Experiences of heat stress while homeless on hot summer days in Adelaide

Abstract

Historically, heat waves have resulted in more Australian deaths than any other natural hazard and continue to present challenges to the health and emergency management sectors. While people experiencing homelessness are particularly vulnerable to adverse effects of heat waves, little research has been reported about their hot weather experiences. This paper reports findings from interviews with 48 homeless people sleeping rough in Adelaide CBD on very hot days. While the majority reported drinking a litre or more of water in the previous 24 hours, 79% reported experiencing one or more heat stress symptoms. The research highlights that the protective actions people sleeping rough can take during hot weather are limited by their circumstances and may not be sufficient to prevent dehydration and heat stress. The levels of dehydration and heat stress symptoms suggest that immediate responses could include making drinking water more readily available. It may be helpful to provide information which highlights heat stress symptoms including indicators of dehydration. The role of outreach in providing connections, support and advice is most likely to ameliorate the risk of heat stress. However, the long-term response to protect people from heat stress is access to housing.

Peer Reviewed

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Introduction

Hot weather and health

The World Health Organization has noted that while heatwaves are among the more dangerous of natural hazards this danger does not always receive widespread public attention because the resulting death tolls are not obvious immediately.[1] It is estimated that during the period 1998–2017, more than 166,000 people around the world died due to heatwaves (Wallemach & House 2018), including more than 70,000 who died in Europe during the 2003 heatwave (Robine *et al.* 2008). In Australia, large numbers of disaster-related fatalities are typically thought of as being associated with highly visible environmental hazards such as bushfires, cyclones and floods. However, over the period 1900 to 2011, there were more deaths resulting from periods of extreme hot weather (4,555) than from all other natural hazards combined (3,655; Coates *et al.* 2014).

Heat stress is an umbrella term for a number of physical symptoms and illnesses that result when the body is unable to cope with exposure to excessive heat. These include dehydration, cramps, fainting and exhaustion. Severe dehydration can lead to hypernatraemia, renal failure, cardiovascular complications and death (Flynn, McGreevy & Melkerrin 2005). The most severe form of heat stress is heat stroke, which occurs when core body temperature rises above 40 degrees and can result in multiple organ failure and death (Leon & Bouchama 2011). To help mitigate the dangers to health posed by heat waves, the Bureau of Meteorology has established a Heat Wave Knowledge Centre (Bureau of Meteorology 2020) and issues local heat wave assessments.

In South Australia, the responses by authorities to periods of extreme heat are guided by the *Extreme Heat Strategy* (SA Health 2016) that assigns a lead coordinating role to the State Emergency Service (SES) and response roles to local health networks and the SA Ambulance Service. To mitigate risks to the public, information about safety in the heat is

1. World Health Organization. At: www.who.int/health-topics/heatwaves#tab=tab_1.

provided on several websites, notably those maintained by SA Health, the Red Cross and ABC Emergency.

Extended periods of hot weather have widespread adverse impacts on public health and present challenges to emergency services organisations, especially ambulance and emergency medical services (Nitschke *et al.* 2011, Nitschke, Tucker & Bi 2007). During the 2018–19 summer, Adelaide experienced both its highest daily maximum and highest nightly minimum temperatures recorded (Bureau of Meteorology 2019). It is expected that in many Australian regions periods of very hot weather will increase in frequency and severity, associated with climate change (Binskin *et al.* 2020) resulting in greater demands on the emergency management sector.

Heat stress can largely be prevented if the dangers are understood and simple protective measures are taken such as seeking out cool environments, reducing physical activity and drinking sufficient water (Akompab *et al.* 2013). However, effective preventive behaviour relies on:

- knowledge about heat-stress risk, indications of dehydration and what actions to take
- availability of, and the ability to access, drinking water and cool environments.

Hot weather, health and homelessness

It is recognised that the adverse effects of natural hazard effects are neither uniformly nor randomly experienced by members of affected communities. Some individuals are more vulnerable to negative effects than others (Tierney 2019). For example, the dangers posed to elderly people by heatwaves have been researched extensively (Leon & Bouchama 2011). Another group that is at risk from extreme weather is the homeless (Aldridge *et al.* 2018). Every and Thompson (2014) concluded that homeless people lacked the resources needed to cope well in times of adverse weather. Every and Richardson (2018) also found that, in Australia, there was a lack of disaster risk and response information and no education specific to the needs of people experiencing homelessness. The *Extreme Heat Strategy* (SA Health 2016) does not mention homeless people as a vulnerable group in its list of those at risk during heat emergencies. The aim of this paper is to investigate heat stress in a sample of rough sleepers in Adelaide. The findings contribute further evidence for best-practice responses to homeless communities in extreme heat.

The term 'homelessness' covers a spectrum of inadequate accommodation circumstances ranging from sleeping in the open (sleeping rough) to various forms of precarious and inadequate shelter arrangements (Kidd, Greco & McKenzie 2020). At the time of the Australian *Census 2016*, the Australian Bureau of Statistics (ABS 2018) reported that 116,427 people were classified as being homeless and that the level of homelessness in South Australia was 37 persons per 10,000 head of population. Homelessness, particularly in large population centres, is recognised as a serious societal problem that governments struggle to address effectively (Parsell *et al.* 2013). In a 2018 report the ABS noted:

> *Homelessness is not just the result of too few houses. Its causes are many and varied. Domestic violence, a shortage of affordable housing, unemployment, mental illness, family breakdown and drug and alcohol abuse all contribute to the level of homelessness in Australia …. Homelessness is not a choice. Homelessness is one of the most potent examples of disadvantage in the community, and one of the most important markers of social exclusion…* (ABS 2018, p.1).

It should be noted that many people who are experiencing homelessness have morbidities that make them particularly vulnerable to adverse effects of extreme heat events. These can include poor physical and mental health issues and side effects of associated medications, and drug and alcohol dependencies (Hansen *et al.* 2008, Kovats & Hajat 2008).

Despite the vulnerability of homeless people to extremes of weather, there is limited published data about heat-stress experiences. In the United States, Kovats and Hajat (2008) reported that of the 13 deaths during a heatwave affecting Phoenix, Arizona, in 2006, 11 were homeless people. Sanchez (2011) interviewed 28 people experiencing homelessness in Phoenix during the summer of 2010 in a study investigating heat-related concerns and coping strategies. The most frequently reported heat-stress symptom was fainting. The most frequently reported coping strategies were seeking shade shelter and seeking refuge in air-conditioned buildings and public transport. Obtaining supplies of drinking water was a major concern. Nicolay and co-authors (2016) surveyed 644 homeless people in the Tampa Bay area of Florida about access to services and awareness of heat-stress symptoms. Awareness levels were found to be low and dizziness was the only symptom nominated by more than 50% of respondents. In an Australian study, Cusack and colleagues (2013) interviewed 25 homeless people and 16 providers of homelessness services in Adelaide about the health needs of the homeless during extreme weather events. That study found that sunburn, dehydration and other heat-stress symptoms such as fainting were major concerns. Access to drinking water and shelter were also reported as problems. In a second Australian study, Every, Richardson and Osborn (2019) found that people experiencing homelessness were vulnerable to losing shelter and access to services during extreme weather events. At that time, no published Australian research could be located that reported findings from homeless people about their heat stress and dehydration experiences on very hot weather days.

Aim

The aim of this exploratory study was to gather information from a sample of homeless people sleeping rough in Adelaide about their experiences of heat stress and dehydration on very hot days.

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Method

This research was approved by the Central Queensland University Human Research Ethics Committee: reference number 0000021344.

Design and methodology

The study was a single sample, cross-sectional, descriptive field survey using a structured interview methodology. Participants were people experiencing homelessness (as rough sleepers) in the Adelaide CBD. The study was conducted during days when the maximum temperature was predicted to be greater than 35 degrees Celsius in early January 2019.

Measures

A structured interview guide and recording form was used to assess heat stress and self-reported levels of dehydration based on the Heat Stress (Basic) Calculator developed by WorkSafe Queensland (n.d.). The interview guide assessed environmental risks (heat, humidity and wind), and personal risks for heat stress (clothing, and length of time outdoors). The guide included questions about 7 symptoms indicative of heat stress, being:

- sunburn
- having a dry mouth
- feeling thirsty
- having a headache
- feeling dizzy or lightheaded
- feeling sleepy
- experiencing muscle cramps.

Participants were asked to report the amount of water they drank during the previous 24 hours. They were also asked to recall the colour of their urine the last time they urinated and compare their recollection with a 4-level urine colour comparison chart developed by New South Wales Health (2019). The range of colours showed that very pale-yellow coloured urine indicated being hydrated and very dark yellow/brown urine indicated being very dehydrated. A copy of the survey guide and recording form can be provided on request to the authors.

Weather details were recorded at the time of the interview (temperature, relative humidity and wind strength) that were sourced from a mobile phone weather app and noted on the recording form.

Procedure

Weather details at the time of the interview (temperature, Relative humidity, and wind strength) were sourced from a mobile phone weather app and noted on the recording form. Potential participants were approached in the Adelaide CBD at locations known to be places where people experiencing homelessness congregated during hot days. They were provided verbal and written information about the interview and those who agreed to take part provided verbal consent to complete the survey.

Approximately 55 people were invited to participate and 48 of those agreed (87%). Most participants completed the interview within 10 minutes. Their responses were noted on a paper recording form. Participants were given a bottle of water and a flavoured ice block on completion of their interview. They were also provided with an information leaflet about the services and support available during heatwaves.

Analysis

The IBM-SPSS version 25 software tool was used to generate descriptive statistics and explore bivariate correlations among the variables.

Results

The sample of 48 comprised 42 men and 6 women. Their average age was 47.5 years (SD 12.52, Median 39, Range 19–78). Table 1 summarises the weather data at the time of the interviews and responses to the interview questions. The mean temperature over the 6 days of interviewing was 39 degrees, well above the daily average daytime summer temperature for Adelaide of 29 degrees. Only one of the 48 interviews was conducted when the air temperature was less than 35 degrees. The majority of participants wore a single layer of light clothing. Most had been outdoors for more than 2 hours, were in part or no shade and had been recently doing moderate to heavy workload activities. While more than half reported drinking a litre or more of water in the previous 24 hours, participant judgements of their (recollected) urine colour compared with chart colours suggested that 81% were appreciably dehydrated. Seventy nine per cent of the participants reported experiencing at least one of the 7 heat-stress symptoms, more than half reported feeling thirsty and more than a quarter reported feeling dizzy or lightheaded.

Table 2 shows the intercorrelations (as Spearman's *rho*) among scores on the 7 heat-stress symptoms. Correlations with reporting sunburn were mostly low and the correlation between sunburn and headache symptoms was negative. After excluding sunburn, scores for the remaining 6 symptoms were summed to form a 6-item heat stress total symptoms scale (HSTSS6).

The internal consistency (Cronbach's α) was 0.71; M=2.1, SD=1.84, Range=0–6. There was limited evidence of meaningful associations between indicators of heat stress and heat-stress risk factors: 3 correlations were significant at the $p<0.05$ level: HSTSS6 score with air temperature (*rho*=0.33) and negatively with reported water consumption in the previous 24 hours (*rho*=-0.30) and recollected urine colour with time outdoors (*rho*=0.33). The limited evidence of links between heat-stress symptoms and personal risk factors suggests that the experience of heat stress for an individual results from complex interactions among the multiple environmental and personal risk factors they reported.

Table 1: Heat-stress environmental and personal risk factors; dehydration indications and heat- stress symptoms (*n*=48).

Environmental risk factors at the time of the interview	Result
Temperature in degrees Centigrade	M=39.3 SD=12.52 Range=34–45
Percentage relative humidity	M=15.4 SD=1.78 Range=13–17
Wind strength:	
No wind (1)*	42%
Light (2)	37%
Moderate (3)	0%
Strong (4)	21%
Personal risk factors at the time of the interview	**Result**
Layers of clothing being worn:	
Single light layer (1)	73%
Single moderate layer (2)	15%
Single thick layer (3)	6%
Multiple layers (4)	6%
Clothing thickness, how much air do they allow in?	90%
Permeable: e.g. cotton (1)	10%
Not permeable: e.g. thick coat (2)	
Location at the time of the interview:	
Indoors (1)	0%
Outdoors, full shade (2)	14%
Outdoors, part shade (3)	71%
Outdoors, no shade (4)	15%
If outdoors, length of time:	
Less than 30 minutes (1)	2%
30 minutes to 1 hour (2)	8%
1 to 2 hours (3)	8%
Greater than 2 hours (4)	82%

Personal risk factors at the time of the interview (cont.)	Result
Current activities:	
Light: e.g. sitting (1)	23%
Moderate: e.g. walking (2)	69%
Heavy: e.g. walking uphill with a pack or gear (3)	8%
Water drunk in the last 24 hours:	
More than a litre (1)	42%
About a litre (2)	19%
About 500 mls: 2 cups, one bottle of water (3)	23%
About 250 mls: one cup (4)	10%
None (5)	6%
Dehydration indications	**Result**
Recalled urine colour match:	
Hydrated (1)	8%
Somewhat dehydrated (2)	11%
Dehydrated (3)	48%
Very dehydrated (4)	33%
Heat-stress symptoms	**Result**
Experiencing any of the following: (no = 0, yes = 1)	2%
Feeling thirsty	40%
Feeling sleepy	35%
Dry mouth	29%
Feeling dizzy or lightheaded	23%
Headache	21%
Muscle cramps	19%
Sunburn	

*Figures in parentheses are coding values.

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Table 2: Intercorrelations (Spearman's *rho*) among heat-stress symptoms (*n*=48).

Symptom	1	2	3	4	5	6	7
1. Feeling thirsty	-	0.29*	0.30*	0.29*	0.28	0	0.11
2. Feeling sleepy		-	0.20	0.61**	0.47**	0.42**	0.27
3. Dry mouth			-	0.10	0.22	0.26	0.20
4. Feeling dizzy or lightheaded				-	0.41**	0.35*	0.16
5. Headache					-	0.33*	-0.14
6. Muscle cramps						-	0.15
7. Sunburn							-

Note: *p<0.05, **p<0.01

Discussion

The findings of this study suggest that participants were in environmental conditions likely to create heat stress, as indicated by the temperature and the amount of time they were outdoors. The protective actions they adopted present a mixed picture. Most wore one layer of permeable clothing, were in part shade, but had engaged in moderate to heavy levels of activity. Most had reportedly drunk a litre or more of water in the previous 24 hours. These findings suggest that people who are sleeping rough respond to hot weather conditions as best as their circumstances allow. However, each of the 7 heat-stress symptoms was experienced by appreciable percentages of the participants (19–52%). In addition, despite the majority of participants reportedly drinking more than a litre of water in the last 24 hours, most, as indicated by the self-report urine test colour comparison, were dehydrated or very dehydrated and more than half reported that they felt thirsty.

Limitations of this exploratory study are acknowledged. The Don Dunstan Foundation Adelaide Project Zero[2] tracks the numbers of people known to be sleeping rough in Adelaide each month and during 2019 these varied considerably, ranging from (approximately) 140 to 280. This sample was smaller than desirable, probably representing between 17% and 34% of the city's homeless and was one of convenience. The findings should be viewed as indicative only. Also, there are many forms of homelessness and the findings are restricted to people who were sleeping rough. Cities vary considerably in their characteristic summer weather patterns, built environments, infrastructure and welfare services and it is uncertain how these findings might apply more broadly. However, this exploratory survey indicates there is a need to respond to heat stress for people sleeping rough.

This may include developing health information targeted towards the specific needs of people experiencing homelessness. The current public health information about heatwaves made available by SA Health (2019) recommends:

- staying indoors in a home prepared for hot weather (e.g. with blinds, fans, air conditioning)
- only going outside in the cooler parts of the day
- wearing light clothing and a hat
- using sunglasses and sunscreen
- drinking plenty of fluids.

Of these recommended protective behaviours, only the wearing of light clothing was immediately relevant for most study participants. Seeking shade shelter and not undertaking heavy physical activity, although not mentioned in the SA Health material, are potentially available heat-stress preventive behaviours for homeless people.

The findings point to some ways in which public health information could be modified to better assist people experiencing homelessness. Most current information assumes that people have ready access to accommodation providing a cool environment using fans or air conditioning. Appropriate information could be added to existing material that highlights the importance of seeking shade shelter, wearing light clothing, reducing physical activity and drinking more than a litre of water each day. Information should emphasise the signs of heat stress such as thirst and feeling faint and the importance of seeking medical assistance if distressed.

Accessing drinking water and cool environments can be challenging for people experiencing homelessness. Outreach by providers of homeless services has been demonstrated as an effective way to support people sleeping rough in extreme weather conditions (Every *et al.* 2019). These services need to be supported by funding bodies to ensure homeless people have regular access to the amounts of water required to stay hydrated during hot weather and to publicly available cool environments. In view of predicted average temperature rises associated with climate change, local governments to review the provision of public drinking water fountains and public access cool environments as public health issues independent of the particular needs of the homeless.

2. Don Dunstan Foundation. At: www.dunstan.org.au/adelaide-zero-project.

Conclusions

The findings provide local governments and emergency management organisations with information about the experiences of a sample of homeless people sleeping rough during hot weather. This could assist homelessness service providers and public health organisations to review the information and support they make available to ensure this takes into account the circumstances of people experiencing homelessness, including appropriate recommended protective actions, the need to consume more than one litre of water per 24 hours in heatwave weather and the common symptoms of heat stress. They could also consider whether their outreach activities to provide extra water and information about accessible cool environments could be expanded. Advocacy groups representing the homeless may use the research to emphasise the health risks posed by hot weather in their endeavours to secure a larger stock of appropriately supportive housing (Hewett & Halligan 2010, McLoughlin & Carey 2013).

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