maker
iron factory worker	dress material shop owner	flower maker
iron welding work	farsan (fried) snacks vendor	kite maker
lathe machine operator	farsan, chana, chapati vendor	idol artisan
machinery work	fruit cart vendor	idol artisan/sell balloons
mill machine operator	fruit shop owner	make hair clips
paint factory worker	fruit vendor	makes plastic bags
pipe co. worker	garment shop owner	ornaments polisher
pipe maker	general store cashier	package tamarind
plastic bags maker	general store owner	photo album maker
plastic products maker	grocery shop worker	photo frame maker
printing press operator	grocery store cashier	plaster of paris contractor
steel factory worker	grocery store worker	plaster of paris maker
waste factory worker	hair salon worker	rakhdi (head ornament) maker
water pump spare parts factory worker	hosery shop owner	ready made clothes maker
welding work	medical store worker	ritual flower leis maker
wood co. machine operator	mobile cart vendor	soft drink maker
wood factory worker	mutton shop owner	
	paan parlour owner	
	pharmacy co salesman	
	pharmacy worker	
	plywood business	
	potato vendor	
	provisions store owner	
	sells cooked foods from home	
	sells readymade suits/shirts	
	snack shop owner	
	toy vendor	
	underwear saleswomen	
	vegetable vendor	
	watch/glass items vendor	
	xerox shop worker	

Appendix K: Recoded reasons for feeling safe/unsafe in neighborhood

Positive relationships
Good relation with neighbors
Live peacefully with neighbors
No quarreling/no conflicts
Help each other
Neighbors are relatives
People from hometown are neighbors
Relatives/family in neighborhood
Live like in hometown
Neighbors are like family

Neutral relationships
Neighbors are good people
Good natured
Helpful
Nice people
Honest neighbors
Good neighbors but their food smells bad
Familiar with all neighbors

Bad relationships
People from other castes within neighborhood
Neighbors are bad people, gamblers
Have small/big quarrels with neighbors
Bad people
Most people are selfish
Alcoholics in neighborhood, no good relations