

# Adaptive capabilities in the elderly during extreme heat events in South Australia

## A population survey

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Authors: <sup>1</sup>Monika Nitschke, <sup>2</sup>Alana Hansen, <sup>2</sup>Peng Bi, <sup>2</sup>Dino Pisaniello, <sup>2</sup>Jonathan Newbury, <sup>2</sup>Alison Kitson, <sup>1</sup>Graeme Tucker, <sup>2</sup>Eleonora Dal Grande, <sup>2</sup>Jodie Avery

<sup>1</sup> Department of Health SA

<sup>2</sup> University of Adelaide

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## Summary

Health problems associated with extreme hot weather are entirely preventable, but recent findings indicated considerable morbidity in the 65 and over age group in metropolitan Adelaide during extreme heat waves.

This survey explores potential risk factors (socio-economic, environmental, behavioural, chronic disease and general health status) that may affect the health of the older population in South Australia during extreme heat. The prevalence of these factors was established together with their relationship to participant's self-reported health during recent extreme heat, their heat resilience and behaviour. Attitudes, preparedness, health behaviour changes, recall of heat health messages, social connectedness were investigated.

The survey established that whilst 29% of older people had one or more concerns about looming heat waves, only 3% were worried about their own health. However, during recent heat waves, 38% experienced one or more symptom(s) with loss of balance/dizziness being the most prevalent problem (13%). Other symptoms were heat stress (12%), shortness of breath (12%), headache (11%), heart conditions (5%) and renal problems (0.7%). During the extreme 2009 heatwave, 17% had similar health problems.

### **The risk of experiencing an adverse health outcome:**

- > increased with age and was higher in the 75 and over age group compared to those younger than 75 years of age.
- > was higher for females.
- > was higher for people with reduced health status (self-reported fair-poor health status compared to good to excellent)
- > was higher for people taking medication for chronic diseases such as high blood pressure and heart disease, mental health issues, diabetes or respiratory disease.
- > was higher for older people with decreased mobility as indicated by the use of mobility aids.

### **Behaviour and resilience during extreme heat:**

- > Older people with minimal social interactions and with increasing age (and diabetes) have less recall of heat-health messages.
- > The survey indicated that 15% of the elderly population said they did not feel confident that they could call on their neighbours and friends and 8% were not confident to call on family members, if they needed help.
- > Of the respondents, 30% received regular phone calls and 18% had regular visits during recent heatwaves.
- > When asked about their use of air conditioning, 21% of the survey participants indicated that they were hesitant to use air conditioning due to financial considerations and 42% had concerns about costs. The survey showed that most of the air conditioners were quite old and were not regularly serviced (only 29% were relatively new, 35% were 10 years and older, 31% were serviced regularly).
- > No air conditioning was present in the homes of 5% of the older population; 19% cooled the whole house and 33% cooled their bedroom.
- > Of the survey responders, 19% reported that they accidentally had the reverse cycle air conditioner on the wrong setting (e.g. heating not cooling).
- > The following behaviours provided relief during the 2009 heat wave: air conditioner use, wearing of light clothes, staying inside, drinking more fluid, reduction of physical activities, use of fans and going somewhere cooler.

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- > The survey indicated that the older age group (75 and over) had a higher prevalence of symptoms during recent heat waves and were more likely to take medications that may increase the risk of heat-related illness. They also felt at greater risk compared to their younger peers, had less recall of heat-related health messages compared to their younger peers; they are also less likely to access information via the internet or by SMS.
  - > The prevalence of outdoor window shading was 61% and the majority of participants were making use of them in summer (94%).
  - > While the survey indicated that many people reduce their physical activities during extreme heat (82%), 74% continued to undertake (most-sometimes) their regular activities and kept their appointments (95%).
  - > When asked about fluid intake, 8% said they did not drink more fluids when it is very hot. Of these, 54% said there was something stopping them drinking more and this was mainly a lack of thirst.
  - > A high proportion of pet owners (84%) had some to major concerns about their pets during hot weather.
  - > Most people (92%) felt that they are prepared for extreme heat, but 8% stated that in the event that a major heatwave were to restrict their activities, they did not have adequate supplies of essential items at home.
  - > Of the respondents, 15% said they would call their doctor and 11% said they would call an ambulance if they felt unwell during extreme heat.

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## 1. Introduction and background

Adelaide experienced a prolonged heat wave in summer 2009 which reached a record maximum temperature of 45.7°C and six successive days over 40°C and record hot temperatures throughout South Australia. The impact on health was investigated using health outcomes from SA Ambulance, hospital and emergency departments and deaths from the Register of Birth, Deaths and Marriages (BDM). During the heat wave period (26 January-7 February 2009) substantial increases in mortality and morbidity compared to previous heat waves were experienced.<sup>1</sup> The burden of morbidity was particularly high in the older age groups. In the 75 and over age group, heat-related admissions to hospitals and emergency units were extremely high (up to 18 times higher compared to non-heat wave days during summer). This is in agreement with worldwide evidence from heat wave impacts and can be explained by physiological and cognitive contributing factors associated with the older age group.<sup>2</sup> Excess deaths for all causes were seen predominantly in the 15-64 age groups, but not in the 65 and older age groups.

Health outcomes during heat waves in Australia are relatively well documented.<sup>1,2,3</sup> But, there is scant Australia-specific information about the potential environmental, behavioural and personal risk factors of falling ill during heat waves. This survey takes the opportunity to ask questions about potential risk factors related to recent extreme heat periods such as the 2009 heat wave. Information about demographic and accommodation-specific environmental factors in South Australia's elderly population was also collected. The survey questions were developed in conjunction with the findings from a qualitative survey (focus groups and interviews) that aimed to investigate heat-susceptibility, adaptive behaviours and barriers in the older population during extreme heat. Key informants were stakeholders (government and non-government) working with older people in the community.<sup>4</sup>

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## 2. Methodology

### 2.1. Survey design

The population based survey was undertaken in collaboration with the University of Adelaide from the 14 February to 10 March 2011 using the population –based telephone interviewing expertise of the Population Research and Outcome Studies (PROS), University of Adelaide in conjunction with Harrison Health Research. Ethics approval was obtained from the South Australian Health Human Research Ethics Committee and from the University of Adelaide.

Computer Assisted Telephone Interviewing (CATI) was used. This system is designed to provide high quality data on large population samples by allowing immediate entry of data and assisting with correct sequencing and organisation of call backs.

All households in South Australia with a telephone connected and the telephone number listed in the current version of the electronic white pages (EWP) were eligible for selection in the sample. Telephone numbers were drawn randomly. Only people aged 65 and over were eligible for inclusion, and a sample of 4200 households was initially drawn in order to reach the target number of 500. Screening calls were undertaken to obtain people in this age category. An initial survey question established whether responders lived in houses, units or retirement villages. If they lived in aged care facilities or nursing homes, the interview was terminated. The interview was also terminated if the respondent did not understand English or was not capable of completing the survey. If there were two or more people in the household aged 65 years and over, the selected respondent was the person with the most recent birthday. Selected people in households were not replaceable. Once a household was selected, there were up to 10 call-backs to busy or unanswered numbers at different times during the day, regardless of whether the target number of interviews had been reached.

The questionnaire was piloted twice to ensure that all difficulties with questions were resolved. Ten percent of each interviewer's work was monitored by a supervisor.

### 2.2 Weighting/processing

Data were weighted by the inverse of the individual's probability of selection and then re-weighted using 'Estimated Residential Population' figures from the Australian Bureau of Statistics to ensure that the sample was representative of metropolitan and country relevant age group and gender distribution of the target population in South Australia.<sup>5</sup>

### 2.3 Data collected

Survey questions were based on a qualitative study conducted prior to the survey. The results from the study highlighted issues that were important for the elderly population in relation to their perceived and existing health problems, and their socioeconomic, psychological and environmental situations. These main themes were used to develop questions that covered the following areas: demographics, including socio-economic indicators, environment and housing, social connectedness, health status, vulnerability and health problems during recent heat waves, heat health knowledge including awareness about heat advisories, and resilience during heat waves.

### 2.4 Statistical analysis

The survey data were analysed using Stata12<sup>6</sup> statistical package. In the first instance a descriptive analysis of the general and topic specific characteristics of participants was conducted using the survey prefix command (svy) taking into account population weighting. Differences in proportions were assessed for significance using chi-square tests and logistic regression.

Bivariate analysis was conducted using simple logistic regression analysis to explore possible risk factors (age, gender, demographics, health status) and their association with health outcomes and heat health behaviours (heat health awareness, vulnerability during heat waves). Plausible influential risk variables with a p-value less than 0.2 at the bivariate level were simultaneously included into the multiple logistic regression models. Using backward elimination, insignificant variables with the highest p-value were sequentially removed to yield the final set of risk factors associated with health outcomes and behaviours (p<0.05). Odds ratios (OR) were calculated to express differences in risks between people <75 and those ≥75 years of age.

## 3. Results

### 3.1 Participation

Of the initial 4200 households drawn in South Australia, a sample loss of 2612 occurred. The reasons for the sample loss were non-residential numbers (36), disconnected numbers (838), fax/modem response only (30), and ineligibility due to age under 65 years or not residing in South Australia (1708).

The remaining sample of 1588 constituted the eligible sample. Non-response was due to refusal of the interview (414), inability to speak English (73), illness/hearing impairment (55), termination of interview due to living in a facility (3), and unavailable (9). Non-contacts after 10 attempts were 534 phone numbers. Five hundred interviews were conducted. This resulted in a participation rate of 47.4% of the eligible sample (500/1599-534 x 100). Generally, the count, percentage, confidence intervals (CI) and standard error (se) results for the survey questions are based on 499 participants unless otherwise stated (e.g. specific questions which only applied to subpopulations).

### 3.2 Demographic information

Table 1 provides information about the demographic profile of the South Australian (SA) target population. To assess how the selected study population compares to the target population, counts and percentages of the demographic variables (i.e. age, sex, country or metropolitan) on which the sampling weights were based are presented in weighted and unweighted format.

The percentage (weighted) of people surveyed in the metropolitan areas in SA was 68% compared to 32% in rural areas. The unweighted proportions were very similar. The proportion of females (weighted) was 54% and males 46% comparing to 61% and 39% respectively for unweighted proportions. Average (weighted) age in SA was 75.1 years (95% CI 74.5, 75.6) and the unweighted average age was 74.5 years (95% CI 74.5, 74.9); Table 1 indicates the proportions of participants in five year age groups.

Annual income was categorised into three groups (table 2). Thirty three per cent of the survey population received less than \$20,000, 32% were in the \$20,000 to 60,000 category and 7% in the category earning more than \$60,000 and 28% refused to provide this information. English was spoken at home in 96% of selected residences (table 2). Other spoken languages included German, Greek, Italian, Polish, Vietnamese, Hindi, Persian, Czech and Chinese.

Of the survey participants 33% lived alone, 62.5% lived with a spouse or partner and 3.0% lived with relatives (Table 2).

Table 1: Demographic survey information by area, age and gender

Demographics	Weighted counts N= 499	Unweighted Counts N=499	Weighted Standard error	Weighted Confidence interval	Weighted Percent	Unweighted percent
Metropolitan	341.2	338	2.2	63.8; 72.6	68.4	67.7
Rural	157.8	161	2.2	27.4; 36.2	31.6	32.3
Age groups						
65-69 years	148.9	159	2.2	25.8; 34.3	29.8	31.9
70-74 years	109.6	111	2.0	18.3; 26.1	22.0	22.2
75-79 years	94.8	92	2.0	15.5; 23.1	19.0	18.5
80-84 years	78	72	1.8	12.4; 19.5	15.6	14.4
85 plus years	67.7	65	1.6	10.7; 17.1	13.6	13.0
<75 years of age	258.5	270	2.4	47.1; 56.5	51.8	54.1
75 plus years	240.5	229	2.4	43.5; 52.9	48.2	45.9
Female	268.8	303	2.4	49.1; 58.6	53.9	60.7
Male	230.2	196	2.4	41.4; 50.9	46.1	39.3

Table 2: Income and living arrangements

Demographics	Weighted counts N= 499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>Annual income</b>				
Up to \$20,000	163	2.2	28.4; 37.2	32.7
\$20,00 to \$60,000	158.5	2.3	27.4; 36.4	31.8
> \$60,000	35.9	1.3	5.0; 10.2	7.2
Refused and not stated	141.6	2.1	24.4; 32.7	28.4
<b>English spoken at home</b>	478.6	1.0	93.5; 97.5	95.9
<b>Living arrangements</b>				
Live alone	163	2.1	28.7; 36.8	32.6
Live with spouse or partner	312	2.2	58.1; 66.7	62.5
Live with relative	15	0.8	1.7; 5.0	2.9
	2	0.2	0.1; 1.3	0.3
Other	7	0.6	0.6; 3.2	1.3
Not stated	2	0.2	0.1; 1.3	0.3
Other: live with husband/wife and son; with grandson; with friend; with nurse				

### 3.3 Health Status and Medication

The majority of participants (75%) assessed their health to be good to excellent and 25% selected fair to poor (Table 3).

Twenty four per cent of people 75 and older stated that their health status was fair to poor compared to 26% in the below 75 age group (not significant). In country areas, 29% stated a health status that was fair to poor compared to 24% in the metropolitan areas (not significant).

Table 3 also shows the frequency distribution of specific medical conditions for which participants had taken medication on a regular basis. These conditions/medications were selected on the basis of evidence of their possible association with increased risk during heat. More than half of the participants were taking medication for high blood pressure (56%), 9% for heart failure, and 20% for other heart problems. Other listed health problems for which prescribed medication was being taken were diabetes (16%), kidney problems (3%), respiratory problems (10%) and mental conditions (10%). No medication for the designated conditions was taken by 26% of the participants. More participants aged 75 and older took medication for chronic conditions (78%) compared to those below the age of 75 (71%) (OR 1.5 95% CI 0.98;2.4, p=0.064).

Four percent of the respondents had been told by a medical doctor to restrict fluid intake based on medical grounds.



Table 3: health status and medication for specific medical conditions

Outcomes	Weighted counts N= 499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>In general, would you say your health is</b>				
Good to excellent	373.4	2.1	70.6; 78.7	74.8
Fair to poor	124.7	2.1	21.1; 29.3	25.0
Don't know	0.92	0.2	0.03;1.3	0.2
<b>Do you regularly take prescribed medications for any of the following conditions?</b>				
Diabetes	79	1,8	12.7; 19.6	15.8
High blood pressure	278	2.4	51.0; 60.4	55.7
Heart failure	42	1.4	6.1; 11.6	8.5
Other heart problems (heart attack, stroke, angina)	101	2.0	16.8; 24.4	20.3
Kidney problem	16	0.9	1.8; 5.5	3.2
Respiratory problem (e.g. asthma, COPD)	49	1.4	7.4; 12.8	9.8
Depression, anxiety, memory loss or other mental condition	51	1.4	7.7; 13.4	10.2
Multiple Sclerosis	1	0.2	0.03; 1.4	0.2
Don't know	14	0.8	1.6; 4.9	2.8
No, don't take any tablets/medications	128	2.1	21.8; 30.0	25.6
refused	0			0
<b>Have you ever been advised by a doctor to restrict your fluid intake due to any medical conditions?</b>				
yes	21	1.0	2.6; 6.6	4.1
may be	3	0.4	0.2; 2.0	0.6
no	475	1.05	92.7; 97.0	95.26
Don't know / not sure	0			0

### 3.4 Mobility and need for household assistance

Eighty three per cent of the responders did not use any mobility aids (Table 4). The main aids (17%) were walking frames and sticks (16%) followed by gophers (3%) and wheelchairs (1%). Thirty eight percent of the elderly participants received help with household tasks, mainly by their spouse (43%), but other main care categories were other family members (10%), friends (8%) and a number of different agencies (Table 4).

Table 4: Mobility and household assistance

Outcomes	Weighted counts N=499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>Do you use any of the following mobility aids?</b>				
Any mobility aid	84.8	1.7	13.9; 20.6	17.0
Walking aids (frames, sticks)	78	1.7	12.7; 19.3	15.7
Wheelchair	6	0.5	0.6; 2.6	1.2
Gopher scooter	13	0.7	1.4; 4.4	2.5
Other	4	0.5	0.3; 2.4	0.9
Other responses included: oxygen cylinder: have aids, but don't use them often				
<b>Do you have someone who helps you with personal or household tasks?</b>				
Yes	192	2.3	33.9;43.1	38.4
<b>Can you tell me who helps you with personal or household tasks? N=192</b>				
Spouse	81	3.9	35.1; 50.3	42.5
Another family member	18	2.1	6.2; 14.4	9.5
Friend	15	2.0	4.7; 12.9	7.9
Domiciliary care	15	2.2	4.3; 13.3	7.7
RDNS	1	0.6	0.1; 4.1	0.6
Meals on Wheels	1	0.5	0.07; 3.7	0.5
Resthaven	3	0.8	0.6; 4.4	1.6
Retirement village	2	0.7	0.2; 3.8	0.9
Home and Community Care/local council	16.5	2.2	5.2; 14.1	8.6
Yes, but don't know who it is	1.6	0.6	0.2; 3.4	0.8
An agency	23	2.3	8.2; 17.4	12
<b>Agencies included:</b>				
Other ACH; CHAPS; ECH; Helping Hands; Italian Benevolent Society; Anglicare; Uniting Care; Resthaven; Murray Mallee Care				
Other responses included: HSS nurse; neighbour, grandson; church friends; through hospital; Uniting Care Wesley; tenant/boarder				
Cleaner	8	0.7	0.9; 3.7	1.9
Department of Veterans Affairs	10.5	0.6	1.2; 3.8	2.1

### 3.5 Social interactions

Table 5 provides information about the social interactions of survey responders. The majority of participants (89%) talked on the phone in the previous week more than two times with friends and relatives. Twice as many people in country areas (16%) had talked on the phone less than twice in the past week compared to those living in the metropolitan area (8.6%) (OR 2.0 95% CI 1.22-3.20 p=0.005).

Eighty seven percent had talked in person to friends, relatives or neighbours in the past week. People 75 and older were more likely to not have talked in person (15%) to contacts (less than twice) in the past week compared to those that were younger than 75 (8%) (OR 2.1 95% CI: 1.3-3.4 p=0.002).

Table 5 indicates that 89% of participants had gone out of the house in the past week for appointments, to visit people, or elsewhere (more than twice), and 10% of people did so less than twice per week. People 75 and older (13%) were more likely to have gone out less than twice in the week previously compared to those younger than 75 years of age (7%) (OR 2.3 95% CI 1.5, 3.7; p<0.001).

Table 5: Frequency of social contact

Outcomes	Weighted counts N= 499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>Approximately, how many times in the past week have you talked with friends and relatives on the phone?</b>				
More than 2 times	435	1.5	83.6; 90.1	89.2
Less than 2	52.7	1.5	7.9; 13.9	10.8
Times or not stated/ don't know	11.1	0.7	1.2; 4.1	2.2
<b>Approximately how many times in the past week have you talked with friends, relatives or neighbours in person?</b>				
More than 2 times	436	1.6	83.8; 90.3	87.4
Less than 2 times	55.7	1.6	8.4; 14.7	11.2
Not stated/don't know	7.2	0.5	0.7; 2.9	1.4
<b>Approximately, how many times in the past week have you gone out (for example to appointments, to visit people, to church or shopping)</b>				
More than 2 times	443.6	1.5	85.6; 91.5	88.9
Less than 2 times	50.1	1.4	7.6; 13.3	10.1
Not stated/don't know	5.3	0.5	0.5; 2.5	1.1

### 3.6 Access to Transport

When survey participants were asked about their normal form of transport 78% nominated themselves as drivers of a car and 19% chose passengers in a car as their main transport option. Other forms of regular transport modes are set out in Table 6.

When those participants who did not drive themselves (N=109) were asked about problems with access to transport, 97% responded that they had no problem (rarely to never had a problem) compared to 3% who had problems (sometimes to most of the time).

Table 6: Modes of and access to transport

Outcomes	Weighted counts N= 499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>What is your normal form of transport?</b>				
Car as a driver	390	1.9	74.2; 81.8	78.2
Car as a passenger	92	1.9	15.1; 22.4	18.5
Public transport	50	1.4	7.6; 13.0	10.0
Taxi/access taxi	23	0.9	3.1; 6.9	4.7
Community bus	7	0.5	0.7; 2.9	1.4
Walk, bicycle	41	1.2	6.1; 10.9	8.2
Other	1	0.1	0.1;0.8	0.2
Gopher/scooter	5	0.4	0.5; 2.4	1.0
<b>How often do you have problems accessing transport when you want go out? (Only those who do not drive themselves N=109)</b>				
Rarely-to never	482.8	0.8	95.0; 98.0	96.8
Sometimes-most of the time	16.2	0.8	2.0; 5.1	3.2

## 3.7 Housing

### 3.7.1 Type of dwelling

People were asked to state the type of dwelling in which they were living. The main response was 'living in a house' (82%), followed by living in a unit (10%) and retirement home (7%) (Table 7).

Table 7: Housing

Outcomes	Weighted counts N=499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>For this study we are interested in people who live at home. Could you tell me if you live in a...</b>				
House	410.7	1.7	78.6; 85.5	82.3
Unit	52.0	1.4	8.0; 13.4	10.4
Retirement home	34.2	1.2	4.9; 9.5	6.8
Other	2.1	0.3	0.1; 1.7	0.4

### 3.7.2 Housing blinds and awnings

Of the 61% of people who had blinds and awnings, 94% stated that they used them in summer (Table 8). Reasons for not using the blinds included too much effort; trees shade the house, use of indoor blinds.

Table 8: Ownership and use of blinds and awnings

Outcomes	Weighted counts N=499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>Do you have outdoor blinds or awnings on windows?</b>				
Yes	305	2.3	56.4, 65.6	61.1
No	193	2.3	34.2, 43.4	38.7
<b>Do you pull down outdoor blinds or awnings on windows in summer (Those who have them N=305)</b>				
Yes	287.2	1.5	90.4,96.5	94.2
Rarely to not	17.3	1.5	3.3,9.5	5.7
Don't know	0.6	0.2	0.03,1.3	0.2
<b>Is there anything stopping you using your outdoor blinds or awnings more often? N=18</b>				
I have trouble putting them up and down	1	6.3	1.6,34.3	8.3
They are broken	0			0
Can't be bothered/too much effort	2	7.7	2.3,39.6	11
I just leave them down all summer	1	3.2	0.3,23.8	3.1
Trees shade the house	4	11.3	5.2,52.8	19.9
I use indoor blinds closed instead	5	12.7	9.1,59.5	27.8
They flap in the wind	0			0
Other	4	10.3	6.6,49.7	21
<b>No need, have A/C, too dark, ½ way</b>				
No				

### 3.7.3 Insulation

The majority of responders (89%) asserted that their house was insulated and 4% could not verify whether their house was insulated (Table 9).

Table 9: House insulation

Outcomes	Weighted counts N=499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>Does your home have insulation?</b>				
Yes	446	1.4	86.4,91.8	89.4
No	31	1.0	4.4,8.6	6.2
Don't know/refused	22	0.9	2.7,6.4	4.4

### 3.7.4 Air conditioning

Air conditioning (A/C) prevalence was 95% among households of older persons in SA, with 66% having reverse-cycle air conditioners, 22% evaporative type air conditioners and 19% have refrigerated A/C systems (Table 10).

Temperature settings were easy to identify for 91% of people who had reverse cycle air conditioners and 2% answered "sometimes"; 3% of the respondents stated that it was not easy to identify and change temperature settings from heating to cooling. About 19% of people with reverse cycle A/C mentioned that they had accidentally put it on heating instead of cooling (or vice versa) one or more times.

The room most often cooled by A/C in SA was the lounge or sitting room (63%), followed by the kitchen/dining (37%), the main bedroom (33%) and family room (14%). Nineteen per cent of the respondents cooled the whole house and 5% most of the house.

The age of the A/C was recalled to be 0-3 years old by 29% of participants, 4-9 years by 34% and 35% thought that the system was 10 or more years old.

In SA, only 1% of people used the A/C when the outside temperature was below 25°C. Twelve per cent started to use it when the temperature was 25-29°C, 37% at 30-34°C and 25% when the temperature was 35-39 °C. Finally, 4% of responders only switched on the A/C when the temperature was over 39°C. Other responses were 'only when I feel hot (8%) and 'only when the house warms up' (10%).

The main reason people were hesitant about running an A/C was the cost (21%). Other reasons included that they did not feel the heat; their A/C did not work well when humidity was too high and environmental concerns about running A/C.

There were 42% of South Australians who had fair to major concerns about the cost of air conditioning compared to 57% who had little to no concern. Although not statistically significant, less people 75 and older were (fair-major) concerned (36%) compared to the 65-74 year age group (47%).

Maintenance of A/C is an issue as 24% of the people who owned an A/C never had it serviced, while 31% serviced it regularly and 23% sometimes.

When asked about the use of fans, 22% of people said they did not use a ceiling fan or another type of fan at home (Table 10).

Table 10: Air conditioning and fans

Outcomes	Weighted counts N=499	Weighted Standard error	Weighted Confidence interval	Weighted Percent
<b>Do you have an air conditioner at home?</b>				
Yes	475	0.98	92.8,96.8	95.2
No	24	0.98	3.3,7.2	4.8
<b>What type of air conditioner is it? N=475</b>				
Reverse cycle ducted	93	2.0	16.0;23.9	19.7
Reverse cycle split system	128	2.2	22.9;31.6	27.1
Reverse cycle window/wall	92	1.9	15.9,23.3	19.3
Evaporative portable	8	0.6	0.9,3.2	1.7
Evaporative ducted	98	2.0	17.0,24.8	20.6
Refrigerate ducted	18	1.1	2.2,6.5	3.8
Refrigerate window/wall	49	1.5	7.8,13.8	10.4
Refrigerate portable	5	0.6	0.3,3.0	1.0
Don't know	16	0.8	2.0,5.4	3.3
Other	0			0

Are the settings on your reverse cycle air conditioner easy to identify and change from heating to cooling? N=300				
No	9.0	1.0	1.7,5.9	3.2
Sometimes	4.8	0.8	0.8,4.1	1.8
Yes	91.2	1.7	86.6;93.6	90.7
Automatic setting for heating/cooling	2.4	1.0	0.9,5.4	2.2
Don't/can't remember	2	0.8	1.0,4.5	2.1
How many times, if ever, have you accidentally had the settings on heating instead of cooling (or vice versa)?				
None	237	2.5	74.3;84.1	79.7
Yes	55	2.4	14.3,23.7	18.5
Don't know	5	0.9	0.7,4.6	1.8
Which rooms in the house do you usually try to keep cool with an air conditioner? N=459				
Lounge/sitting room	291	2.5	58.4,67.9	63.3
Main bedroom	151	2.4	28.4,37.8	32.9
Kitchen/Dining	169	2.4	32.1,41.7	36.7
Family room	66.3	1.9	11.2,18.5	14.4
Other room	21	1.1	2.8,7.3	4.6
Whole House	88.5	2.0	15.6,23.5	19.3
Most of the house	25	1.2	3.5,8.2	5.4
How old is your air conditioner? N=459				
0-3 years	131	2.3	24.3,33.3	28.5
4-9 years	156	2.4	29.4,38.9	34.0
10 or more	159	2.4	30.2,39.4	34.6
Don't know	13.2	0.8	1.7,4.9	2.9
At what outside temperature do you turn on the A/C?				
<25 °C	6	0.5	0.7,3.0	1.4
25-29	55	1.6	9.2,15.6	12.0
30-34	171	2.4	32.6,42.1	37.2
35-39	113	2.2	20.5,29.2	24.6
> 39	17	0.9	2.2,5.9	3.6
Only when I feel hot	39	1.4	6.0,11.6	8.4
Only when the house warms up	47	1.5	7.6,13.5	10.2
Only when visitors come over	0			0
Varies	2	0.3	0.1,1.5	0.4
Other	5	0.5	0.4,2.7	1.0
Never	1	0.2	0.1,1.0	0.3
Don't know	4	0.5	0.3,2.5	0.9

What are the things that make you hesitant to use the A/C?				
Nothing	334	2.3	68,76.8	72.6
Can't afford	98	2.1	17.5,25.7	21.3
Don't need it	4	0.5	0.2,2.4	0.8
Don't know how to use it	0			0
Have difficulties in understanding the settings	0			0
Does not work	1	0.2	0.1,1.0	0.2
Air blows on me	1	0.2	0.03,1.5	0.2
Too noisy	4	0.5	0.3,2.4	0.9
Concern about impact on environment	3		0.2,1.7	0.6
Causes power failures	0			0
Fire risk	0			0
Evaporative: don't like to have windows open	0			0
Too cold	2	0.4	0.1,2.8	0.4
Too difficult to get up and down	0			0
Other	23	1.1	3.2,7.6	5.0
Other responses included: can't rely on thermostat, humidity makes it ineffective, overloading power circuit.				
Don't know	1	0.2	0.03,1.6	0.2
refused	0			0
How much concern to you are the costs associated with running air conditioning in your home?				
N=459				
Little to no concern	261	2.5	51.8,61.6	56.7
Fair to major concern	192	2.5	37.0,46.7	41.8
Don't know	7	0.7	0.6,3.6	1.5
Does your air conditioner get serviced?				
Regularly	143	2.3	26.8,36.0	31.2
Sometimes	105	2.1	19.0,27.3	22.9
Never	109	2.1	19.8,28.1	23.7
Only filters	64	1.7	10.8,17.7	13.9
Other	33	1.4	4.9,10.4	7.2
Don't know	5	0.5	0.5,2.5	1.1
Other responses included: just installed, does not need maintenance, just bought				
Do you use a ceiling fan or other type of fan at home? N=499				
Ceiling fan	235	2.4	42.2,51.8	47.0
Other	106	1.9	17.8,25.1	21.3
Both	49.7	1.4	7.5,13.2	10.0
No	108	2.0	18.0,25.8	21.6
Refused	1	0.1	0.1,0.9	0.1



### 3.8 Behaviour during Heat waves

For the following section participants were questioned about their perceptions and behaviours during heat waves. Heat waves were described as several days in a row when the temperature is very hot.

#### 3.8.1 Heat wave concerns

Participants were asked about what concerns them when they 'hear there is a heat wave looming' (Table 11). 72% of participants had concerns, while 29% had no concerns. Major concerns were about how it makes them feel (18%) (hot, no energy etc), health concerns (3%), coping (8%), concerns about the garden (13%), disruption of normal routine (8%), bushfire concerns (5%) and how hot the house will get (6%). Other concerns are listed in table 11.

Table 11: Concerns about heat waves

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>When you hear there is a heat wave looming what concerns you most?</b>				
No concerns	142	2.2	24.4,33.0	28.5
Yes concerns	357	2.2	67.0,75.6	71.5
<b>What are the concerns?</b>				
How it makes you feel	88	1.8	14.3,21.5	17.6
Your health	15	0.8	1.7,4.9	2.9
How you cope	39	1.2	5.8,10.7	7.9
How others cope	14	0.9	1.6,5.2	2.9
Health and welfare of others	10	0.8	0.9,4.1	1.9
Welfare of pets	13	0.8	1.5,4.6	2.7
The garden	63	1.6	9.8,16.3	12.7
Cost of cooling	18	0.9	2.2,5.7	3.6
Disruption of normal routine	41	1.3	5.9,11.2	8.1
inconvenience	8	0.6	0.8,3.4	1.6
Water restriction	4	0.4	0.3,2.1	0.8
Bushfire	26	1.0	3.5,7.6	5.2
How long it will last	10	0.7	1.0,3.8	1.9
How hot the house will get	32	1.2	4.4,9.2	6.4
Other	79	1.7	12.7,19.5	15.8
Examples for other concerns	Electricity failure, sleeping at night, how to keep cool, don't have cooling, how to keep up fluids, heat in car, health concerns			

#### 3.8.2 Personal changes of behaviour during very hot weather

Table 12 provides results related to personal changes of behaviours. To cool off, 27% of participants took extra baths or showers (sometimes - often) and this was more prevalent in the country (30%) than in the metropolitan areas (25%).

Most people (91%) wore lighter or cooler clothes during very hot weather and 82% reduced activities requiring physical effort (sometimes to most of the time) (Table 12). When the remainder were asked why they did not (i.e. rarely to never) reduce their activities, 31% answered that things still had to be done. Many participants (56%) had other reasons as set out in Table 12. Ninety two percent of people closed their indoor blinds and curtains to keep the sun out. During a heat wave, 22% of participants used wet clothes on face or neck to cool down.

Table 12: Behaviour change

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>How often do you have extra cool showers or baths to cool off?</b>				
Sometimes to often	133.6	2.1	22.9,31.0	26.8
Seldom to never	365.4	2.1	69.0,77.1	73.2
Don't know	0			0
<b>When it is very hot, how often do you wear lighter or cooler clothing than normal?</b>				
Often-sometimes	456.3	1.3	88.3,93.8	91.4
Rarely-never	39.7	1.3	5.7,11.0	8.0
Don't know	3.1	0.4	0.2,1.9	0.6
<b>When it is hot, how often do you reduce the number of activities you do that require physical effort?</b>				
Sometimes to most of the time	410	1.9	78.1,85.6	82.2
Rarely to never	77.8	1.8	12.3,19.5	16.0
Don't know	11.2	0.7	1.2,4.1	2.3
<b>Why don't you reduce the number of activities that require physical effort? N=89</b>				
Things still have to be done	27.1	5.5	20.8,42.3	30.5
other	50.2	6.0	44.4,67.7	56.4
Don't know	11.7	4.1	6.9,23.6	13.1
Examples for 'Other' reasons:	Fit and healthy, don't do much anyway, A/C helps, normal as possible, do things in the morning, like to be busy			
<b>When it is very hot, how often do you close your indoor blinds or curtains during the day to keep the sun out?</b>				
Sometimes-most	457.2	1.3	88.7,93.9	91.6
Rarely-never	38.3	1.2	5.6,10.5	7.7
Don't know	3.5	0.4	0.2,2.2	0.7
<b>During a heat wave, how often do you place a wet cloth on your face and neck to cool down?</b>				
Sometimes-most	107.3	1.9	18.0,25.5	21.5
Rarely-never	391.7	1.9	74.5,82.0	78.5

### 3.8.3 Changes of regular activities during very hot weather

Table 13 provides information for peoples' changes in indoor and outdoor activities during heat waves. Most people claimed to stay indoors during heat waves (sometimes-most times) (95%). Similarly, 95% claimed that they reduce outdoor activities during the heat of the day. Nevertheless, participants stated that they kept their appointments (95%) (Sometimes- mostly) and undertook their regular activities (74%) during heat waves.

Table 13: Indoor and outdoor activities during heat waves

Outcomes	Weighted counts N=	Standard error	Confidence interval	Percent
<b>During a heat wave, how often do you stay indoors and avoid the sun?</b>				
Sometimes-mostly	474	1.0	92.5,96.6	94.9
Rarely-never	23	1.0	3.0,6.9	4.6
Don't know	3	0.3	0.2,1.6	0.5
<b>During a heat wave, how often do you reduce outdoor activities in the heat of the day?</b>				
Sometimes-mostly	472	1.0	92.2,96.4	95.4
Rarely-never	23	1.1	3.0,6.9	4.6
Don't know	4	0.4	0.3,2.1	0.8
<b>Generally, during a heat wave, do you keep your appointments (such as doctors or hairdressers?)</b>				
Sometimes- mostly	475	0.9	93.0,96.7	95.2
Rarely-never	20	0.8	2.6,6.0	4.0
Don't know	4	0.4	0.3,2.2	0.8
<b>During a heat wave, do you still undertake your regular activities (such as shopping, chores, visiting, sporting activities, church)?</b>				
Most-sometimes	369.3	2.1	69.7,77.9	74.0
Rarely-never	59.6	1.5	9.3,15.3	12.0
It depends	41	1.3	5.9,11.3	8.2
I re-schedule	26.2	1.0	3.6,7.7	5.3
Don't know/refuse	2.8	0.3	0.2,1.8	0.6

### 3.8.4 Behaviour changes during recent heat waves

When asked about their behaviour during recent heat waves when their house was hot, 73% of people stated that they did not go somewhere cooler and 14% specified that their house did not get hot (Table 14). People living in metro areas were more likely to go out (11%) compared to those living in the country (6.6%). Those who went somewhere else went to a shopping centre (62%), to a library (9%), to a friend's (11%) or family member's house (8%) and (5%) to the beach. Other examples are listed in Table 14.

Those that did not go somewhere cooler stated as reasons they didn't want to leave their home (26%), transport reasons (7%), and 2% couldn't be bothered. Examples for other reasons (11%) are tabulated in Table 14.

Most people in the survey (93%) opened their house in the evenings during heat waves to let a cool breeze in (most to all times). Those that did not open up stated that nothing prevented them from doing so; their house was already cool or it was too noisy or household security prevented them (Table 14).

Table 14: Use of cooled spaces and home ventilation

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>In recent heat waves if your house has been very hot, have you gone somewhere else to be cooler?</b>				
Yes	48.5		7.3,12.8	9.7
Sometimes	19.8		2.5,6.3	4.0
No	363.5		68.5,76.8	72.9
Not applicable, house does not get hot	67.2		10.6,17.0	13.5
Don't know	0			0
<b>Where did you go to be cooler? N=68 those who went somewhere else</b>				
Shopping Centre	43	6.0	49.8,73.3	62.3
Library	6	4.0	3.8,20.7	9.2
Beach	4	3.4	1.5, 17.7	5.4
Park	0			0
Cinema	5	3.4	3.3,17.9	8.0
Hotel/Club	1	1.4	0.5,7.9	2.0
Family member's house	6	3.2	3.9,17.5	8.4
Friend's house	8	3.6	5.8;20.5	11.2
Neighbour's house	1	1.6	0.5,8.8	2.0
Other	8	3.6	6.4,21.2	11.9
Other responses included: Adelaide hills, art gallery, beach, river swim, library, pool, pub				
<b>If you would have liked to go somewhere cooler, what stopped you?</b>				
<b>N=364, those that said no to going somewhere else in previous question</b>				
Didn't want to leave my home	95	2.5	21.5,31.3	26.1
Didn't want to leave my pet/ animal(s)	2	0.6	0.1,3.4	0.7
I am ok at home	215.0	2.8	53.56,64.6	59.2
Didn't want to leave my garden	0			0
Too difficult to arrange	3	0.6	0.2,3.5	0.7
Transport issues	26	1.5	4.7,10.7	7.1
Couldn't be bothered	8	0.9	1.0,4.7	2.2
Wasn't invited	1	0.2	0.02,1.2	0.2
Physical limitations	1		0.05,2.4	0.3
Other	39	1.8	7.8,14.8	10.8

Other responses included: nothing, ridiculous to go out for no good reason, comfortable at home, never thought of it, distance, getting hot on the way, small town with no shopping centre, organisation.				
Don't know	16	1.2	2.5,7.4	4.3
Refused	0			0
Nothing	11	0.8	1.2,4.4	2.3
Nowhere to go	3	0.3	0.2,1.8	0.6
When there is a cool breeze in the evenings how often do you open up the house to let the cool breeze in? N=499				
Most-all of the time	463.6	1.1	90.3,94.8	92.9
Never-sometimes	31.4	1.1	4.5,8.8	6.3
Not applicable/don't know	4.0	0.4	0.3,2.1	0.8
Is there something that prevents you opening up your house if there is a cool breeze at night? N=8				
Responses included: no, nothing, household security, windows are too heavy				

### 3.8.5 Welfare concerns during very hot weather

Table 15 relates to questions about welfare concerns during very hot weather. Thirty percent of people received regular phone calls from someone to check on their welfare during recent heat waves. Of those who were contacted, 81% were contacted by family members and 7% by friends. Telecross Redi represented 7% of the welfare calls, other agency contacts were minimal; their distribution and feedback on service quality are shown in Table 15. People aged 75 and older had almost three times more check-up phone calls (41%) than those below the age of 75 (20%) (OR 2.7 95% CI: 1.8, 4.3;  $p < 0.001$ ).

Welfare visits were mainly undertaken by family members (76%), neighbours (15%) and friends (4%). Domiciliary Care was the main agency visiting (Table 15). People 75 and older (24%) were visited more often than those below 75 years of age (12%) (OR 2.4 95% CI: 1.5, 3.1;  $p = 0.001$ ).

Table 15: Visits and phone calls to check on welfare during very hot weather

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>During the heat waves in the past few years has someone telephoned you regularly to check on your welfare?</b>				
Yes-sometimes	150	2.2	26.0,34.5	30.1
No-quite ok	343.8	2.2	64.4,73.1	68.9
Don't know/remember	5.2	0.6	0.3,3.2	1.0
<b>Who was it that phoned you? N=153</b>				
TeleCrossRedi	10	2.0	3.5,11.9	6.5
Local Council	1	0.6	0.1,4.5	0.6
Domiciliary Care	3	1.1	0.6,5.8	1.8
RDNS	0			0
Centrelink	0			0
Veterans Affairs	1	0.7	0.1,4.6	0.7
Home and Community Care	1	0.5	0.1,3.4	0.5
Other agency	4	1.1	1.0,5.9	2.5
<b>Other agencies: staff from the Lutheran village, Resthaven, Vietnamese Women's Association, doctor's surgery and hospital staff.</b>				
Family member	124	3.3	73.2,86.3	80.6
Friend	11	2.4	4.3,14.2	7.2
Don't know	2	2.0	4.1,12.5	1.5
<b>How happy were you to receive this call service? N=11</b>				
Moderately happy	2	11.3	2.6,55.7	15.5
Mostly happy	1	13.1	1.3,65.2	13.7
Very happy	7	15.6	31.2,92.8	70.8
<b>During heat waves in the past few years has someone visited you regularly to check on your welfare? N=499</b>				
Yes or sometimes	87.7	1.8	14.3,21.4	17.6
No	409.6	1.8	78.3,85.4	82.1
Can't remember	1.8	0.3	0.1,1.4	0.4

Who was it that visited you? N=88				
Red Cross	0			0
Local Council	0			0
Domiciliary Care	1	0.2	0.03,1.8	1.4
RDNS	0			0
Home and Community Care	0			0
Carer	1	0.6	0.1,4.5	0.6
Other agency	1	0.9	0.1,6.5	0.9
Other responses: Helping Hand Aged Care				
Family	67	4.6	65.7,83.8	75.9
Neighbour	13	3.8	9.0,24.3	15.1
Friend	4	2.2	1.6,11.6	4.4
Other	3	2.0	1.4,10.5	3.9
Other responses: retirement village worker, nursing sister in Wallaroo, nurse from local doctor				

### 3.8.6 Fluid intake during very hot weather

The majority of people (91%) drank more fluids when the weather was very hot (Table 16).

When people were asked what stopped them from drinking more fluid, 31% answered that they don't get thirsty or don't think of it, 3% stated that their doctor had advised them not to drink more fluid. Other reasons (18%) are listed in Table 16.

The first preference was water (86%), followed by soft drink (9%), cordial (8%). Other fluids were preferred by 18.4% and they are listed in Table 16.

Table 16: Fluid intake

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>Do you drink more fluids when the weather is very hot?</b>				
Yes-sometimes	456.2	1.3	88.5,93.7	91.4
No	40.0	1.3	5.8,10.9	8.0
Don't know/can't remember	2.8	0.3	0.2,1.9	0.6
<b>Is there something that stops you drinking more when the weather is hot? N=69</b>				
Yes	32	5.6	21.0,43.0	54.0
No	38	5.6	57.0,79.0	46.0
I don't get thirsty or I Don't think of it	21	5.6	21.0,43.0	31.0
It makes me feel unwell	1	1.6	0.2,11.0	1.6
It will make me go to the toilet more often	1	0.8	0.1,5.8	0.8
I have a continence problem	0			0
The doctor advised me not to drink too much	2	2.9	0.4,18.8	3.0
Other	13	4.8	10.7,29.8	18.4
<b>Other responses included: Drinks 4L every day, likes to drink at night, does not like water, diabetes, as required, forget, kidney problems</b>				
Don't know	1	0.9	0.1,6.5	0.9
<b>If it was very hot and you were thirsty what would you most often drink? N=499</b>				
Water	431	1.7	82.7,89.3	86.3
Tea	37	1.2	5.3,10.2	7.4
Coffee	22	1.0	2.9,6.8	4.4
Milk drink	2	0.3	0.1,1.7	0.4
Fruit juice	20	1.1	2.3,6.6	3.9
Cordial	39	1.3	5.6,10.9	7.9
Alcoholic beverage	23	1.1	2.9,7.4	4.6
Soft drink	44	1.4	6.5,12.0	8.9
Whatever is in the fridge	1	0.2	0.03,1.4	0.2
Other	22	1.0	2.8,7.0	4.5
<b>Other responses included: cool drink, lemonade, lemon and water, soda, poweraid, diabetic cordial, rain water</b>				
I don't get thirsty	1	0.2	0.03,1.4	0.2



### 3.8.7 Concern for pets or animals during extreme hot weather

Of the people who had pets (N=206), 84% had concerns (some to major concerns) for them during hot weather (Table 17). People younger than 75 years of age (89%) were more worried than those  $\geq 75$  years of age (76%) (OR 2.6 95% CI 1.2-5.9;p=0.02)

Table 17: Pets

Outcomes	Weighted counts N = 499	Standard error	Confidence interval	Percent
If you have pets or animals, how concerned are you about their health and welfare in the heat?				
Little to no concern	33.0	1.2	4.6,9.4	6.6
Some- major concern	173.4	2.3	30.4,39.4	34.8
No pets	292.6	2.4	53.9,63.2	58.6
Of the people with pets N=206				
Little to no concern	33	2.7	11.3,22.1	16.0
Some- major concern	173.4	2.7	77.9,88.7	84.0

### 3.8.8 What helped during the 2009 heat wave?

Table 18 lists the things which had helped responders during the extreme heat wave in 2009. Air conditioning (84%) was on the top of the list. Wearing cool and light clothes was stated by 81% of participants, followed by staying inside (80%), drinking more fluid (76%), and reduction of physical activities (72%), fans (63%) and going somewhere cool (12%). Other things (11%) that were helpful for participants are listed in Table 17.

Table 18: Behaviours during the 2009 heat wave

Outcomes	Weighted counts N = 499	Standard error	Confidence interval	Percent
As you may recall we had an extreme heat wave in 2009. Which of the following did you find useful to help you get through it?				
Air conditioner	419	1.7	80.3,87.1	84.0
Fan	313	2.3	58.0,67.1	62.7
Wearing cool and light clothes	404	1.9	77.0,84.5	81.0
Reducing physical activities	385	2.2	67.2,75.7	71.7
Staying inside	399	2.0	75.8,83.5	79.9
Drinking more fluids	377	2.1	71.2,79.4	75.6
Going somewhere cooler	62	1.6	9.7,15.8	12.4
Something else	54	1.5	8.2,14.3	10.9
Something else responses included: Beach, cold showers house keeps cool, damp cloth, bed rest with ceiling fan, eating cold, damp clothes, sat in bath, sitting in blow up pool recreation centre exercise early, shopping at night, use of curtains and awnings, cinema				
Can't remember	18	0.9	2.2,5.9	3.6
Don't know	0			0
Refused	0			0
N/A	4	0.4	0.3,2.0	0.8

### 3.9 Resilience

Power failures during heat waves were of concern (some-major concern) to 72% of the participants (Table 19). People below the age of 75 (78%) were more concerned about power cuts than people 75 and older (69%) (OR 1.6 95% CI 1.02-2.4; p=0.04).

In the event of a major heat wave, 92% of the elderly population said that they would be (quite to well) prepared with supplies (e.g. medication, food, drink). Eighty three percent were confident that they could call on neighbours and friends in case they needed help. Ninety two percent expressed confidence that they could call on a family member if they needed help.

Table 19: Resilience

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>How much of a concern to you are long blackouts/power failures during heat waves?</b>				
Little to no concern	130	2.1	22.2,30.4	26.1
Some to major concern	358	2.2	67.4,75.8	71.8
Don't know	11	0.7	1.2,4.1	2.2
<b>In the event of a major heat wave that may restrict your activities, how prepared would you be with supplies of essential items at home (medications, food, drink)?</b>				
Not to somewhat prepared	38.5	1.3	5.5,10.7	7.7
Quite to well prepared	457	1.4	88.5,94.0	91.7
Don't know refused	3.2	0.5	0.2,2.7	0.6
<b>How confident are you that you could call on friends or neighbours if you need help?</b>				
Not confident	73.7	1.7	11.7,18.5	14.8
Somewhat to very confident	415.6	1.8	79.5,86.5	83.3
Not sure, don't know	9.8	0.6	1.1,3.6	2.0
<b>How confident are you that you could call on a family member if you need help?</b>				
Not confident	38	1.3	5.4,10.6	7.6
Somewhat to very confident	457	1.3	88.5,93.8	91.5
Not sure/don't know	4.3	0.4	0.4,2.2	0.9

### 3.10 Heat Health

This section asks questions about the health of responders during recent heat waves. Table 20 explores specific health issues people may have experienced.

#### 3.10.1 Experienced health effects

No health issues were experienced by 63% of the survey participants. The remaining 38% of the population had one or more symptoms during recent heat waves. Loss of balance was felt by 13%, followed by heat stress and shortness of breath both 12%; headache was experienced by 11%, anxiety by 5% and heart condition also by 5%. Other conditions are listed in table 20.

When asked whether they had any of these conditions during the 2009 heat wave, 17% said yes. Further conditions are listed in Table 20.

Extreme heat is of some to a major concern for 51% of the participants. Compared to an average person of the same age, 14% of the responders felt that extreme heat puts them at greater risk, whilst 82% felt to be at the same or lesser risk level.

Table 20: Heat health

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>During heat waves in the last few years, have you ever experienced any of the following?</b>				
Anxiety	27	1.0	3.7,7.7	5.3
Loss of balance – feeling dizzy	64	1.6	10.1,16.3	12.9
A fall	15	0.9	1.7,5.4	3.1
Headache	57	1.5	1.7,5.4	11.4
Shortness of breath	61	1.5	9.5,15.6	12.3
Heat stress	60	1.5	9.3,15.3	12.0
Heart condition	23	1.0	2.9,7.0	4.5
Renal/kidney condition	3	0.3	0.2,1.8	0.7
Something else	25	1.0	3.4,7.4	5.0
Something else included: wobbly legs, tired, swollen ankles, blurred vision, sense of blackness, nausea, nose bleed, heat rash.				
No, none of the above	312	2.3	57.9,67.0	62.5
Don't know	2	0.4	0.1,2.6	0.4
Refused	0			0
Any symptom				
Yes	187		33.05,42.1	37.5
No	312		57.9,67.0	62.5
<b>Did you have any of these problems during the extreme 2009 heat wave?</b>				
Yes	84	1.8	13.7,20.7	16.9
No	363	2.1	68.3,76.6	72.7
Don't know	14	0.8	1.6,4.7	2.8
Can't remember	38	1.2	5.5,10.3	7.6
Refused	1	0.1	0.0,0.8	0.1
<b>How much of a concern do you think extreme heat is for your health?</b>				
No to little concern	257	2.4	42.2,51.6	46.8
Some to major concern	233.7	2.4	46.7,56.1	51.4
Don't know	8.6	0.6	0.9,3.4	1.7
<b>Compared to an average person of your age, do you feel you are more or less at risk of the heat affecting your health?</b>				
Less to same risk	409.8	1.9	78.2 85.48	82.1
More at risk	68.3	1.7	10.72 17.32	13.7
Don't know -refused	20.9	0.9	2.678 6.482	4.2

### 3.10.2 Assistance during heat waves

Table 21 informs about sources of assistance which responders would call upon if required during heat waves.

Most people stated that they would ring a family member (43%) or a spouse (23%) if they felt unwell, 15% would seek the help of a medical doctor. Altogether, 33% would seek some sort of medical assistance. Sources of medical and other assistance are listed in table 21.

Table 21: Calls for assistance during extreme heat

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>If you felt unwell during the heat, who would you call for assistance?</b>				
Spouse	112	2.1	18.6,26.9	22.5
Family member	215	2.4	38.4,47.7	43.0
Carer	2	0.5	0.5,1.5	0.5
Friend	22	4.5	3.0,6.6	4.5
Neighbour	60	1.5	9.3,15.3	12.0
000	8	0.6	0.8,3.5	1.7
Ambulance	55	1.5	8.3,14.4	11.0
Doctor	73	1.7	11.5,18.4	14.6
Healthdirect	4	0.4	0.4,2.2	0.9
Emergency call button	22	0.9	3.0,6.6	4.5
Other	17	0.9	2.1,5.8	3.5
<b>Other responses included: retirement village, local hospital, St Johns, hop into the car to the next hospital</b>				
Depends on the situation	11	0.7	1.2,4.1	2.1
No one	1	0.2	0.03,1.4	0.2
Don't know	11	0.7	1.2,3.9	2.2

### 3.10.3 Health warnings

Seventy six per cent of responders remembered health warnings being issued in recent years and 21% did not (table 22). Health warning recall was better for people younger than 75 years of age (87%) compared to people 75 and older (70%) (OR 2.8 95% CI 1.7-4.5; p<0.001).

People heard about heat wave messages mainly via the radio (61%), the TV (60%) and the newspaper (8%). Other sources are listed in table 22. Sixty four percent of the participants recalled some of the messages about how to maintain "good health in the heat". Of those that recalled messages (N=321), 78% recalled "stay hydrated", 53% recalled "minimise sun exposure" or "stay indoors", 24% recalled "dress for summer" and 19% "make use of air conditioners. Other recalled messages are listed in Table 22.

When asked whether heat wave warnings would change their behaviour when a heat wave is called, 34% answered in the affirmative.

Table 22: Recollection of health warnings

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>In recent years, do you recall there being Health Warnings being issued during extreme heat waves?</b>				
Yes	381	2.1	72.2,80.2	76.4
No	104	2.0	17.3,25.0	20.9
Don't know/not sure	13	0.8	1.5,4.8	2.6
<b>How did you hear about the warnings?</b>				
TV	228	2.7	54.4,65.0	59.8
Radio	231	2.7	55.1,65.7	60.5
Radio stations: 5AA, 774, ABC, 891, 3AW				
Friends	2	0.3	0.15,1.5	0.5
Health professionals	1	0.3	0.04,1.9	0.3
Health shop	1	0.3	0.04,2.0	0.3
Internet	1	0.3	0.04,1.8	0.3
Library	0			0
Local council	1	0.3	0.04,1.8	0.3
Community group	0			0
Mail/letter box	2	0.3	0.1,1.8	0.4
Newsletter	5	0.7	0.5,3.8	1.4
Newspaper	32	1.6	5.7,12.1	8.3
Telephone	1	0.3	0.04,2.1	0.3
SMS	5	0.6	0.6,3.2	1.4
Other	4	0.4	0.4,2.3	0.9
<b>Other included: Resthaven called, Meals On Wheels, neighbours, Red Cross</b>				
Don't know/can't remember	2	0.4	0.1,2.2	0.6
<b>Do you recall any of the messages about how to maintain good health in the heat?</b>				
Yes to some recall	321.4	2.3	59.7,68.8	64.4
No to didn't understand- too complicated-don't know	177.6	2.3	31.2,40.3	35.6

Can you describe any of the messages about how to maintain good health in the heat? N=321				
No, don't recall any	6	0.7	0.842, 4.02	1.9
Stay hydrated/drink more Yes	250	2.6	72.5,82.5	77.9
Dress for summer Yes	79	2.5	19.8,29.8	24.4
Check on those at risk Yes	12	1.08	2.0,6.5	3.6
Minimise sun exposure/ stay indoors Yes	170	3.0	47.0,58.5	52.8
Make use of air- conditioners Yes	62	2.3	15.0,24.1	19.2
Look after your pets Yes	6	0.8	0.7,4.2	1.7
Seek medical advice if necessary Yes	1	0.3	0.1,1.6	0.4
Other Yes	88	2.6	22.6,32.9	27.4
Messages that were remembered included: stay inside with A/C switched on; take an extra shower; staying cool; cool bath/shower/sponge/wet towels; stay in contact with family members; stay inside and out of the heat; don't over-exercise; go to shopping centre; wear a hat, water garden early; open windows at night; keep house darkened.				
Don't know	3	0.7	0.3,4.2	1.0
When you hear the warnings does it change when or how you do things (e.g. chores, shopping, appointments)? N=499				
No - sometimes	318.2	2.3	59.1,68.2	63.8
Yes - I changed the way I normally do things	168.5	2.3	29.5,38.3	33.8
Don't know/can't remember	12.4	0.7	1.4;4.28	2.5

### 3.10.4 Heat communication

This section provides information about heat wave risk communication. Table 23 shows that health information was likely to be accessed by 81% of the responders if it was to be distributed via TV, followed by radio (66%), via letter drop (73%) and the newspaper (54%). If it were distributed via the internet, 22% of respondents were likely to see the information. People in the age group below 75 years of age (30%) were almost three times more likely to see information on the internet compared to people 75 and older (13%) (OR 2.9 95%CI 1.7, 4.8;  $p < 0.001$ ). There are more people in the metro area (80%) compared to the country (73%). that would not access internet information.

When participants were asked about the best means of communicating critical heat wave information to them, preferences in sequence of frequency were 49% TV, 35% radio (see preferred radio stations in table 23), 15% SMS, 9% newspaper, 9% landline phone, 4% mail box and 4% internet.

SMS is less preferred as best means of communication in the over 75 age group (11%) compared to people below 75 years of age (65%) (<75 are almost 7 times more likely to read SMS: OR 6.8 95% CI 3.4, 13.9;  $p < 0.001$ ).

Table 23: Most effective communication methods for heat wave warnings

Outcomes	Weighted counts N=499	Standard error	Confidence interval	Percent
<b>The next few questions are about the best means of communicating heat wave warning information to you? Can you tell me: Would you be likely to see the information if it...N=498</b>				
Was on TV?	403	1.9	76.7,84.1	80.7
Radio	330	2.3	61.6,70.3	66.0
Newspaper	270	2.4	49.4,58.7	54.1
Letter box drop	364	2.2	68.5,77.0	73.0
Internet	109	2.0	18.1,26.1	21.8
SMS	187	2.3	33.0,42.2	37.5
<b>What would be the best means of communicating heat wave warnings to you?</b>				
TV	242	2.4	43.7,53.2	48.4
Radio	172	2.3	30.2,39.1	34.5
<b>Radio stations mentioned: ABC radio national; 891; 5AA; 102.3, 1323,</b>				
Newspaper	44	1.4	6.5,12.0	8.9
Mail box	18	0.8	2.3,5.7	3.6
Internet	17	1.0	2.0,5.9	3.5
SMS by mobile phone	76	1.7	12.07,19.0	15.2
Other	12	0.8	1.3,4.6	2.5
<b>Other responses included: Mainly landline, 'normal phone'; word of mouth; CFS; in church; microphone in village</b>				
Don't know	10	0.8	1.1,3.5	2.0
Landline phone	47	1.4	6.9,12.5	9.4

### 3.11 Relationship between heat health outcomes and risk factors

In this section the relationships between heat health effects experienced during recent heat events and potential risk factors are explored. Also, risk factors potentially related to resilience responses and behaviours are investigated.

Bivariate analysis indicated a large number of potential risk factors (at  $p < 0.2$  level) which are tabulated in Table 24. Taking medication for pre-existing illnesses (mainly heart failure, heart attack, diabetes, respiratory-related and mental health), a reduced health status, gender, mainly being female, increasing age, need of help in the household, transport problems, reduced social interaction, use of mobility aids and reduced income were all associated with a number of health outcomes. Taking medication for chronic diseases and a range of other aforementioned risk factors were also related to behaviours during recent heat waves.

Table 25 shows the risk factors that were significantly related to outcomes in the final multivariate analysis. The results strongly indicate that relevant pre-existing illnesses requiring prescribed medications (for mental health, heart failure, diabetes and respiratory health) were strongly correlated with health outcomes reportedly experienced by the survey participants in recent heat waves. Overall, health status was an important factor indicating that people whose health status was fair to poor had an increased risk of experiencing symptoms during extreme heat. Females were more at risk of having had one or more symptoms during recent heat waves. Survey responders who were at risk of ill health during recent heat waves were also more likely to use mobility aids and needed help in the household.

The confluence of reduced health status, use of mobility aids and taking medication for respiratory and mental health problems was also relevant in relation to responders for whom extreme heat is of great concern and who believed themselves to be more at risk during extreme heat than the average person of their age.

Increasing age, taking medication for diabetes and having reduced social contact predicted a reduced recall of health messages. Those with reduced income and taking mental medication were more likely not to change their behaviour after extreme heat warnings.

Those that had reduced social contacts and females were less confident to ask for help from friends and neighbours than those having more frequent contacts. People with reduced social contact and reduced income were less confident to contact family members.

**Table 24: Bivariate relationships between health and behaviour outcomes (dependant variables) and risk factors (independent factors).**

Outcomes	Risk factors
Experienced anxiety during heat waves in the last few years	Increased risk: reduced health status; taking medication for heart failure, for mental health, use of mobility aids.
Experienced loss of balance during heat waves in the last few years	Increased risk: reduced income, living in the country; reduced health status, taking medication for heart failure; mental health, need of help in household; less than two phone calls in the last week; use of mobility aids.
Experienced a fall during heat waves in the last few years	Increased risk: increased age, reduced health status, taking medication for diabetes, heart failure.
Experienced headaches during heat waves in the last few years	Increased risk: females; younger age, taking medication for mental health
Experienced shortness of breath during heat waves in the last few years	Increased risk: increasing age; reduced income, metro living, reduced health status, taking medication for heart failure, for respiratory health, help in household needed, transport access problems, reduced social interaction (going out for a visit) use of mobility aids, living alone.
Experienced heat stress during heat waves in the last few years	Increased risk: females, living in the country, reduced health status, taking medication for diabetes, heart failure, heart attack, kidney problems, for mental health, help in household needed, less than two social interactions (phone, contact), mobility aids needed.
Experienced a heart condition during heat waves in the last few years	Increased risk: increasing age; reduced health status, taking medication for heart failure, for heart attack, help in household needed, less than two social interactions in the last week(phone), use of mobility aids.
Experienced 'something else' during heat waves in the last few years	Increased risk: females, reduced health status taking medication for diabetes.
One or more of the above symptoms	Increased risk: females, age, reduced income, reduced health status, taking medication for diabetes, heart failure, for heart attack, for respiratory health, for mental health; help in household needed; less than two social interactions in the last week (visit outside), use of mobility aids.
Extreme heat is a concern for health	Increased risk: decrease in health status; taking medication for heart attack, kidney disease, respiratory health; mental health, help in household needed; less than two social interactions in the last week(phone); use of mobility aids



Feeling more at risk during extreme heat than other people of the same age	Increased risk: decrease in health status; taking medication for diabetes, heart failure, for mental health, help in household needed, use of mobility aids.
No recall of health messages	Increased risk: male, increasing age, medication for diabetes, help in household needed, access to transport problems, minimal social interactions (personal contact), use of mobility aids, living alone.
Not changed behaviour after heat health warnings	Increased risk: females, decreasing income, no A/C, taking medication for diabetes, high blood pressure, respiratory health, mental health, less than two social interactions in the last week (visit outside)
Worried about blackouts during extreme heat	Increased risk: increase in age, living in the city, having A/C.
Well prepared for extreme heat	Increased risk: females, people 75 and older
Not-somewhat prepared	Increased risk: males, transport problems, , less than two social interactions in the last week(contact).
Not confident calling friends and neighbours	Increased risk: females, no A/C, problems with access to transport, less than twice a week social interactions (personal contact).
Not confident calling on family members	Increased risk: decreased income, decreased health status, less than twice a week social interactions (phone, in person).

Table 25: Multivariate analysis

Risk Indicator variables OR (95%CI) p-value		
Anxiety	Medication(M) mental health	6.1 ( 2.5,15.1) p<0.001
	use of mobility aid	3.2 (1.3,7.8) p=0.009
Loss of balance/dizzy	Reduced health status	2.6 (1.3,5.3) p=0.009
	income	1.8 (1.1,3.0) p=0.033
	M for heart failure	2.6 (1.0,7.1) p=0.06
A fall	M for diabetes	4.3 (1.3,14.4) p=0.02
Headache	Reduced health status	2.0 (1.0,3.8) p=0.04
	M for mental health	2.7 (1.2,6.0) p=0.014
Shortness of breath	Reduced health status	2.4 (1.28,4.6)p=0.007
	M for heart failure	3.5 (1.7,7.3) p=0.001
	M for respiratory problems	3.5 ( 1.6,7.4) p=0.001
	Help in household	1.9 (0.95,5.7) p=0.07
	Using mobile aids	2.9 ( 1.5,5.8) p=0.002
Heat stress	M for mental health	4.6 (2.2,9.4) p<0.001
	Use of mobile aids	2.3 (1.2,4.4) p=0.01
Heart condition	M for heart failure	34.1 (11.48,101.6) p=<0.001
	Help in household needed	2.7 (0.90,8.0) p=0.08
Something else	Gender (females)	4.0 (.2, 12.7) p=0.02
	diabetes	3.1 (1.3, 7.7) p=0.015
Any of the above symptoms	Gender (female)	1.6 (1.02,2.4) p=0.04
	Reduced health status	2.2 (1.4,3.5) p=0.001
	M for heart failure	2.4 (1.2, 4.8) p=0.02
	Use of mobile aids	1.8 (1.0,3.0) p=0.04
Extreme heat a concern	M for respiratory problems	1.9 (0.98,3.6) p=0.06
	M for mental health problems	2.7 (1.4,5.4) p=0.004
More at risk during extreme heat	Reduced health status	2.3 (1.3, 4.4) p=0.008
	Use of mobile aids	2.2 (1.1,4.3) p=0.02
Recall of health messages (No versus yes)	Age	1.09 (1.05,1.1) p<0.001
	Diabetes	2.2 (1.2,4.1) p=0.02
	Contact in person less than twice in the last week	1.7 (1.2-5.9) p=0.02
Not changed behaviour after warnings	Decreasing income	1.6 (1.1,2.2) p=0.02
	M for mental health issues	3.1 (1.4,6.7) p=0.005
Not confident calling friends and neighbours	Contact in person less than twice in the last week	2.8 (1.4,5.7) p=0.006
	Gender (females)	1.8 (1.01,3.3) p=0.045
Not confident to contact family member	Phoned with people less than twice in the last week	6.1 (2.4,15.9) p=<0.001
	Decreased income	2.9 (1.2,7.0) p=0.02

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## 4. Discussion

This is the first study to focus on possible heat-related risk factors for an older, but independently living population (behaviours, environmental and health status-based) in South Australia. This subpopulation was chosen because older people had a high incidence of hospitalisation during the 2009 heat wave in South Australia and are known to be more at risk when exposed to extreme heat.<sup>1</sup> Considering that climate change may over a period of time increase the frequency and the duration of extreme heat days, it is important to find out about what causes problems and what helps to prevent adverse effects. There have been a number of studies which have explored possible risk factors following major heat waves in other countries,<sup>7, 8, 9</sup> but the identified factors may not necessarily coincide with those in Australia. This study aimed to glean information from older people about their behaviours, perceptions and pre-existing illnesses using a representative population sample. Questions were formulated based on a preceding qualitative study which used interviews and focus group discussions with policy makers and health care providers engaged in care for older people to elicit relevant themes. The qualitative study extracted four broad themes that were utilised in the survey. They were age-related physiology and health problems, socio-economic factors, psychologically-based issues and adaptive behaviours.<sup>4</sup>

Gender, area (metropolitan versus country) and age of the SA general population were used for calculation of survey weights. When the weighted and unweighted percentages of age group and area were compared, only minor discrepancies were seen indicating that the survey results reflect the age group distribution in the general population. In relation to gender, the survey results show that females were more compliant with participating in the study or were more likely to be at home during survey calls than males. To further assess the generalizability of the survey, the frequency distribution of the health status variable in this survey was compared with the results obtained in a 2011 SA survey in the 65 and over age group (personal communication with the Population Research and Outcome Studies, Discipline of Medicine University of Adelaide). The health status categories results were similar for both surveys indicating that the selection process for this survey produced results that are generalizable to the general population of people 65 and over who have a landline, who speak English and who live independently. Caution should be taken when only few people responded to a question.

Presence of an A/C has been shown to be highly protective of heat-related illness and mortality in studies elsewhere.<sup>7, 8, 9</sup> While the survey results indicate that 95% of South Australians have an A/C, some short-comings have also been identified. The survey showed that 5% of older people in South Australia do not own an A/C, 67% do not have one in the bedroom, 35% of A/C were 10 years and older and only 31% were serviced regularly. Forty two per cent of respondents had fair to major concerns about the cost of using an A/C and 21% said that they hesitate to use it because they can't afford it. There were 18.5% of respondents who reported having their reverse cycle air conditioner on the wrong setting one or more times.

Air conditioning can provide effective shelter from heat, but can be expensive to operate; older people with an air conditioner should be encouraged to use it during extreme heat. Furthermore, installation of blinds, awnings or outdoor shutters have been recommended for keeping houses cool during heat waves<sup>10</sup> but in our study only 61% of older people claimed to have window shades. In terms of long term planning, sustainable cooling methods for housing such as outside shutters should be high on the agenda as some argue that relying on air-conditioning alone is not a sustainable option in the longer term, and may place householders at risk if power outages occur during times of peak electricity demand.<sup>11</sup>

The survey indicated that there is a high prevalence of older people who undertake adaptive behaviours during heat waves. The majority of responders have concerns when a heat wave is forecast (72%), but overall make good decisions that have the potential to relieve heat exposure including wearing cooler clothes (91%), use of indoor blinds or curtains (92%), avoiding physical effort (82%), avoidance of sun exposure (95%), reduction of outdoor activities (95%), opening up the house for a cool breeze in the evening (93%), and drinking more liquids (91%). Nevertheless, this still leaves a sizeable percentage of older people who may not consider themselves at risk and hence may not undertake preventive behaviours. The vast majority of older people seem to keep their regular appointments (95%) and undertake their regular activities during a heat wave (74%) which has the potential to adversely affect their health in extreme circumstances. Preventive messages may need to emphasize that it is acceptable to change appointments and activities in the event of extreme weather.

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Of people who have pets, 84% had some to major concerns during heat waves. It may be useful to have pertinent information available for pet owners about caring for pets during the heat.

During recent heat waves, 30% of older people were contacted regarding their welfare by phone and 18% were visited during these periods. Fifteen per cent of older people felt not confident to call on friends or neighbours, and 8% to call on family members if they needed help in the event of a major heat wave. Furthermore, there were 11% of older people who phoned or talked in person (with other people) less than twice in the week prior to the survey, and 10% who went out less than twice per week indicating some level of social isolation among older people in South Australia. This is an area of concern, particularly as social isolation puts people at risk during extreme heat, especially if they have pre-existing ill health or are in need of mobile aids. Overseas studies have clearly shown that social connectedness is an indicator for reduced risk of mortality during extreme heat.<sup>8, 12</sup> On the positive side, people 75 years and over received more check-up calls and were visited more often during heat waves than those below 75 years of age indicating heat health awareness by family, friends and neighbours. People and agencies dealing with those vulnerable to extreme heat events need to remain vigilant as to the potential for heat-related effects, especially older people with pre-existing diseases, those with limited social networks and/or people living alone. To this end various agencies in SA have already put in place programs that promote the need to check on older residents such as the registration service for phone support during extreme heat by the Red Cross (Telecross REDi).

Survey results indicated that 8% of older people in SA do not drink more fluids when the weather is very hot. Reasons for this were not feeling thirsty, not wanting to visit the toilet more often, or their doctor had advised fluid restrictions. A similar prevalence of 6% of people in the general population ( $\geq 18$  age group) was found to not increase their water intake in a NSW survey.<sup>13</sup> This raises issues of potential dehydration, especially for the older subgroup. It is well known that it is necessary to sweat in order to lower body temperature when ambient heat levels exceed the body temperature. Due to physiological changes, elderly people are less able to sweat, they do not feel the heat and have health problems that also contribute to the reduced ability to perspire. In addition, older people are more likely to take medications that reduce the ability to sweat.<sup>14</sup> This has also been demonstrated in this survey in relation to the type and prevalence of medications older people were taking. Diminished fluid intake can cause acute renal and coronary outcomes. Hence, it is important to pass on the right health messages that explain the biological causal relationships in an easy to understand manner and provide concise advice about how to effectively reduce the risks by adopting adaptive measures. A number of adaptive behaviours that helped survey participants during the 2009 heat wave were A/C, appropriate clothing, staying inside, drinking more fluids, reducing physical activities, using a fan and going somewhere cooler.

Fair to poor health status was identified in 25% of the study population. Seventy four per cent of this population were taking medication for one or more chronic diseases, with high blood pressure and heart-related issues being the most prevalent diseases, followed by diabetes, mental and respiratory health issues. All of these chronic conditions have the potential to interact adversely with extreme heat. Some of this older population was also in need of assistance in the household (38%) and use mobility aids (17%). Using a multivariate analysis, these risk factors were identified as being significantly associated with health effects experienced during recent heat waves. These relationships are in line with findings from a number of overseas studies. Presence of chronic diseases, reduced social contacts, reduced access to transport and reduced mobility were all significantly associated with felt and objective morbidity during severe heat waves in France, US and Canada.<sup>7, 9, 12, 15, 16</sup> Of the medications used by participants in this survey, cardiovascular-related medications were highly associated with having had health symptoms during recent heat waves. Significantly increased hospital admissions for ischaemic heart disease during the 2009 heat wave in Adelaide and the observation of increased myocardial infarction during raised temperatures in Melbourne in men below the age of 65 years of age, raises an urgent need to look at effective prevention of cardio vascular-related disease during extreme heat in Australia.<sup>3, 4</sup>

Heat waves have an effect on health in the older age group, with loss of balance being the most common effect, followed by shortness of breath, heat stress and headache. This is in line with current evidence indicating that physical and physiological pre-existing factors increase the risk of illness during extreme heat in this age group.<sup>4, 14</sup> However, many people (82%) did not feel that they were more at risk compared to their age peer group and 47% felt that extreme heat is of no or little concern for their health. This indicates that older people may be over confident and may not know enough about the potential risks.

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While 76% of older people remembered health messages associated with heat waves, this recall was significantly reduced in the 75 and older age group challenging the one size fits all approach of health warnings. Radio and television were the main sources for hearing about heat warnings and they were voted to be the best means of communicating warnings, but SMS was also considered (15%). Interestingly, only 9% of participants considered newspapers to be the best means of effective communication. However, despite hearing the warnings, 64% of people said that they never or only sometimes changed their behaviours. This optimism in older people about their health in the face of extreme heat has also been shown in a UK study, where older people (72-94 years old) expressed their confidence in themselves and their heat-related behaviours.<sup>17</sup> This warrants special attention of the older people when formulating health promotion strategies.

In conclusion, this survey was undertaken to investigate behaviours, perceptions and risk factors related to recent experiences with extreme heat periods in older people in SA. Overall, the target population was informed about risks associated with heat and demonstrated good adaptive behaviours, but there was also a sizable group which did not see themselves as vulnerable and which did not engage in behaviour change. The survey indicated that 25% of older people have a fair to poor health status and 74% took medication for chronic health conditions with the numbers increasing in the 75 and over age group. These self-reported health problems, especially use of cardiovascular-related medications, were strongly correlated with health problems experienced during recent heat waves. Other risk factors impacting on having experienced health issues were the need for mobility aids and needing help in the household. The results of this survey indicate a number of risk factors amenable to prevention through targeted education and policy development. Lead agencies in various jurisdictions have begun this process, including both web-based and traditional media casting approaches. The early extreme heat warning system for metropolitan SA brings together government and non-government agencies on a regular basis and provides a forum for discussion and implementation for short and long-term preventive community responses

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## 6. References

1. Nitschke, M.; Tucker, G.; Hansen, A.; Williams, S.; Zhang, Y.; Bi, P., Impact of two recent extreme heat episodes on morbidity and mortality in Adelaide, South Australia: a case-series analysis. *Environmental Health* **2011**,*10*, doi:10.1186/1476-1069X-1110-1142.
2. Hansen, A.; Bi, P.; Nitschke, M.; Pisaniello, D.; Newbury, J.; Kitson, A., Older persons and heat-susceptibility: the role of health promotion in a changing climate. *Health Promotion Journal of Australia* **2011**,*22*, 17.
3. Loughnan, M. E.; Nicholls, N.; Tapper, N. J., When the heat is on: Threshold temperatures for AMI admissions to hospital in Melbourne Australia. *Applied Geography* **2010**,*30*, 63-69.
4. Hansen, A.; Bi, P.; Nitschke, M.; Pisaniello, D.; Newbury, J.; Kitson, A., Perceptions of heat-susceptibility in older persons: barriers to adaptation. *International Journal of Environmental Research and Public Health* **2011**,*8*, 4714-4728.
5. Australian Bureau of Statistics Population by Age and Sex, Regions of Australia, 2009.
6. Stata Statistical Software Version Release 10. College Station: TX StataCorp.
7. Semenza, J. C.; Rubin, C. H.; Falter, K. H.; Selanikio, J. D.; Flanders, W. D.; Howe, H. L.; Wilhelm, J. L., Heat-related deaths during the July 1995 heat wave in Chicago. *N Engl J Med* **1996**,*335*, 84-90.
8. Naughton, M. P.; Henderson, A.; Mirabelli, M. C.; Kaiser, R.; Wilhelm, J. L.; Kieszak, S. M.; Rubin, C. H.; McGeehin, M. A., Heat-related mortality during a 1999 heat wave in Chicago. *Am J Prev Med* **2002**,*22*, 221-227.
9. Vandentorren, S.; Bretin, P.; Zeghnoun, A.; Mandereau-Bruno, L.; Croisier, A.; Cochet, C.; Riberon, J.; Siberan, I.; Declercq, B.; Ledrans, M., August 2003 heat wave in France: risk factors for death of elderly people living at home. *Eur J Public Health* **2006**,*16*, 583-591.
10. Health Canada *Extreme Heat Events Guidelines: Technical Guide for Health Care Workers*; Ottawa, Ontario. **2011**.
11. Maller, C. J.; Strengers, Y., Housing, heat stress and health in a changing climate: promoting the adaptive capacity of vulnerable households, a suggested way forward. *Health Promot Int* **2011**.
12. Bouchama, A.; Dehbi, M.; Mohamed, G.; Matthies, F.; Shoukri, M.; Menne, B., Prognostic factors in heat wave related deaths: a meta-analysis. *Arch. Intern. Med.* **2007**,*167*, 2170-2176.
13. Oakman, T.; Byles-Drage, H.; Pope, R.; Pritchard, J., Beat the Heat: don't forget your drink - a brief public education program. *Aust. N. Z. J. Public Health* **2010**,*34*, 346-350.
14. Wilson, L.; Black, D.; Veitch, C., Heat waves and the elderly - The role of the GP in reducing morbidity. *Aust Fam Physician* **2011**,*40*, 637-640.
15. Larrieu, S.; Carcaillon, L.; Lefranc, A.; Helmer, C.; Dartigues, J. F.; Tavernier, B.; Ledrans, M.; Filleul, L., Factors associated with morbidity during the 2003 heat wave in two population-based cohorts of elderly subjects: PAQUID and Three City. *Eur J Epidemiol* **2008**,*23*, 295-302.
16. Kenny, G. P.; Yardley, J.; Brown, C.; Sigal, R. J.; Jay, O., Heat stress in older individuals and patients with common chronic diseases. *CMAJ* **2009**,DOI: 10.1503/cmaj.081050.
17. Abrahamson, V.; Wolf, J.; Lorenzoni, I.; Fenn, B.; Kovats, S.; Wilkinson, P.; Adger, W. N.; Raine, R., Perceptions of heat wave risks to health: interview-based study of older people in London and Norwich, UK. *J Public Health (Oxf)* **2009**,*31*, 119-126.



For more information

**Adaptive capabilities in the elderly during  
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**Public Health and Clinical Systems**  
**Scientific Services**  
**Level 1/ 11 Hindmarsh Square**  
**Telephone: 82267126**

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