This book chapter can be found in the 'Handbook of Climate Change Resilience'

Managing the Increasing Heat Stress in Rural Areas

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Key Words: heat stress, heat related symptoms, differential vulnerability, rural health, semi-arid regions

ABSTRACT

Increasing temperatures are likely to impact human health. An increase in severe heat wave days and heat mortalities has been observed in India over the past few decades. At present, there is little evidence on the heat exposure, impact and the adaptation measures in the rural context. The present study examines vulnerability of rural communities to heat stress in the semi- arid villages in Maharashtra state of India.

The study was conducted in five villages of Jalna and Yavatmal districts of Maharashtra. Household survey covering 20% of the households was conducted in Jalna during 2016 summer months. Twenty data loggers were installed to measure the indoor temperatures in Yavatmal.

Exposure to heat in various circumstances, both outdoors and indoors were reported. Age, gender, wealth and pre-existing health conditions were significantly associated with occurrence of Heat Related Symptoms (HRS). Exposure factors such as working outdoors during mid-day, roofing material and indoor ventilation were significantly associated with occurrence of HRS. The indoor temperature in houses with tin roofs was found to be higher as compared to cement roof houses.

Existing coping strategies appear to be inadequate to protect people from outdoor and indoor heat stress. People from poorer households reported socio-economic and livelihood challenges in adopting coping strategies as well. A long term and locally appropriate strategy in terms of knowledge about HRS and infrastructure and access to timely medical facilities is needed. Development of effective surveillance mechanism and a comprehensive state level heat action plan is needed to prevent and monitor heat mortalities in the future.

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BACKGROUND

The risk of heat related illnesses and deaths are likely to increase due to rising temperatures (Intergovernmental Panel on Climate Change, 2014). In India, there has been an increasing trend of heat wave-related deaths in the last few decades. A report by National Disaster Management Authority highlights that between the periods 1992 to 2015, about 22,562 heat related deaths were reported (Government of India, 2016). In fact, heat stroke was the second major cause of deaths from natural disasters in India (accounting for 15% of those deaths) during the decade 2001- 2012 (Paul and Bhatia, 2016). Most studies on the health impacts of heat have been conducted within the context of officially declared heat waves. It has been found that significant mortality and morbidity can be attributable to heat exposure. The effect could be up to 43% increase deaths due to heat wave in urban India (Azhar et al., 2014).

Future climate projections for India indicate that heat waves will likely be more intense, have longer durations, and occur more often and earlier in the year. Intensification of heat waves will also lead to increased mortality rates (Dholakia et al., 2015; Murari et al., 2015). It was also found that death attributable to extreme heat were about the same as moderately high temperatures (Gasparrini et al., 2015).

Increasing heat exposure is linked to occupational health risks and negatively impacts work productivity (Dash and Kjellstrom, 2011; Kjellstrom et al., 2009). Studies on occupational heat stress impacts in India found that decreased productivity were reported most commonly among outdoor/semi outdoor occupations with high workload (e.g., brick manufacturing, metal fabrication, construction etc.), whereas productivity losses were reported less frequently among indoor workers (Venugopal et al., 2015).

An association between high temperature and non-infectious disease mortality was found in a study conducted in rural western India. Men in working age involved in outdoor activities like agricultural and industrial workers were more vulnerable to heat (Ingole et al., 2015).

In Gujarat and Rajasthan, workers in the rural and semi urban industries of ceramics, pottery, iron works and stone quarry were found to be vulnerable (Nag et al., 2009). In the rural context, it was found that amongst the rice farm workers in West Bengal, high workplace heat exposure caused heat strain and reduced work productivity (Sahu et al., 2013).

Apart from decreased work productivity, increased temperatures also have other social impacts. A 21-year rural longitudinal survey conducted in Pakistan showed that men move out of the village due to extreme heat stress and that the landless and asset less poor are more likely to do so (Mueller et al., 2014). A large scale study conducted in Thailand found that working under heat stress conditions is associated with worse overall health and psychological distress (Tawatsupa et al., 2010).

Apart from outdoor heat stress, exposure to hot indoor conditions is also a concern. In a study assessing the impact of heat wave events on dwellings, (Quinn et al., 2014) it was found that a substantial fraction of houses exceeded dangerous heat thresholds during extreme events. Older adults staying indoors during hot indoor temperature conditions are at a risk of significant detriment of physical functions (Lindemann et al., 2017). There is a need to improve awareness regarding management of indoor heat stress. The use of passive building designs strategies such as shading, thermal mass and internal air movement have been suggested to mitigate the overheating of dwellings and to postpone the use of active systems (Din and Brotas, 2017). It has also been demonstrated in an experimental study that simple and effective hybrid passive cooling system can significantly help in reducing thermal loads of roofs (Ponni and Baskar, 2015).

A recent study from urban India identified exposure (geographic location, housing characteristics and occupational and behavioral factors), susceptibility (age, pre-existing health status, and socioeconomic factors), adaptive capacity (access to health services and information, coping mechanisms, and societal factors (infrastructure, information, and social capital) determine vulnerability to heat (Tran et al., 2013). Pre-existing conditions, such as cardiovascular diseases, may be exacerbated by heat stress (Khan et al., 2014). However, there is little evidence of the heat experience, impact of heat exposure, and adaptation measures to heat and heat waves in the rural context.

Most of the above studies examine vulnerability to heat stress due to work exposure (occupational hazard) and focused on urban areas. Very few studies have attempted to understand the factors contributing to vulnerability of the communities. In this context, this study examines vulnerability of rural communities to heat stress in villages located in semi-arid regions of Maharashtra state in India. An exploratory qualitative study was conducted to inform this survey (Mhaskar et al., 2016). The specific objectives addressed by this study are:

(i) To quantify heat related symptoms and illnesses in the rural communities during summer time
(ii) To identify the categories of the rural population that are most affected by heat stress
(iii) To understand exposure to outdoor and indoor heat stress
(iv) To identify factors contributing to vulnerability to heat stress
(v) To examine various existing strategies being used to cope with heat stress

METHODS

Study Location

The study was conducted in Jalna and Yavatmal districts of Maharashtra. Jalna is located in the central part of Maharashtra state in northern Marathwada region. The district has a sub-tropical climate with average annual rainfall ranging between 650 to 750 mm. The district experiences years of drought with annual rainfall recording as low as 400 mm. The hot dry summer season is from March to June. During summer, the maximum day temperature ranges between 42°C and 43°C (Govenment of India, 2018). The summer months are dry, with relative humidity generally between 20% and 25% in the afternoon.

The blocks of Jafrabad and Bhokardan in Jalna district were selected as there was anecdotal evidence of few deaths due to heat stress in 2014. Exploratory visits were undertaken during the months of April and May 2015 to select the villages. The factors considered for selecting the villages were: sparse vegetative cover, lack of access to water and remoteness. Three villages were purposively selected for the study, namely *Adha* and *Sindi* in the Jafrabad Block and *Goshegoan* in the Bhokardan block. In *Goshegaon* village, the local government authorities had supplied drinking water in tankers during summer of 2015.Village *Adha* had a primary health sub-centre in the village whereas the nearest government health care system for *Sindi* and *Goshegaon* villages is located at a distance of 15 km and 7 km respectively.

For understanding indoor temperatures, *Sonurli* and *Ekhlara* villages located in the Ralegaon block of Yavatmal district were selected for measuring indoor temperatures using data loggers. According to the India Meteorological Department, when the temperature reaches 45°C, it is considered as heat wave condition. In both Jalna and Yavatmal districts, the maximum summer temperature ranges between 42-43°C thus nearing the heat wave conditions. Figure 1 shows the location of Jalna and Yavatmal districts and of the study villages.

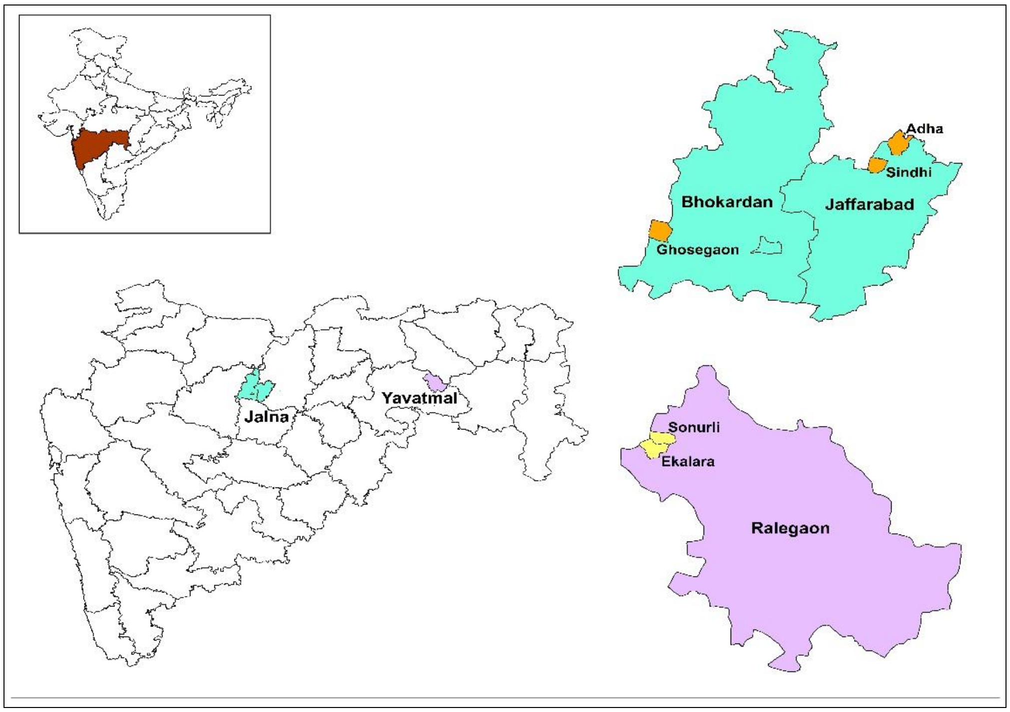


Figure 1: Location map of Jalna and Yavatmal districts

Sample Survey

Households in each village were categorized according to socio-economic criteria based on a participatory wealth ranking exercise. Wealth ranking exercise is a participatory tool for classifying the households based on the indicators related to land ownership, asset ownership, food security, migration and sources of income. The households are classified as – very poor, poor, middle class and better off.

From each of the three villages, a sample of 20% of total households was selected for survey. Stratified random sampling was used for selecting the respondent households. Accordingly, the sample households were selected in proportion to the number of households in the respective wealth categories. In total, 215 households contributed to the detailed household survey (Table 1).

Table 1: Socio-economic status of sampled households

Wealth category of household	Total Households in the study area	Households included in study
Very Poor	226 (21.9%)	46 (21.4%)
Poor	420 (40.7%)	87 (40.5%)
Middle Class	241 (23.3%)	51 (23.7%)
Better off	146 (14.1%)	31 (14.4%)
Total	**1033 (100%)**	**215 (100%)**

Information collected from the respondents included: living conditions (housing structure, access to water for drinking and domestic use, access to electricity), work profile (type of livelihood activities, exposure to outdoor heat), health problems (pre-existing health conditions, self-reported heat related symptoms, access to medical facilities and sources of information on preventive measures) and coping strategies used to manage heat exposure and impacts. This list was informed by literature and also based on our exploratory qualitative study conducted prior to this survey (Mhaskar et al., 2016).

Monitoring of indoor and outdoor temperatures

The selection of household for installation of data loggers was made based on types of roofing. Twenty indoor digital temperature data loggers were installed, inside the houses in the room where maximum time was spent by household members. Twelve of these loggers were installed in houses with tin/galvanized sheet roof structure, 7 loggers in houses with cement concrete roofs and one in a tiled roof structure. Each data logger had a unique serial number embedded within its firmware, allowing for tracking of deployed loggers. The data loggers and the automated weather station were set to record temperatures at a 10 minute interval allowing for a maximum monitoring period of summer months.

An automated weather station was also installed in the village for measuring the location specific outdoor temperature during the summer months.

Data collection

A structured questionnaire was developed and pretested. Individual interviews were conducted in the month of May 2016, which is the peak summer period in Maharashtra. An adult household member was selected as the respondent who provided information regarding all other members of the family (in the context of exposure to heat and heat related symptoms).

The types of Heat Related Symptoms (HRS) included in the survey: small blisters or pimples, dry mouth, fatigue, leg cramps, heavy sweating, intense thirst, rapid heartbeat, headache, leg swelling, paranoid feeling, swelling of face, fever, diarrhoea, vomiting, hallucinations and fainting. The occurrences of these were recorded with a recall of two months (the hottest months – April and May, during the year 2016).

Hallucinations and fainting were considered as severe HRS whereas the rest were considered as mild HRS for analysis. This list was informed from literature and also from the exploratory qualitative study conducted prior to this survey.

Sample characteristics

The sampled households comprised of 1224 individuals in total. Out of these, there were 671 male members and 553 female members (accounting for 55% and 45% of total individuals, respectively). About 64% of the total household members were in the age groups of 15-30 years and 31-59 years.

About 18% of persons interviewed belonged to households that were very poor and 37% to households that were poor (based on wealth ranking). The majority of the households belonged to forward caste category (62% of total sample households) followed by scheduled caste category (23%). Illiteracy is prevalent among 25.6% of individuals covered by the survey. About 37% of individuals reported wage labour (agricultural and non-agricultural) as the major summer occupation (Table 2). About 23% of the individuals indicated farming as an important livelihood source. Non-income generating activities such as household chores, education and other such activities were indicated by 22% of the total individuals from the sample.

Table 2: Socio-demographic characteristics of the study population

Variable	Number of individuals (% of total, n=1224)
Gender	
- Male	671 (54.8)
- Female	553 (45.2)
Age	
- 0-4	104 (8.5)
- 5-14	212 (17.3)
- 15-30	450 (36.8)
- 31-59	330 (27.0)
- 60+	128 (10.5)
Wealth ranking	
- Very poor	223 (18.2)
- Poor	448 (36.6)
- Middle class	335 (27.4)
- Better off	218 (17.8)
Caste category	
- Scheduled caste	276 (22.8)
- Scheduled tribe	57 (4.7)
- Nomadic and Denotified Nomadic Tribes	44 (3.6)
- Vimukta Jati Nomadic Tribes	13 (1.1)
- Other Backward Classes	66 (5.4)
- Forward caste	757 (62.4)
Education	

- Illiterate	286 (25.6)
- Primary school	210 (18.5)
- Secondary school	450 (39.8)
- High school	122 (10.8)
- Graduate and above	54 (4.8)
Summer occupation	
- Non income generating activities	205 (22.2)
- Farming	211 (22.9)
- Agricultural and non-agricultural labour	342 (37.0)
- MGNREGS work	113 (12.2)
- Others	52 (5.6)

Data analysis

Descriptive statistics and cross-tabulations were first used to understand the data. The occurrence of at least one HRS in the individual was the health outcome of interest. This health outcome was cross-tabulated against every other variable (all of which relate to susceptibility, exposure and coping strategies), through which odds ratios (OR) were calculated on the lines of multinomial logistic regression. Confidence intervals (CI) and p-values for the odds ratios were also reported to help with the interpretation. All the ORs presented are unadjusted.

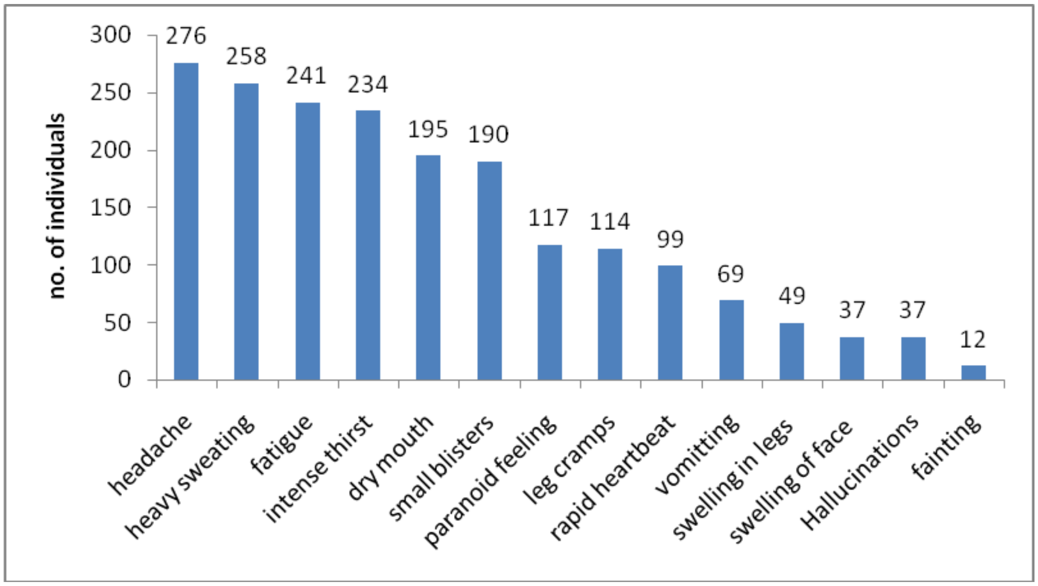
For analyzing the temperature data generated from each data logger, Hoboware software was used. The software allowed the temperatures to be plotted on a continuous graph covering the monitoring period.

RESULTS AND DISCUSSION

Heat related symptoms among the households

Among the heat related symptoms experienced by the household members, headaches, heavy sweating, fatigue, intense thirst, dry mouth and small blisters/ rash were found to be the most commonly reported symptoms (Graph 1).

Graph 1: Frequency of reported Heat Related Symptoms



Of all individuals, 46.2% experienced at least one HRS during the study period. On average, at least 2 individuals were affected per household (Table 3). Individuals from 64.5% households experienced fever and 21.5% households experienced diarrhoea during the study period.

Table 3: Occurrence of heat related symptoms (HRS) at individual level

Particulars	**Number of individuals (N=1224)**
Total individuals experiencing at least one HRS (%)	566 (46.2)
Average individuals affected in each household	2.64
Heat stress categories	
No HRS (%)	658 (53.8)
Mild HRS (%)	523 (42.7)
Severe HRS (%)	43 (3.5)

*Figures in parenthesis indicate percentage to total

Vulnerability to heat stress

The analysis is based on the framework given by Tran et al. wherein heat vulnerability is conceptualized as a function of interacting biophysical and socioeconomic determinants that can be broken down into heat hazard probability as well as factors associated with population exposure, susceptibility and adaptive capacity (Tran et al., 2013) (Figure 2).

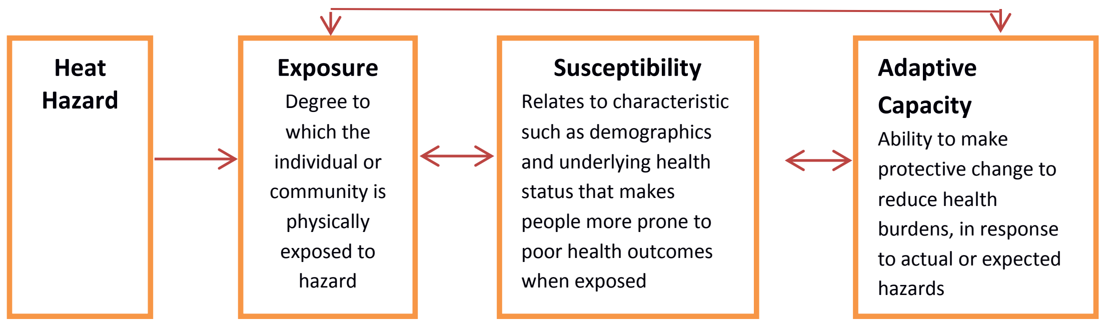


Figure 2: Framework for assessing heat vulnerability (Adapted from Tran et.al, 2013)

Susceptibility factors

Susceptibility factors included age, gender, and pre-existing health conditions. The analysis of Wealth status has also been discussed here for convenience, though it relates to all dimensions of vulnerability through various pathways.

Elderly population (>60 years old) were more affected as compared to children under 4 years (OR 0.16; CI 0.09 – 0.29) and those between 5- 14 years (OR 0.23; CI 0.15 – 0.30) and those under 30 years of age (OR 0.55; CI 0.37 – 0.82). Only adults between 30-59 years of age were more affected (OR 1.86; CI 1.22 – 2.85) than the elderly (Table 4). This is also the age group where higher percent of individuals (71.2%) reported heat related symptoms. It has been reported in literature that elderly and children (Li et al., 2015; Lundgren et al., 2013; McGeehin and Mirabelli, 2001; Oudin Åström et al., 2011) are more susceptible to heat stresses. Our finding indicates that "exposure" might be driving the health impact in our study region, rather than "susceptibility".

Both men and women reported suffering from HRS. However, the proportion of men reporting HRS (49.5%) was relatively more as compared to women (42%). The unadjusted odds ratio for this comparison was 0.75 (CI 0.6, 0.94). This could be due to a greater proportion of men working outdoors during the day (76% vs 71% respectively), performing strenuous work (41% vs 36% respectively), and use of protective clothing by women, and not due to physiological susceptibility among men.

Table 4: Occurrence of HRS in relation to demographic variables (Univariate analysis)

Parameter	Odds Ratio (unadjusted)	Lower CI	Upper CI	p-value
Age				
0-4	**0.16**	0.09	0.29	**<0.001**
5-14	**0.23**	0.15	0.37	**<0.001**
15-30	**0.55**	0.37	0.82	**0.003**
31-59	**1.86**	1.22	2.85	**0.004**
60+ (ref)	**1**			

Gender				
Male (ref)				
Female	**0.75**	0.6	0.94	**0.012**
Pre-existing health conditions				
None (ref)				
At least one pre-existing health condition	**6.34**	4.16	9.66	**<0.001**
Wealth categories				
Very poor (ref)				
Poor	**1.07**	0.78	1.48	**0.676**
Middle class	**0.67**	0.48	0.94	**0.021**
Better off	**0.52**	0.36	0.77	**<0.001**

Those belonging to middle-class category (OR 0.67; CI 0.48 – 0.94) and better off families (OR 0.52; CI 0.36 – 0.77) were less affected as compared to the very poor. Higher proportion of individuals from the 'very poor' and 'poor' categories reported at least one HRS (about 51% and 53% of total individuals in respective categories) as compared to the individuals in the 'better off' category (only 35%). Our finding corroborates previous literature which have indicated that people with low socio-economic status have been reported to be more affected by heat stress (Harlan et al., 2006; Li et al., 2015).The mechanisms through which poverty might make individuals more susceptible include general health condition, and working and living conditions.

Among the 1224 total individuals in the sample households, 157 individuals (about 13% of the sample) reported to be suffering from at least one pre-existing health condition (ranging from asthma to cancer). Those with at least one pre-existing chronic health condition reported relatively high HRS (OR of 6.34, CI 4.16, 9.66) (Table 4). Individuals with pre-existing health conditions have been reported to be more susceptible to heat stress (Li et al., 2015; McGeehin and Mirabelli, 2001).

The majority of the sample population in the study area belonged to General and Scheduled Caste categories. The difference in proportion of individuals reported HRS among the two social categories was not statistically significant.

Exposure factors

Exposure can be influenced by hazard factors, amplifying factors and protective factors (Tran et al., 2013). In this study, the hazard factors are the outdoor and indoor temperatures, the amplifying factor include outdoor work during peak heat hours, type of occupation, and roofing material, and the protective factors include the coping strategies being employed. In this section, the key amplifying factors are discussed.

Exposure to heat was reported both outdoors and indoors. While the working adult population was exposed to direct sunlight outdoors, the elderly and children were exposed to hot indoor environments during mid-day and afternoons (Mhaskar et al., 2016). Those from the poorer sections and from the lower castes were disproportionately exposed based on their daily activities and roofing material used for the houses.

Photo 1: Villages working at MGNREGS sites during summers

(Source: WOTR)

Exposure due to livelihood activities

One of the amplifying factors affecting exposure was the type of occupation an individual is engaged in. Majority of the individuals from the sample households (72%) were engaged in outdoor livelihood activities during summer months such as farming on own land, wage labour (agriculture, non-farm) and in the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), a government employment scheme.

Those engaged in wage labour (whether privately employed or through the governmental MGNREGS scheme) were more affected as compared to those engaged in activities such as household chores and education. Those engaged in farming (OR 2.05, CI 1.38 – 3.03), labour activities (agriculture and non-agriculture) (OR 3.35; CI 2.33 – 4.80) and MGNREGS (OR 3.71; CI 2.28 – 6.04) were more affected as compared to those performing non-income generating activities (Table 5). Occupation (especially physically intense occupations) is a known risk factor for heat related illness (Centers for Disease Control and Prevention, 2011; Jackson and Rosenberg, 2010). People perceived those working outdoors (farm labourers), and the elderly and young children stay indoors in heat-trapping tin houses to be more exposed to heat. It was also perceived that those working outdoors during daytime, especially women labourers are most vulnerable to health impacts of heat exposure. Exposure during travel to work was also reported by many local respondents (Mhaskar et al., 2016).

Table 5: Occurrence of HRS in relation to other variables (Univariate analysis)

Parameter	Odds Ratio	Lower	Upper	p-value

	(unadjusted)	CI	CI	
Summer occupation				
Non-income generating activities (ref)				
Farming	**2.05**	1.38	3.03	**<0.001**
Agricultural and non-agricultural labour	**3.35**	2.33	4.80	**<0.001**
MGNREGS labour	**3.71**	2.28	6.04	**<0.001**
Others	**1.95**	1.06	3.61	**0.03**
Minutes spent performing activities outdoors during peak heat hours				
0 (ref)				
1 to 90 minutes	**1.56**	1.00	2.44	**0.050**
91 to 180 minutes	**2.88**	1.90	4.35	**<0.001**
181 to 360 minutes	**1.75**	1.14	2.69	**0.010**
Exposure				
Type of roof				
Tin (ref)				
Cement slab	**0.69**	0.52	0.92	**0.011**
Others	**1.96**	1.22	3.13	**0.005**

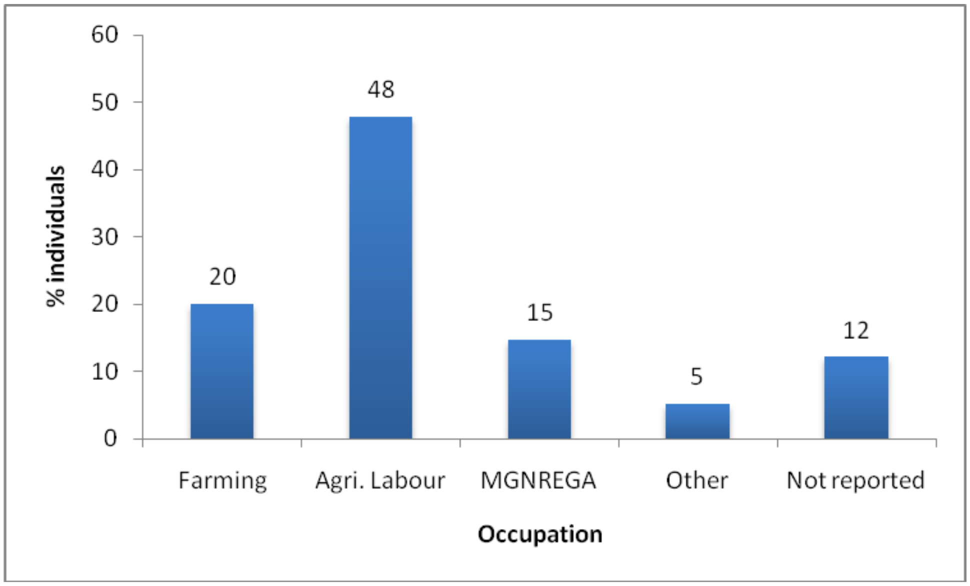
The work day was divided into four segments – morning (4 AM to 11 AM), mid-day (11 AM to 3 PM), afternoon (3 PM to 5 PM), and evening (5 PM to 7 PM). Of these, mid-day and afternoon together were considered as "peak heat hours" based on local people's opinion (Mhaskar et al., 2016). The total number of individuals exposed to peak heat hours for 1.5 to 6 hours is 428 (55%) (Table 6). Majority of these individuals were engaged in physically strenuous work such as wage labour (47.9%) and farming (20%). About 14.7% worked as MGNREGS labourers during peak heat hours (Graph 2). Respondents from over 83% households reported regularly using synthetic clothing during summer, which may add to heat-related discomfort.

Occurrence of HRS was relatively much higher in individuals spending more time outdoors during peak heat hours (Table 5).

Table 6: Time spent outdoors during peak heat hours

Time spent outdoors during peak heat hours for work or activities	No. of individuals
0	195 (25.4)
< 1.5 hours	145 (18.9)
1.5 to 3 hours	255 (33.2)
3 to 6 hours	173 (22.5)
Total individual responses	**768 (100)**

Graph 2: Occupation of individuals working outdoors for more than 1.5 hours during peak heat hours (N=428)



Exposure during other household chores

Apart from the livelihood activities, other household activities could also result in outdoor exposure to heat. Over 96% households collect firewood from field and forest. In 43.7% households, only women take the responsibility for collection of firewood. About 84% of households indicated spending more than 4 hours each week on this activity. The preferred time for this activity was in the morning, early evening and evening (these are times with relatively less heat outdoors (Mhaskar et al., 2016)).

On an average, during summer, the time taken for collecting water was 71 minutes (against 40 minutes during other seasons). In over 93% households, the women were primarily responsible for fetching water. But during summer, in some households men also support women in fetching water. Similar to the practice of collecting firewood, water too is collected during morning, early evening and evening hours.

Type of Roofing

Another amplifying factor of exposure is the type of shelter or dwellings. A large proportion of households (about 74% of sample households) were living in tin-roofed houses. Tin roofs get heated quickly during daytime as compared to cement slab roofs but they also cool up rapidly as compared to the cement roofs. About 47% of respondents residing in tin roofed houses indicated at least one HRS as compared to 38% living in cement slab houses (Table 7). Cross ventilation helps in dissipating heat. However, only 13% of the households reported having cross ventilation in all rooms. Those living in households with cement roof were less affected as compared to those with tin roof (OR 0.69, CI 0.52 – 0.92).

Table 7: Roofing material

	Total individuals living in those houses	Total individuals who experienced at least one HRS	Proportion of individuals experiencing at least one HRS
Tin	887	412	47.0
Cement slab	260	99	38.1
Others	82	52	63.4

Photo2: Tin roof households in the villages

(Source: WOTR)

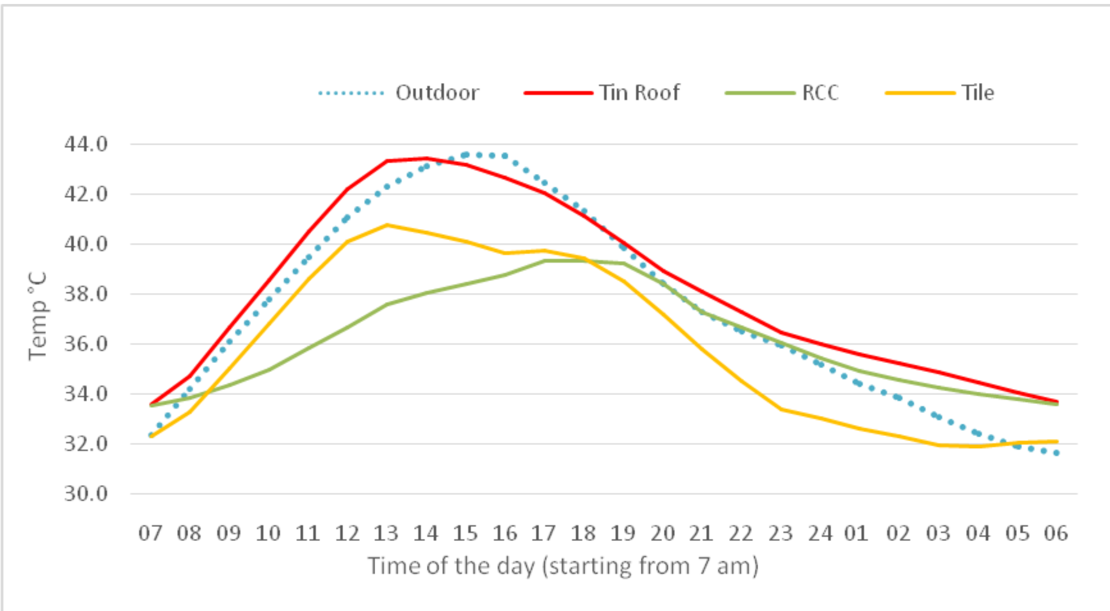
Without adequate rest and recovery time from heat, people become more vulnerable to heat stress (Khan et al., 2014). Poor design of houses with inadequate ventilation (lack of windows) could exacerbate the condition due to high daytime and night time temperatures. The elderly were also perceived as vulnerable due to their physiological condition, with several reported cases of fatigue, dehydration, and loss of consciousness, despite majority of them staying back at home (Mhaskar et al., 2016).

Monitoring of indoor temperatures

Graph 3 depicts the indoor temperatures of the houses in Sonurli village recorded using data loggers for the period of 10th May to 5th June 2017. On average, as the day progressed, the indoor temperature increased and peaked at around 2 pm. Among the three different roofing types, tin roofs get heated the most (having the highest diurnal maximum and minimum temperatures). During the peak heat hours (11 am- 5 pm), the indoor temperature in tin roof houses was also more than the outdoor temperatures. Elderly, children and women who rest indoors during morning and afternoon hours may be at risk for heat stress. Local elderly people felt indoors were "intolerable" after 12 noon. Some of them reportedly rest just outside their houses under the shade of a tree or a portico (Mhaskar et al., 2016).

During the day the indoor temperatures recorded in cement-roofed houses were consistently less than the outdoor temperatures but during the night the temperature in cement houses were more than the outside temperatures. These houses heated up relatively slowly but they also cool down slowly. These characteristics of houses and their respective indoor temperatures have important implications for health vulnerability, especially with cooler night-time temperatures being important for recovering from daytime heat exposure.

Graph 3: Average indoor and outdoor temperatures during the whole day (period of 10 May- 5 June 2016)



Coping strategies and adaptation measures

Individuals, families and the community took various steps to cope with heat and its impacts. These include changing work timings, resting under trees, resting between working hours, planned reduction in work, using fans indoors, staying hydrated, eating appropriate foods and using protective clothing are some of the means used. These address the immediate problem and are mostly employed during hot days or following them (Mhaskar et al., 2016).

The different strategies used to cool the houses were: use ceiling fans, use water coolers, spread layer of crop residue over the roof or a combination of these (Mhaskar et al., 2016). Table 8 shows the difference between the indoor and outdoor temperature when different coping strategies were employed by the households. It indicates that irrespective of the coping strategy employed, houses with tin roof get more heated as compared to houses with cement roof. Even after employing some kind of coping strategy, the temperature inside tin roof households was higher by over 4°C as compared to outdoors. In those houses where water cooler was used, the indoor temperatureswere found to be somewhat lower as compared to outside (in cases of both tin and cement roofed houses respectively).

Thus using water coolers may provide some relief. However, many times erratic electricity supply and inadequate water availability prevent the households from using these coolers. In addition, coolers were found in less than 4% of study households. There is no clear indication about what might be the best option for roofing and other housing related aspects. The choice of the roof material also depends on the economic condition of the household. It might be a combination of things including use of hay or crop residue over the roof, and improving indoor ventilation. Respondents from poorer families reported that tin roofs were useful during the rainy season as compared to thatched roof (Mhaskar et al., 2016) indicating the need for holistic understanding before making knee-jerk recommendations on addressing the challenge of heat stress.

Table 8: Indoor and Outdoor temperature difference when coping strategies employed by households

Time of the day	Temperature difference (indoor - outdoor) (°C) when different coping strategies employed						
	Tin roof+fan	Tin roof+fan+layer of crop residue	Tin roof+cooler	Tin roof+cooler+crop residue layer	Cement slab+fan	Cement slab+Cooler	Tile +cooler
11 am	2.8	-3.3	-3.4	-0.5	-5.4	-4.7	-0.9
12 pm	3.5	-4.2	-4.3	-1.1	-6.8	-5.6	-1.0
1 pm	4.0	-4.8	-5.1	-2.2	-7.4	-6.1	-1.6
2 pm	3.9	-4.7	-5.8	-4.1	-7.3	-6.9	-2.7
3 pm	3.4	-4.4	-5.9	-5.2	-6.5	-7.3	-3.5
4 pm	2.9	-3.7	-5.4	-6.1	-5.4	-7.1	-3.9
5 pm	2.4	-2.5	-4.0	-4.7	-3.4	-5.2	-2.7

(Time period- 10 May to 6 June)

Finding time to rest was found to be a challenge for women having responsibilities at home and in the fields. Those who work on their own land stated that they rest for an hour or more at home during the afternoons. People prefer to sit outdoors under the shade of trees. It was also observed that some house, especially ones which did not have trees around, have erected a thatched roof propped up by sticks outside the front of the house. Traditional cots were also kept outside the houses in the shade during summer months. Some shared that they rest for a day or two when they are affected by HRS.

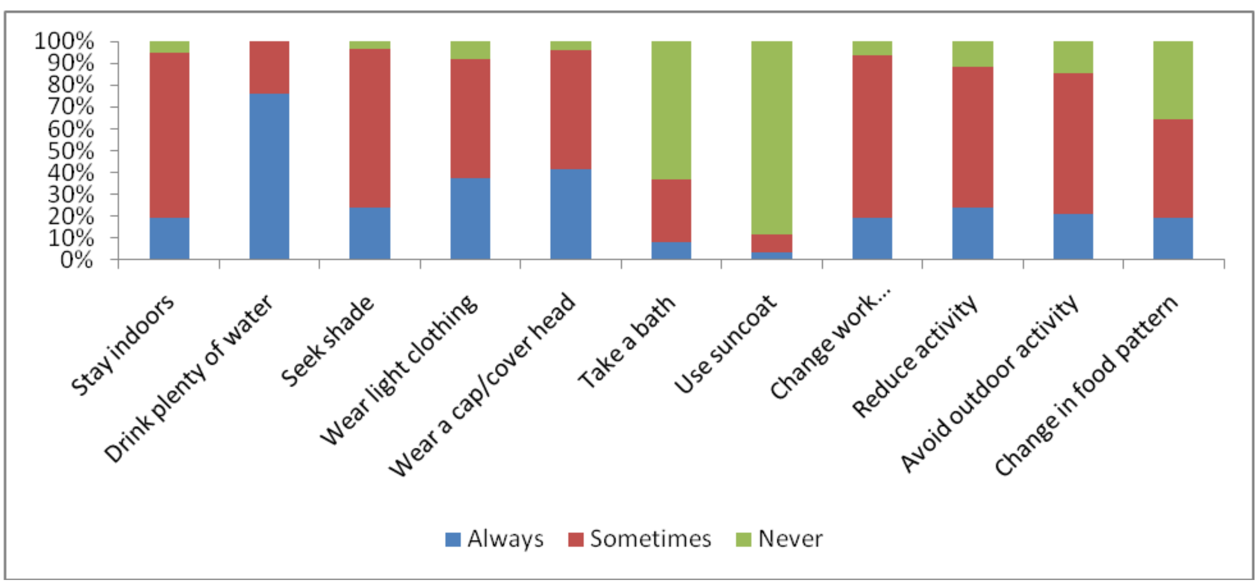
About 25.6% households reported no specific measures being used. Almost all families reported increased consumption of water for drinking during summer. Almost 60% of families change their cooking schedules, with most of them (49.8%) cooking earlier in the day during summer months. In majority of households, male and female members slept outdoors and changed their sleeping pattern (waking up earlier in summers).

Photo3: Elderly woman resting outside house during summer afternoon

(Source: WOTR)

Respondents reported drinking more water. Other simple strategies such as seeking shade, staying indoors, wear protective clothing, change work schedule, avoid outdoor activity received less affirmative responses (performed only sometimes), which indicates limited scope to adopt such measures (Graph 4). Almost 89% and 79% respondents reported that the water bodies and tree cover in their respective villages were poor or very poor.

Graph 4: Coping strategies employed by respondents during very hot weather (In %, N= 215)



A large proportion of households (44%) approached private doctors for HRS. The average distance between villages and their preferred healthcare facilities was 9.5 km. Most people reported that the doctor they consulted was qualified (94.6%) (though this did not adequately corroborate with our earlier qualitative enquiries with local health practitioners). While individuals provided various reasons for inconvenience of visiting healthcare providers, poor transport facilities (reported by 65.7% households) was the most important, followed by distance to health centre (41.4%) and cost of utilizing healthcare (31.4%).

Table 9: Reported sources for information on heat stress

Type of source	Number	Percentage (N=215)
At least one reliable source of information (TV, Radio, newspaper, medical professional)	114	53.0
Hear-say	49	22.8
Didn't hear any information	52	24.2

About 53% of the study households reported having received information on heat stress from at least one reliable source like TV, radio, newspaper or a medical professional. Majority of respondents (72% of sample households) felt it was important to have access to weather information.About 23% households received information only through word of mouth (Table 9). Other sources included information from friends, TV, family members, and doctors.

In recent years, heat action plans have been prepared at state level (e.g.Uttar Pradesh, Andhra Pradesh, Orissa and Telengana), city level (e.g. Ahmedabad, Nagpur) and district level (e.g. Hazaribaug in Jharkhand state). Broadly, these action plans aim to build public awareness and community outreach; develop early warning system and institutional mechanism for inter-agency cooperation; capacity building of health care professionals and promote adaptive measures. Their effectiveness on the ground needs to be assessed.

CONCLUSIONS

Heat related symptoms were highly prevalent in the area. The common HRS were found to be headache, heavy sweating and fatigue, which are typically of mild or moderate nature. It could be useful to use HRS as indicators of heat stress in an area to intervene before they become severe. However, it is important to note that these symptoms are not specific to heat stress, and so there is scope for underreporting and over-reporting. Though heat was considered a problem locally, its priority was relatively low for local people (Mhaskar et al., 2016).

Findings indicate that age, gender, wealth and pre-existing health conditions were significantly associated with occurrence of HRS. Working men and women (31-59 year category) had the highest proportion of affected individuals compared to all other age groups. Though a greater proportion of men were affected as compared to women, the dimensions of vulnerability and exposure need further study to understand the mechanisms through which more men were found to be affected. Local people, in our qualitative study, attributed the perceived poorer health resilience in the current generation to change in diets over the years (Mhaskar et al., 2016).

The identified exposure factors of working outdoors during mid-day, roofing material of the households, and indoor ventilation were significantly associated with occurrence of HRS. A smaller proportion of women reported experiencing HRS as compared to men. The type of livelihoods and housing structures influenced exposure to heat stress. It was found that individuals performing physically intensive tasks were more vulnerable to heat stress and so were individuals residing in tin-roofed houses. Indoor temperature in tin roof houses was found to be generally high as compared to other roofing types – cement or tiled. During the peak heat hours, temperatures inside tin-roofed houses were more than the outdoor temperatures. This has implications for elderly and young children who may rest inside these houses during those times. The use of coolers reduced indoor temperatures, but the availability of electricity and water as well as the funds to purchase coolers is a challenge in rural areas. A very small proportion of houses (<4%) had these facilities. In addition, relatively high night-time temperatures inside tin and cement roofed houses are of health concern for persons resting indoors.

Further in-depth studies are needed to monitor the indoor temperature of various housing structures (considering not only roofing but also ventilation, location of windows, type of walls and flooring) and the effect on individuals. This would provide insights for improving the housing designs that can better handle peak heat conditions. There is a need for policy studies as well, as during the time of the study subsidies were being provided for purchase of tin roofs for houses. There is a need for health assessment before the launching of health-sensitive policies.

Existing coping strategies were found to be inadequate to protect people from indoor and outdoor heat related stresses. Changing the work timing and reducing work on hot days was a challenge for many labourers working in other people's farms. Those from poor families and woman-headed households also reported having to work without rest and even during periods of illness. Sleeping outdoors at night was also relatively common, despite other reported health risks such as mosquitoes (Mhaskar et al., 2016). A major challenge in rural areas in the context of heat stress is accessibility to well-equipped health centres. Though accessing healthcare was found to be a relatively common coping strategy, poorer families found healthcare expensive and avoided accessing it (Mhaskar et al., 2016). A more long-term strategy for competence on HRS, infrastructure and accessibility to timely medical facilities is needed. For this, investments in upgrading of rural health infrastructure to handle heat stress related incidences should be considered in all areas with high temperatures. In addition, there is a role for improved awareness on heat stress and associated precautionary measures.

In future, population exposed to heat waves is projected to increase. Hence, there is a need for pre-emptive strategies to ensure that people in areas where heat waves are not yet a phenomenon, are adequately supported to reduce their vulnerability. Improving health systems will benefit not just in the context of heat related illnesses, but for all illnesses, and so it is a no-regret intervention. Heat stress symptoms are easily recognised and can be used for early identification and prevention of more serious impacts such as heat stroke. Such measures will help protect individuals as well as the livelihoods.

Effective planning through development of surveillance mechanism to monitor heat related mortalities and morbidity could help in mitigating and avoiding heat related stresses and deaths in the future. Housing designs should be improved to facilitate adequate ventilation and reduce the adverse impacts of tin roofs. The government can play an effective role here through existing housing schemes. Our study aims at understanding vulnerability within few villages in a semi-arid area. It may be useful to compare our findings to villages in other agro-climatic regions to get a better understanding relative vulnerability. However, different areas have different temperature-health response relationships, which make it difficult to compare.

At present there are heat action plans for some states and for few cities. Maharashtra does not have a state level heat action plan. Therefore, priority should be given to develop a comprehensive state level heat action plan for Maharashtra, which addresses the needs and contexts of both urban and rural communities to prepare and prevent heat related illness and deaths.

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