

# **Heating Up: Exploring Motivation and Experiences of Independent At-Home Living Elderly in Adopting Health Protective Behaviours during Heatwaves**

Master Thesis

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## **Abstract**

**Background:** Global temperatures all over the world are rising, causing more heat waves in the summers. Especially for elderly, this can have adverse health effects. To handle the heat and prevent adverse health effects health protective measures can be taken, however elderly do not always follow these measures. The Extended Parallel Processing Model (EPPM) explains that a lack of perceived threat of the heat or lack of perceived efficacy in executing the health protective measures can lead to not being motivated to take effective action (Witte, 1998).

**Aim:** The aim of this study was to explore the experiences with and motivation to engage in health protective behaviours of independent at-home living elderly.

**Method:** 12 elderly adults living in the Dutch city of Enschede were interviewed (six individual interviews and three interviews with a couple). All had a semi-structured interview scheme based partly on the EPPM. A thematic analysis was done to identify patterns in the data.

**Results:** Some elderly perceived the heat as nice, whereas others found it strenuous. Elderly did not deem themselves susceptible to the heat. They knew about health protective measures and executed most of the measures they knew about, such as drinking extra water and avoiding physical strain. However, financial barriers were present for using air conditioning for example. Elderly would like to be reached with health protective measures via television or newspapers.

**Conclusion:** Elderly have different experiences with the heat, indicating that their circumstances, such as housing, influence how well they are able to handle the heat. Although elderly are aware of health protective measures, they seemed to be unaware of the health risk heat poses. Perceived threat of the heat could be increased with an appropriate form of fear appeal to instigate elderly to use health protective measures against the heat.

## 1. Introduction

Due to climate change the average global temperatures have been rising all over the world, in the Netherlands as well. One of the most pressing issues is the heat and heat waves during summer. When temperatures are above 25 degrees Celsius for a prolonged period of time people can be negatively affected by the heat, especially for elderly over 75 years in age it is a health risk (Rijksinstituut voor Volksgezondheid en Milieu, 2015). Taking into account that extreme or prolonged heat is appearing more often and the global population is aging (Meade et al., 2020), empowering elderly to take protective measures against the heat is important.

### Elderly at risk

Many negative health effects caused by heat are known and can affect elderly worse than younger people. Examples of health issues caused by heat are heat stroke, acute myocardial infarction and ischemic stroke (World Health Organisation, 2018). Heat can cause negative health effects that can be put in four different categories: 1) *Heat illness*, 2) *Cardiovascular disease*, 3) *Fluid and electrolyte balance and kidney function*, and 4) *Other* (such as fatigue, death or worsening of chronic conditions). A full overview of the illnesses and injuries can be found in Appendix A. Elderly especially are at risk for these negative health effects in times of heat due to their declining body functions (Meade et al., 2020) and the higher prevalence of comorbidities among elderly (Rijksinstituut voor Volksgezondheid en Milieu, 2015). The declining body functions can be put into three categories: 1) *Thermoregulation impairments*, 2) *Cardiovascular impairments*, and 3) *Fluid regulation impairments* (Meade et al., 2020). A full overview of the impairments per category can be seen in Table B1 in Appendix B. Comorbidities can also make elderly more vulnerable to heat, although they can also cause elderly to be dependent on others, which in turn can hinder them in adapting to heat as they are not able to take measures themselves (Malmquist et al., 2022). As such, elderly are in particular at risk for experiencing negative health effects due to heat.

To reduce the dangers caused by heat, health protective measures can be taken. An overview of the measures prescribed by the Dutch National Institute for Public Health and the Environment (RIVM) can be seen in Table 1. Health protective measures can be taken on an individual level, as well on a community level (Casanueva et al., 2019). On an individual level the health protective measures can be divided into the following five categories: 1) *increasing hydration*, 2) *adjust activity*, 3) *keep yourself cool*, 4) *take care of each other*, and 5) *keep your house cool* (Rijksinstituut voor Volksgezondheid en Milieu, 2015; World Health Organisation, 2018).

**Table 1***Individual measures to be taken to prevent health risks due to heat*

Category	Measure
Increase hydration	Drink enough fluids
	Drink less alcohol
	Always bring a water bottle when going out
Adjust activity	Avoid physical strain
	Do your groceries our daily walk in the early morning or in the evening
Keep yourself cool	Stay out of the sun
	Stay in the shadows
	Use white hats or other protective head wear when you have to be in the sun
	Wear thin and comfortable cotton clothes
	Take a (foot)bath or a shower
Take care of each other	Do not sleep under too warm covers
	Take care of each other: keep an eye out for people in your environment who might need some help.
Prevent your house from getting too hot	Use blinds
	Ventilation is important: keep rosters open and open windows. Do this extra when it is colder outside. Also do this for your bedroom.
	Use a fan
	Use air conditioning

*Note.* Source: Rijksinstituut voor Volksgezondheid en Milieu (2015)

While all elderly adapt in one way or another, not every measure is executed by the vast majority of the elderly, as research among independent-living elderly in Cologne found (Kemen et al., 2021). For example, while almost all elderly adjusted their clothing, only about four out of five drank more fluids and less than half turned on a fan (Kemen et al., 2021). Reasons for elderly not to engage in drinking enough water in times of heat can be considering the guideline of how much to drink as unachievable, having misconceptions about these guidelines or not considering them important (Bhanu et al., 2019). Yet, little is known about this for many of the other guidelines, let alone in the Netherlands. On a community level, measures such as educational campaigns, media announcements and assistance for people with limited resources (Casanueva et al., 2019) can be employed. Other measures taken in heat health warning systems are media announcements, bulletins or webpages, leaflets, a telephone help-line and the opening of cooling centres (Kovats & Kristie, 2006). However, it is unclear which measures seem to appeal to elderly, which ones are effective and how messages and information regarding heat should be delivered.

## The Extended Parallel Processing Model

To explain why people accept or reject guidelines that are communicated to them through a message, the Extended Parallel Processing Model (EPPM) from Witte (1992) can be employed. It includes that the unpleasant sensation of fear drives the subject to react either emotionally or cognitively, which is based upon a threat appraisal and coping appraisal. To summarize the EPPM, four core constructs can be detected in the EPPM: 1) *fear*, 2) *threat*, 3) *efficacy*, and 4) *response* (Popova, 2012). The first construct, *fear*, is the underlying construct, as the EPPM aims to predict when and why a fear appeal message will or will not succeed in changing behaviour (Popova, 2012) and can be described as an emotion that can be provoked by personally relevant threat (Witte, 1998). In relation to heat, it is unclear if and to what extent elderly experience fear and what these fears entail.

The concept of *threat* is about how one evaluates the threat as it is communicated in a message (Popova, 2012) and allows for a threat appraisal. Perceiving threat is a prerequisite for taking action (Witte, 1998). Threat consists of two factors: perceived severity and perceived susceptibility. *Perceived severity* refers to how serious, severe and harmful the implications of the threat or emergency are (Popova, 2012; Shi & Smith, 2016; Witte, 1998). The *perceived susceptibility* on the other hand are specifically about how high one considers the risk of experiencing the threat themselves (Popova, 2012). This perceived susceptibility seems low among elderly in the case of heat, they do not consider themselves vulnerable to heat yet they do consider others elderly or elderly from the same age group extra vulnerable to heat (Howe et al., 2019; Kemen et al., 2021). Another factor influencing the perceived threat are comorbidities, as healthier elderly perceived the risk of heat as lower, whereas less healthy elderly perceived the risk of heat as more dangerous (Eady et al., 2020). Still, little is known about the perceived severity of heat among elderly, just like little is known about the perceived threat as a whole.

The concept of *efficacy* is about how effective, feasible and doable the recommended response is. It concerns thoughts and cognitions regarding these concepts, which manifest in the response efficacy and the self-efficacy (Witte, 1998). *Response efficacy* is how effective the one deems the recommended response to avert the threat (Witte, 1992, as cited in Shi & Smith, 2016). This can become an obstacle for executing health protective measures, an example being elderly believing that fans do not help to reduce indoor temperature (Malmquist et al., 2022) and people that believed air-conditioning to have negative drawbacks used it less often than people who considered it useful (Richard et al., 2011). The *self-efficacy* on the other hand is

about people believing they themselves can execute the recommended response (Bandura, 1977; Shi & Smith, 2016). Resources are a key term here, as limited resources are a barrier in handling the heat (Sampson et al., 2013). Regarding heat, important internal resources are motivation to protect oneself against the heat (Valois et al., 2020) as well as physical limitations and abilities because healthy people are able to adjust better to the heat (Malmquist et al., 2022; Valois et al., 2020). Important external resources are access to equipment and financial resources. Equipment such as air-conditioning, a parasol or pool impacts the intention elderly have to engage in health protective behaviours in times of heat because they have a higher sense of perceived control (Valois et al., 2020). Financial barriers are often recognized in combination with air-conditioning, because it is an excellent way to keep cool, yet it can be costly which limits elderly in having access to one (Malmquist et al., 2022; Sampson et al., 2013; Valois et al., 2020). Furthermore, the control panels of air-conditioning can be challenging for elderly, which can even cause them to use it as a heater (Hansen et al., 2011). In short: elderly need to believe the health protective measures are useful and that they are able to execute them by having the abilities and resources to do so. How to enable this on the other hand is still unclear.

The last concept concerns the *response* and according to the EPPM, the perceived threat and perceived efficacy lead to a response to messages in which fear appeals are included. There are three possible responses: no response, fear control and danger control. The latter is the response to aim for. *No response* happens when there is no perceived threat (Witte, 1998). The *fear control response* is about reducing or managing fear instead of the threat (Witte, 1998), which happens when people do perceive a threat although they do not or only slightly perceive efficacy (Popova, 2012). Common fear control responses are defensive avoidance, denial and reactance, although fear responses are considered maladaptive, because subjects fail to protect themselves from a threat (Witte, 1998). A *danger control response* on the other hand can be seen as a cognitive process in which the subject makes a change to avert a risk, in line with the recommendations in the given message (Witte, 1998). To achieve this, people need to perceive a threat and perceive efficacy (Witte, 1998). This danger control response can still be overthrown when the perceived threat exceeds the perceived efficacy (Witte, 1998), when pets are involved in the threat (Sampson et al., 2013), or when social isolation and a lack of social support are present (Eady et al., 2020). However, peers can play a key role in motivating a danger control response (Ashida et al., 2016; Sampson et al., 2013), which means that elderly can motivate their peers to take health protective measures. As such, the role of peers is

important in motivating elderly to take action against the heat, although it is unclear which other facilitators and barriers in executing health protective measures are present.

### **Reaching Elderly**

In addition to having the necessary elements included in a message, conveying the message via the right channels is important to get it across to elderly effectively. Reaching and motivating elderly can be difficult, especially when trying to reach elderly with a low socioeconomic status (SES), a small social network or a non-western ethnicity (Garritsen & Verkaik, 2018). Multiple ways of reaching elderly are known, such as via health care workers, via peers or family, and via internet. Means that can be employed are local media (e.g. television or papers), newsletters, leaflets, posters, or a combination of those (Garritsen & Verkaik, 2018). Reaching elderly via internet can become more common, due to elderly using the internet more often: almost half uses the internet daily, two out of five even search for health information online, and one out of every five elderly aged 75 or over even uses social media (Arends, 2021). However, little is known regarding the preferences of elderly on how they would like to be reached, either via internet or other channels.

### **Scientific Relevance**

The Veiligheidsregio Twente, has taken an interest in reaching elderly to enable following guidelines and adjusting behaviour for reducing heat related issues to improve adherence to health protective behaviours. The Veiligheidsregio Twente is one of the 25 Dutch regional network organisations for emergency services which is situated in the Twente region in the Netherlands. They are concerned with safety of the inhabitants of their region regarding calamities and crisis situations and with heat becoming a more pressing and repetitive issue each year, a safety issue for the inhabitants in Twente has been discovered. When co-ordinated efforts are missed, vulnerable populations are put at risk (Paterson & Godsmark, 2020). Therefore, they would like to know more about what elements to include in their risk communication regarding heat related issues among elderly and how to reach this group to improve health protective behaviours. Especially among independent at-home living elderly, as institutions do not check up on their welfare. With the interests of Veiligheidsregio Twente in mind, this research aims to explore the experiences with and motivation to engage in health protective behaviours of independent at-home living elderly. The EPPM can be useful in this situation to explain behaviour as well as help to design an intervention regarding public health emergence preparedness (Barnett et al., 2014). Yet, too little is known about the perceived threat, the perceived efficacy and what factors influence them in terms of heat. Knowledge about the

awareness of health protective measures and how to reach elderly is also lacking. Therefore three research questions have been defined to explore the experiences with and motivation to engage in health protective behaviours of independent at-home living elderly:

- 1. What are the experiences and perceived threat (perceived severity and perceived susceptibility) of the heat among independent at-home living elderly in the summer of 2022?*
- 2. To what extent are elderly aware of health protective measures and what is their perceived efficacy (response efficacy and self-efficacy) to execute these health protective measures?*
- 3. How should elderly in the city of Enschede be reached to convey health protective measures and to persuade them in executing the health protective measures?*



## **2. Method**

### **Research design**

For this study, a qualitative research design was used. In total 12 elderly people were interviewed in six individual interviews and three interviews with a couple. These interviews followed a semi-structured interview scheme based upon the Extended Parallel Processing Model.

### **Participants & Procedures**

Inclusion criteria were being 70 years or older and living independently in their own house, either by themselves or with a partner in the city Enschede. Exclusion criteria were living in a nursing home or receiving intensive in-home care. To gather participants, elderly were approached on two local markets and invited for participation in the study. Multiple elderly were asked to participate, gathering participants stopped when nine appointments were planned and in total 12 interviewees agreed to participate. If the elderly was/were willing to participate and also met the inclusion criteria, an appointment for an interview was made. Then, the interviewee received a flyer with information about the topic of the study, the name and email address of researcher, if needed a phone number of the researcher, and information on the date and time of the interview. Participants were asked for their name, address and phone number. The interviews took place in the home of the interviewee and lasted between an hour and two and a half hours. Elderly were visited at their homes to reduce the strain of travelling. Additionally, it is easier to make them feel at ease in their own home.

Ethical approval was obtained from the Ethical committee from the Behavioural and Management Sciences of the University of Twente (request number 221261). Furthermore, after being informed about the study, their rights and how the data would be handled the interviewees were asked for their written and oral consent. The informed consent can be found in Appendix C. Only when the interviewee agreed to the informed consent, the interview started. The interviews were audiotaped. At the end of the interview, the interviewee could indicate if they wanted to receive a summary of the results, either by email or by regular mail.

### **Instruments**

An interview scheme was made to ensure information on all necessary topics was gathered, which can be seen in Table 2. Information regarding demographics, the constructs of the EPPM (Witte, 1992, 1998), and on how to reach the elderly was gathered. As such, every question contributed to an answer for one of the research questions. The interviews were structured into

five topics for the participants, which caused the questions to follow each other up logically. The topics were: *demographics*, *experiences with heat*, *health risks*, *heat guidelines*, and *guideline adherence*. The interviews were held in Dutch. Important to note, the examples of health protective measures were only given after asking elderly about their current knowledge on health protective measures to prevent priming. Furthermore, whenever an interviewee said something that could potentially be of importance, the researcher could deviate from the interview scheme by changing up the order of questions or by asking follow-up questions.

**Table 2**

*Questions included in the interview scheme*

Topic	RQ	Category EPPM	Question included in interview scheme
Demographics	-	-	What age are you?
	-	-	Which grade of 1 to 10 would you give your health? Why?
	-	-	Are you under supervision of a doctor or specialist for a chronic condition?
	-	-	What is your highest finished education?
	-	-	Do you own this house?
	-	-	Do you live here alone or (did you live here) with a partner?
	-	-	Did you have an occupation? If so, what?
	-	-	Do you have children or other family members living nearby?
Experiences with heat	1	Response	How did you experience the heat of the previous summer?
	1	Response	Can you describe what you did on a hot day in the previous summer?
	1	Response	How did this differ from a normal day?
	1	Response	How do you deal with the heat?
	1	Response	Which alterations do you do on your days when it is very warm?
Health risks	1	Threat	To what extent do you think the heat comes with health risks?
	1	Threat/awareness	Can you give an example of this?
	1	Threat	To what extent is the heat a risk for you?
	1	Threat	What health risks does the heat bring for you?
Heat guidelines	2	Awareness	Which measures against the heat do you know?
	3	Awareness	How do you know about these measures?
	2	Awareness	What do you think about that?
	-	-	<i>Telling about a few of the measures against the heat: drinking extra water, doing straining activities when it is colder outside, stay out of the sun, using a fan or air conditioning.</i>
	2	Response	To what extent did you execute these measures?
	3	Awareness	In what way would you like to be notified of these measures? And what way preferable not?
	1 & 2	Threat & Efficacy	What do you think about these measures?
Guideline adherence	2	Response	Why or why not would you follow these measures?
	2	Efficacy	To what extent do you think these measures are effective?
	2	Efficacy	To what extent are you able to follow these measures?
	2	Efficacy	What do you need to follow these measures?
	2	Efficacy	What are barriers for you in following these measures?
	2	Efficacy	What measures are easy to execute for you?
Round-up	-	-	Is there anything that I missed and that you would still like to tell me?

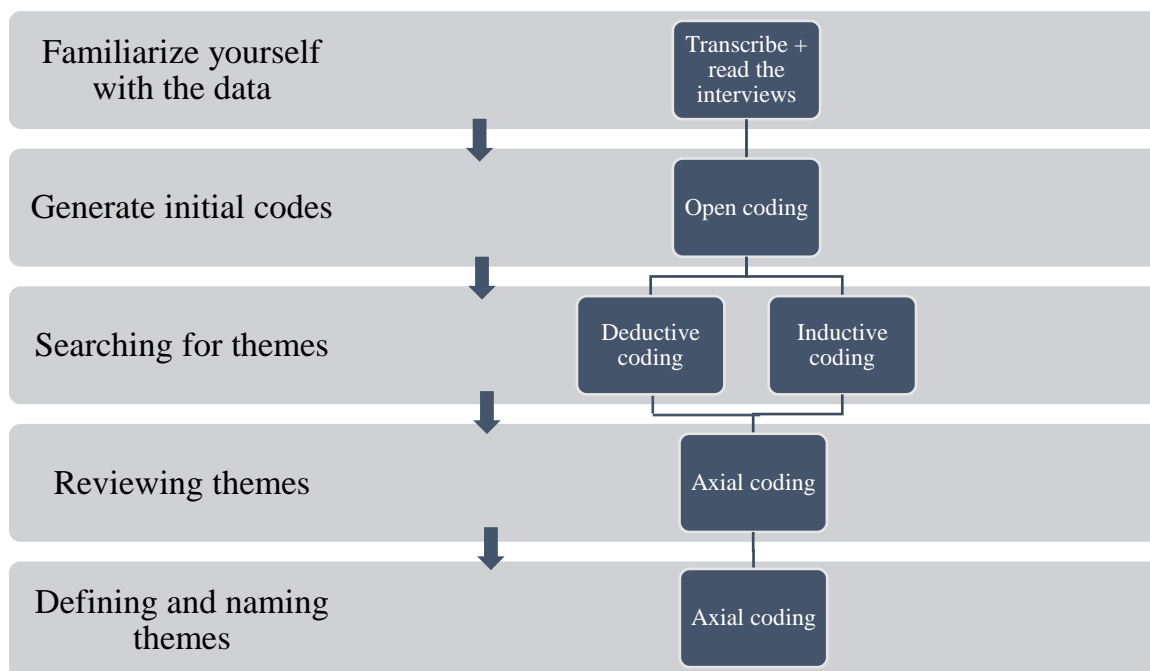
## Data analysis

The audio recordings of the interviews were transcribed. Names were immediately anonymized in the transcripts and contact information was removed from the files that included the interview data. With the use of Atlas.ti a thematic analysis was carried out, which can be used for “identifying, analysing and reporting patterns (themes) within data” (Braun & Clarke, 2006). According to Braun and Clarke (2006), thematic analysis can be done in six steps: 1) *familiarizing yourself with your data*; 2) *generating initial codes*; 3) *searching for themes*; 4) *reviewing themes*; 5) *defining and naming themes*; and 6) *producing the report*.

An overview of the steps from the thematic analysis can be seen in Figure 1. To *familiarizing yourself with your data* the interview data was transcribed and read several times. Then, to *generate initial codes* open coding was employed in which interview data were selected and divided into fragments (Boeije, 2010). These fragments were compared to each other and grouped in categories that were linked to the research questions. *Searching for themes* was done by both deductive coding and inductive coding. The deductive coding was employed which makes use of pre-existing knowledge based on previous literature (Braun & Clarke, 2006), in this case the EPPM. This resulted in the codes *Threat (perceived severity)*, *Threat (perceived susceptibility)*, *Efficacy (self-efficacy)*, *Efficacy (response efficacy)*. Inductive coding took place in addition to deductive coding to find themes unrelated to the EPPM, as it is said to be data-driven: without trying to fit the data in pre-existing ideas, themes were identified (Braun & Clarke, 2006). The steps *reviewing themes* and *defining and naming themes* took place via axial coding, which could be used to find categories and subcategories among the codes (Boeije, 2010). An overview of the final categories is seen in Table 3 below. Categories were made, merged, separated and changed until no new links or new categories appeared. The last step, *producing the report*, is the results section of this study.

**Figure 1**

*Overview of the thematic analysis*



**Table 3***Overview of codes*

Theme	RQ	Definition	Subtheme		Codes
Awareness	2	What the interviewee knows about health protective measures against heat. This includes oftentimes the health protective measures the interviewee is aware of.	-		<ul style="list-style-type: none"> <li>• Health protective measures known</li> <li>• Health protective measures executed</li> </ul>
Experiences	1	The interviewee tells about their experiences with the heat and their behaviours	Heat experiences	The experiences the interviewee had with heat and the perceptions of heat.	<ul style="list-style-type: none"> <li>• Positive heat perceptions</li> <li>• Negative heat perception</li> <li>• Neutral heat perceptions</li> <li>• Effects of heat</li> <li>• Previous heat experiences</li> <li>• Activities on warm days</li> </ul>
			Behaviour	The behaviours of the interviewee in times of heat.	
Beliefs	1 + 2	Included are beliefs the interviewee has regarding heat, its effect on health and the health protective measures against heat. Factors that enable or hinder the interviewee in executing HPM are included as well.	Heat threat	Danger and/or threat caused by the heat as perceived by the interviewee	<ul style="list-style-type: none"> <li>• Perceived severity</li> <li>• Perceived susceptibility</li> </ul>
			Efficacy of HPM	The efficacy and capability to cope with the heat as perceived by the interviewee	<ul style="list-style-type: none"> <li>• Response efficacy</li> <li>• Self-efficacy <ul style="list-style-type: none"> <li>○ Facilitators</li> <li>○ Barriers</li> </ul> </li> </ul>
Reaching elderly	3	Comments of the interviewee regarding how they can and would like to be reached for information regarding health protective measures.	-		<ul style="list-style-type: none"> <li>• Communication: media</li> <li>• Communication: people</li> <li>• Logical thinking</li> <li>• Thoughts on communication</li> </ul>

### **3. Results**

#### **Description of the study group**

An overview of the characteristics of the interviewees can be seen in Table 4. Half of the interviewees were female and half were male, with the oldest interviewee was 82 and the youngest was 73. There were only two types of living situations among the participants: either together with a spouse or alone because the spouse had passed away. The type of housing differed between apartments and houses. Some rented, others had bought their residence. Most interviewees were able to keep their house relatively cool as they mentioned that in the interviews. Even though some were able to keep their house relatively cool, there were different individual experiences in how the interviewees perceived the heat.

**Table 4***Demographics*

Interviewee	Gender	Age	Partner	Living situation	Type of house	Owning or renting	Was able to keep house cool	Perceived heat as
1	female	82	Widowed	Alone, spouse passed away	Appartment	Renting, social housing	Medium	Strenous
2	Male	79	Widowed	Alone, spouse passed away	House	Owning	Yes	Positively
3	Male	75	Married interviewee 4	to With spouse,	Appartment	Renting	Medium	Neutral
4	Female	74	Married interviewee 3	to With spouse	Appartment	Renting	Medium	Strenous
5	Male	83	Widowed	Alone, spouse passed away	House	Renting, social housing	No	Neutral
6	Male	76	Married interviewee 7	to With spouse	House	Owning	Yes	Positively
7	Female	74	Married interviewee 6	to With spouse	House	Owning	Yes	Positively
8	Female	76	Widowed	Alone, spouse passed away	Appartment	Renting, social housing	No	Strenous
9	Male	76	Widowed	Alone, spouse passed away	House	Owning	Yes	Strenous
10	Female	83	Widowed	Alone, spouse passed away	Appartment	Renting, social housing	No	Positively
11	Male	74	Married interviewee 12	to With spouse	House	Owning	Yes	Neutral
12	Female	73	Married interviewee 11	to With spouse	House	Owning	Yes	Neutral

## Experiencing heat & perceived threat

The experiences and the experienced perceived threat of the heat differed among elderly, as can be seen in Table 5. An overview of the activities they engaged in on a warm day can be seen in Table 6. Most experiences elderly had with the heat were neutral and had to do with being able to handle the heat. Positive experiences mostly included enjoying the heat or enjoying the activities during the heat, whereas negative experiences were more about the struggles with heat. The interviewees with negative experiences all lived in an apartment. During those warm days, elderly mostly went about their day and adjusted to the heat when necessary. Elderly took it easy on warm days, they mostly engaged in indoor activities. It was mentioned they did not do anything “crazy”, meaning activities with a lot of physical strain. When they did engage in activities with more physical strain, they were likely to do these activities in the early morning or later in the evening.

**Table 5**

### *Heat experiences among elderly*

Main code	Example quote	Mentioned in number of interviews
<b>Neutral perceived heat</b>		
Able to handle the heat	<i>“We will adjust very well to the heat.” - Interviewee 3</i>	6
Did not experience heat as bothersome	<i>“I can believe that there are plenty of people that detest the heat or who always have a hard time when it very warm. Well, I do not.” - Interviewee 2</i>	5
Did experience heat	<i>“Sometimes, it was very hot. But it did not kill us and we did not feel very lousy.” - Interviewee 10</i>	5
<b>Positive perceived heat</b>		
	<i>Interviewee 6: “A bit of reading and watching the news. And suddenly you think, oh, I might have fallen asleep.” Interviewee 7: “It is delightful.”</i>	3
<b>Negative perceived heat</b>		
Heat affects life	<i>“It’s difficult to fall asleep. And in the morning, you wake up early.” - Interviewee 4</i>	2
Heat is bothersome	<i>“For me, summer is a period to survive.” - Interviewee 8</i>	3

**Table 6**

### *Activities for warm days*

Type of activity	Quote	Mentioned in number of interviews:
Social activity	<i>“Or sometimes, you’ll have a cup of coffee with some others who live in this building. That’s also nice, you know?” - Interviewee 1</i>	7
Physical activities	<i>“When you are cycling, it isn’t that bad, the temperature. There is a little bit of wind.” - Interviewee 9</i>	7
Chores	<i>“I did not do anything special, so I would do some dusting for example.” - Interviewee 9</i>	6
Hobbies	<i>“We did not have to do a lot. [...] Well, I pick up a book and we like to read. And you play Bridge.” - Interviewee 12</i>	6
Resting	<i>“I have these wooden loungers, which I put in the shadows. In the afternoon I then take a nap sometimes.” - Interviewee 2</i>	3



The assessment of the perceived threat as mentioned by the interviewees can be seen in Table 7. Most interviewees did not consider the heat to be a severe threat. The interviewees were quick to answer that it might be dangerous for other people with a co-morbidity or other, older, people. Risks they knew about were hydration, sunstroke, heat being tough on your heart/lungs/blood pressure, and also death. In addition to heat being a health risk, the sun was mentioned to pose a risk to one's health. Still, positive effects of the heat were mentioned, such as getting enough vitamin D. Some of the interviewees mentioned to be unsure how susceptible they were to the health risk heat poses, while others mentioned that the heat was no risk for them. Reasons for this were not considering the heat a risk at all, considering themselves as able to handle the heat, or taking health protective measures. Interviewees that did consider the heat to be a health risk which they were susceptible to, gave various reasons for this, such as heat being able to cause disease, affect functioning, or having co-morbidities.

**Table 7**

*The perceived threat of heat as mentioned by the interviewees*

Subtheme	Definition	Mentioned number interviews	in of
<b>Perceived severity</b>			
Heat has no negative effects on health	<i>"That can not be unhealthy, right? The sun on your body. What else would you want? That can not be unhealthy, right? - Interviewee 5</i>	2	
Heat is a health risk to others	<i>"Maybe if you're a heartpatient, you know? That you'll have to take it easy, especially with the heat. And if you have high blood pressure, that you definitely shouldn't wind yourself up. But other than that, I really do not know." - Interviewee 1</i>	4	
Heat is a health risk	<i>"It [heat] brings along risks, that I know. I have experiences it, I have had skincancer." - Interviewee 2</i>	5	
Heat has positive health effects	<i>"Without the sun, you also skip the vitamine D." - Interviewee 6</i>	1	
<b>Perceived susceptibility</b>			
Being unsure about the danger of heat	<i>Interviewer: "To what extent do you think the heat is a health risk to you?" Interviewee: "I have no idea. Well listen, I am feeling alright. At least, for as far as I know. I do not have any issues with my heart. My blood pressure is fine. What else do you want if you are almost 82?" - Interviewee 1</i>	3	
Heat is no health risk to me	<i>"If I would not have kept calm than it would have been a big health risk, you still need to adjust." - Interviewee 9</i>	6	
The heat is a risk to me	<i>"Sometimes I see people going for a walk and think: how are you able to bring yourself about to take a walk? Especially when your bronchi are affected, that it is not comfortable at all. If you suffer from that, you should not do it. I am not actively looking for problems, I am not." - Interviewee 6</i>	6	
The sun is a health risk	<i>The heat by itself is not that bad of course. The sun, that is what it is about. [...] You will have to watch out for the sun, I do as well. - Interviewee 2</i>	2	

## Awareness and perceived efficacy of health protective measures

Overall, elderly were aware of many health protective measures they could take against the heat, even more than recommended by the RIVM and more than they executed as can be seen in Table 8. Additionally, some interviewees engaged in maladaptive behaviours, which they considered to be health protective measures.

**Table 8**

*Known and executed health protective measures as discussed in the interviews*

Theme	Measure	Explicitly recommended by RIVM?	Mentioned as known in number of interviews:	Mentioned as executed in number of interviews:
Hydration	Drink enough fluids	Yes	9	8
	Always bring a water bottle when going out	Yes	2	1
Avoid strain	Adjust daily rhythm (e.g. Do your groceries our daily walk in the early morning or in the evening)	Yes	9	9
	Avoid physical strain	Yes	8	8
Heat avoidance	Limiting physical activity	No	2	2
	Staying inside	No	6	5
	Finding the coolest place to be	No	2	2
	Going someplace else to escape the heat	No	1	1
Sun avoidance	Stay out of the sun	Yes	5	5
	Use sunscreen	No	4	3
	Stay in the shadows	Yes	3	3
	Use awning	No	3	3
	Use parasols	No	2	2
Keep yourself cool	Use protective headwear	Yes	2	1
	Adjust clothes to the heat	Yes	7	7
	Take a (foot)bath or a shower	Yes	5	4
Social	Do not sleep under too warm covers	Yes	2	2
	Take care of each other: keep an eye out for people in your environment who might need some help.	Yes	3 (only by the couples)	3 (only by the couples)
Keeping your house cool	Use air conditioning	Yes	8	4
	Use blinds	Yes	7	7
	Ventilation when it's colder	Yes	6	6
	Use a fan	Yes	6	5
	Keeping windows closed	No	5	5
	Trying to keep your house cool	Yes	2	1
	Use a cooling unit	No	1	1
Isolation	Use a climate system	No	1	1
	Isolating your house	No	3 (all own a house)	3 (all own a house)
	Isolated or double paned windows	No	3 (same interviewees as the isolated houses)	3 (same interviewees as the isolated houses)
Eating habits	Eating well	No	5	5
	Eating adapted meals/more cold meals	No	3	3
	Eating ice cream	No	3	2
Activities to deal with the heat	Going swimming	No	2	0
	Going cycling	No	1	1
	Going out on scoot mobile	No	1	1
Maladaptive behaviours	Keeping windows open for fresh air	No	2	2
	Drinking alcohol	No	1	1

In Table 9 it can be seen that elderly in general considered the health protective measures as helpful, as it shows information regarding the response efficacy of health protective

measures. The elderly stated they would not execute measures they deemed ineffective, meaning that a lack of response efficacy can be seen as a barrier in executing health protective measures.

**Table 9**

*Response efficacy of health protective measures as perceived by the interviewees*

Main & subcodes	Definition	Mentioned number of interviews	in of
<b>Response efficacy</b>			
Health protective measure comes naturally	Interviewee 11: "We just execute the things we mentioned, it's in our ritual."	4	
Measure is useless	Interviewee 12: "Yes, we do them automatically." "I do have such a thing here, a fan is also included but it does not help because it brings the heat from outside to inside the house. So we will not turn it on." - Interviewee 8	4	
Measure is useful	"Yes, they are effective. Otherwise you will not execute them. I mean, if you turn on the air conditioning you notice the results immediately." - Interviewee 11	6	
Unsure about effectiveness	"I'm not sure [if they are effective]. I do not know them at all, and if you have such a thing [fan or air-conditioning] in your home, what do I have to do with it? I can barely change the settings on my television." - Interviewee 5	2	

Elderly considered themselves mostly able to execute the health protective measures, as can be seen in Table 10, which gives an overview of the facilitators and barriers that influence the self-efficacy of executing health protective measures among elderly. Considering a measure as useful was seen as a prerequisite for being able to execute a health protective measure. Additionally, elderly were physically capable of executing most measures. Financial means could be seen as barrier, most often mentioned in combination with air conditioning. Although the elderly are able to execute the health protective measures, they are not always motivated to do so. One of the interviewees mentioned not caring about executing health protective measures due to not caring if he would die this year or in ten years as his wife already passed away.

**Table 10**

*Self-efficacy of executing health protective measures as perceived by the interviewees*

Main & subcodes	Definition	Mentioned number of interviews	in of
<b>Self-efficacy</b>			
Able to execute measure	Interviewee 11: "Well, it is no problem, it is not like we are forgetting things." Interviewee 12: "No, those things are just embedded into us. You do not have to think about it at all."	6	
Facilitators			
- Low effort	(about opening the windows) "Why wouldn't I do it? There are no costs and it is not a lot of effort." - Interviewee 3	4	
- Discomfort due to heat	"We'll try to make it as comfortable for ourselves as possible, and if you want to do that you'll also have to do some of the measures a little." - Interviewee 6	3	

-	Believing measure to be useful	<i>"What's useful for us, that's what we'll do." – Interviewee 6</i>	4
-	Liking the measure	<i>"I'll do it automatically, regularly drinking a cup of thee, a glass of water or a glass of buttermilk. Well, I also like all of them. Green tea, I like that." – Interviewee 1</i>	3
-	Accessibility of the measure	<i>"It also has to do with being retired, so you can do whatever you want. [...] Today you are doing a bit less, so you will do the other things tomorrow. And if it takes a bit longer, well, it will just have to sit there for a bit." - Interviewee 6</i>	7
<b>Barriers</b>			
-	Financial barriers	<i>"I want to do anything for it, but it should not cost me too much money because that is simply not possible." - Interviewee 8</i>	4
-	Negative side effect	<i>"Well, they are moving bacteria. So that and the cold air at once, if that gets on your limbs... [...] You know, just like in your car there is a ventilator and when you turn it on, it can give you a cold oftentimes." - Interviewee 6</i>	4
-	Not wanting to execute measure	<i>"I do not execute them [the measures]. They can tell me: you have to do this or you have to do that, but I will not. I do not want to do it or I do not need it. Let me say it like this: I do not need it." - Interviewee 2</i> <i>"Since my wife is not here anymore, I do not care too much about life. Or if I will die tomorrow or in ten years." - Interviewee 2</i>	6
-	No barriers	<i>"Barriers? There are none." – Interviewee 7</i>	3

## Reaching Elderly

The interviewees mentioned multiple ways in which they are reachable and would like to be reached, of which an overview can be seen in Table 11. The biggest divide can be made in being reached via either channels or people. The overview on how to reach elderly is a combination of the ways they were reached in the summer of 2022 as well as the ways they would like to be reached. Examples on how they would like to be reached are specific TV shows or the weather report. However, seeing the health protective measures that others used also helped them to know about or to use the health protective measure. In contrast of getting information regarding health protective measures, many interviewees mentioned that they knew about health protective measures because of logical thinking. Furthermore, interviewees mentioned being perfectly able to decide which health protective measures to execute, they wanted to decide for themselves which advice to listen to.

**Table 11***Overview on how elderly can and would like to be reached*

<b>Main &amp; subcodes</b>	<b>Example</b>	<b>Mentioned in number of interviews</b>
<b>Channels</b>		
Newspaper	<i>"The newspaper, you'll read a lot in that." – Interviewee 1</i>	4
Television	<i>"You'll hear something on TV you know?" – Interviewee 1</i>	6
Radio	<i>"You'll get flooded with it by the radio, I always have radio channel four on." – Interviewee 10</i>	3
Facebook	<i>Interviewee: "Oh, they are burrying me in advertisements, on facebook and you name it." - Interviewee 2</i>	1
Mobile phone	<i>"How do you call those? Well, messages on your phone." – Interviewee 3</i>	1
<b>People</b>		
Children	<i>"My son, he warns me." – Interviewee 9</i>	3
Doctor	<i>"When it's warm he says: do you drink enough fluids? I will say: yes doctor, absolutely. You'll also hear some things in this manner." – Interviewee 1</i>	2
Peers	<i>"It goes around via word of mouth: the neighbour get an air-conditioning." – Interviewee 11</i>	2

## 4. Discussion

This study aimed to explore the experiences with and motivation to engage in health protective behaviours of independent at-home living elderly of 70 years and older. Elderly experienced the heat in different ways, some found it strenuous whereas others experienced it rather positive. Most of the elderly were aware of some risks due to heat to some extent, although they did not see it as an immediate threat to their own health. Still, elderly knew about health protective measures executed them. Financial barriers were present, hindering the usage of more expensive health protective methods such as air conditioning. When trying to inform elderly regarding health protective measures, television and newspapers are preferred channels to do so. Below, the answers to the research questions will be discussed.

1. *What are the experiences and perceived threat of the heat among independent at-home living elderly in the summer of 2022?*

Although the experiences of elderly with the heat differed, most considered themselves able to handle the heat and some even liked the heat, indicating that they did not fear the heat. The different experiences can be attributed to individuality in experiencing heat (Malmquist et al., 2022). This is influenced by different housing situations, as apartment characteristics influence indoor temperatures (Tsoulou et al., 2020), which is especially seen in social housing (Nederlandse Omroep Stichting, 2022). In this study, this phenomenon was also present as the elderly who perceived the heat as particularly negative almost all lived in apartments. It should be taken into account however, that these experiences are subjective. Future research could focus on objective experiences of elderly in different types of housing, to indicate which circumstances and elements of their residence influence their heat experiences.

Overall, elderly did not perceive the heat as a threat to them in particular. Previous research also indicated that elderly do not necessarily perceive the heat to be a threat to their health (Valois et al., 2020). However, elderly did consider the heat a risk due to their co-morbidities in this study, as also seen in previous research in which elderly were aware of a link between their health status and their heat perception (Kemen et al., 2021). Mostly, elderly considered co-morbidities or old age of others to be risk factors, which is similar to findings that most elderly considered older people to be at risk during times of heat whereas only one out of five considered the heat a threat to themselves (Kemen et al., 2021). Subsequently, elderly did not seem to be aware of their own age and declining body functions as they did not mention it, even though bodies decline from the age of 65 onward, making it harder for the

body to regulate temperature, fluids and keeping cardiovascular activities in check (Meade et al., 2020). This can be dangerous, as elderly might rely on their thirst sensation to prompt them into drinking more, which is not a reliable cue for them (Bhanu et al., 2019). According to the EPPM, this lack of perceived threat would lead to no response (Witte, 1998). To increase the perceived threat fear arousal can be employed (Bartholomew Eldredge et al., 2016), which might be especially useful considering research indicated that a higher perceived threat can lead to a bigger behaviour change. More than 80% the elderly who perceived heat as very threatening adjusted their behaviour, whereas only about 20% of the elderly who found heat not dangerous at all adjusted their behaviour (Kemen et al., 2021). Former research from Valois et al. (2020) indicated that a high perceived threat did not affect behavioural or control beliefs, meaning that preventive interventions regarding heat should focus on the on perceived efficacy rather than the perceived threat. However, according to the EPPM, a perceived threat does not lead to perceived efficacy, as both factors are necessary for an effective response (Witte, 1998). Therefore, it would be recommended to include the perceived threat of heat in the risk communication regarding heat. It should be kept in mind however, that even though fear appeals are effective (Rijksinstituut voor Volksgezondheid en Milieu, 2015), when fear exceeds the perceived efficacy this can result in a fear control process, which leads to controlling the fear instead of an effective response (Witte, 1998). Therefore, future research could focus on quantitative studies regarding the level of fear appeal needed to create a behaviour change as well as the objective level of threat elderly experience in relation to heat.

2. *To what extent are elderly aware of health protective measures and what is their perceived efficacy to execute these health protective measures?*

In general, elderly were aware of health protective measures and considered most recommended measures effective and believed themselves to be capable of executing them, although a hinderance in executing health protective measures were financial barriers. This is in line with previous research (Hansen et al., 2011; Malmquist et al., 2022; Sampson et al., 2013; Valois et al., 2020) and was mostly in relation to the air conditioning, about which previous research found that people with a lower income are less likely to use it when they are warm (Gao et al., 2020), and (lack of) availability of resources affects elderly's behaviour to keep indoor temperatures low (Tsoulou et al., 2020). As such, the focus in risk communication regarding heat efficacy should be on cost effective measures which target individual behaviours (Tsoulou et al., 2020), examples being increasing water intake, wearing protective headwear,

using blinds or taking more baths/showers (Valois et al., 2020). To increase awareness on these cost effective measures, consciousness raising can be helpful which can include providing information (Bartholomew Eldredge et al., 2016). More specifically, the communication should also include how these health protective measures help the elderly in their daily life, such as sleeping better at night or helping them feel better physically (Valois et al., 2020), which is in line with elderly stating they would only execute a measure if it was useful for them. To sum it up, campaigns should be set up and include information on cost effective measures as well as information on how those measures help elderly immediately. Future studies could research which types of prompts and arguments regarding the effects of the measures will change elderly's willingness to engage in cost effective health protective measures best. Additionally, a large scale study might help to point out the awareness and adherence among a bigger group of elderly to increase generalizability.

Besides barriers in executing health protective measures, some elderly took maladaptive measures, such as drinking alcohol. This is considered maladaptive behaviour as the RIVM recommends drinking less alcohol (Rijksinstituut voor Volksgezondheid en Milieu, 2015), although previous research found alcohol to contribute to fluid intake of elderly (Bhanu et al., 2019), making the adverse effects debatable. Still, elderly do not always recognize the risk of alcohol intake and even see it as enabling social and leisure activities (Bareham et al., 2019; Bhanu et al., 2019). Taking into account that their bodies have a harder time to regulate fluids (Meade et al., 2020), alcohol consumption can be a risk and maladaptive behaviour for elderly. Based on this, changing drinking behaviour among elderly can be valuable, yet challenging, as drinking alcohol could have been routinised during one's life course (Bareham et al., 2019). As such, elderly should be educated on which fluids to drink during warm weather (Bhanu et al., 2019), which can be done by creating awareness (Bartholomew Eldredge et al., 2016). To do so, campaigns could be set up, leaflets can be distributed and commercials might be broadcasted on television, as elderly prefer this type of medium. Additionally, to aid elderly in drinking enough and adjusting the habitual behaviour of drinking alcohol, implementation intentions can be employed (Bartholomew Eldredge et al., 2016). An example of this can be to set or strengthen an intention to drink when one takes medication or has a meal, which are already distinguished as habitual drinking patterns among elderly (Bhanu et al., 2019). Like this, elderly can be prompted to drink more at those moments. Other important factors in drinking behaviour are taste preference and the social factors (Bhanu et al., 2019). Therefore, future research could



focus on elderly swapping out alcoholic drinks for alcohol free alternatives, such as alcohol free beers, to see if elderly deem this a suitable alternative based on taste and social implications.

3. *How should elderly in the Twente region be reached to convey health protective measures and to persuade them in executing the health protective measures?*

Elderly in the city of Enschede indicated that their knowledge regarding health protective measures came, and preferable should come, from television, newspapers, their children or peers. This opposes the idea that elderly use the internet for finding information (Arends, 2021), which could be linked to elderly not looking for information on heat as they do not perceive it as a threat. It is, however, in line with preceding literature that stated that elderly could be reached by television (Garritsen & Verkaik, 2018) and that found television to be the most effective medium to bring along behavioural change when sending health messages regarding heatwave awareness, followed by the newspaper which had a stronger effect (Das, 2016). Both television and newspapers are useful for stories of persuasion, information with many details and vicarious reinforcement while it also allows a wide distribution (Bartholomew Eldredge et al., 2016), making them suitable media for messages regarding health protective measures. As little is known on when and how these messages should be presented on television and in newspapers, further research might help to clarify this. The option of including a peer in the messaging could be interesting to study, as peers supporting each other could improve seniors reliance to heat (Eady et al., 2020) and it can aid modelling, a behaviour change technique in which elderly can be reinforced to engage in health protective behaviours (Bartholomew Eldredge et al., 2016). Moreover, as elderly are more receptive to changing health-related behaviours when encouraged by trusted media personalities, testimonies from those personalities might also help (Valois et al., 2020). However, this was not mentioned by any of the participants in this study, although there was no specific question regarding this topic. Therefore, future research could indicate whether including a peer or trusted media personalities in the messaging regarding health protective behaviour is useful. Overall, traditional media still seem to be the most effective manner to reach many elderly.

### **Strengths & Limitations**

A few strengths and limitations can be named regarding this study. Strengths of this study included the participants all living in the same city, indicating similar circumstances and temperatures. Including city inhabitants is crucial, as especially cities are prone to develop heat islands: they can be 10 to 15 degrees warmer than their surrounding rural areas (Joint Research

Centre, 2022). Moreover, the last interview in this study did not provide any new arguments, ideas or concepts and almost all themes were mentioned in multiple interviews which according to Boeije (2010) can be interpreted as the saturation that takes place when no new insights are taken from new cases. Although the sample of participants was relatively small, the sample included participants with diverse Socioeconomic statuses (American Psychology Association, n.d.). Differences in education, previous occupation (before retirement) and the places of residence were apparent.

In contrast to the strengths of this study, it also has its limitations. First of all, the choice was made to use the EPPM, a model based upon fear appeals (Popova, 2012). The participants did not consider heat a threat and heat might also be described as an unpleasant sensation, which means that the health protective behaviours are not necessarily risk based. A previous study made use of the Theory of Planned Behaviour (TPB; Ajzen, 1991) and recognized this as a useful framework for understanding elderly's adjusting behaviours to the heat (Valois et al., 2020). Both the TPB and EPPM include elements of perceived threat and perceived efficacy (control in the TPB), however the factors attitude and perceived social norms from the TPB also had a significant effect on the intention of elderly to change their behaviour (Valois et al., 2020). These factors are not included in the EPPM, indicating that the model does not encompass all factors that play a role in changing adherence to health protective behaviours. Especially the social norms can be researched more in the context of adherence to health protective measures, for example by using the TPB or the COM-B model (Michie et al., 2011). Furthermore, while facilitators and barriers in executing health protective measures have been identified, these have not been identified per measure. As measures were still being identified in the interviews, it was not possible to identify barriers and facilitators per measure.

### **Future research**

In addition to the aforementioned recommendations, the following subjects for future research should be taken into account. To build upon the limitations of this study: facilitators and barriers have not been identified per health protective measure, therefore this might be a focus area for future research, to gain a complete idea of how doable each health protective measure is for elderly. Moreover, research into specific differences in experiences of inhabitants of social housing and other residences should be done as the type of housing can influence the indoor temperature (Tsoulou et al., 2020) and inhabitants of social housing experience especially strenuous circumstances in times of heat (Nederlandse Omroep Stichting, 2022). Signs of this have also been seen in this study, future research can make clear what these

specific differences in residences are that make the heat extra strenuous. Furthermore, research into creating awareness of the heat as a health risk among elderly by real time health tracking with smartwatches in times of heat can be done. Older adults can perceive smartwatches as useful for tracking their health (Chung et al., 2023), which might help them to keep track of their body to create awareness of their declining body functions and difficulties their body has in handling the heat (Meade et al., 2020). Additionally, extensive research into how elderly execute and understand health protective measures can be useful to gain knowledge on the implementation of health protective measures. Knowing how exactly elderly execute health protective measure can help to understand why or why not they would execute them and if anything goes wrong in executing those measures.

### **Practical implications**

Based upon the EPPM, this study found that elderly do not always perceive the heat as a threat for themselves and financial barriers exist in executing health protective measures. In the light of this research, it would be recommended to Veiligheidsregio Twente to increase this perceived threat among elderly, both by creating awareness regarding heat being a health risk and using a fear appeal to instigate elderly to action. Effective fear appeals to increase the perceived threat need to be chosen carefully, based on what seems threatening to the target group (Witte, 1998). Therefore, it would be suggested to have a co-create session or focus group with elderly to craft formats of this message. Moreover, a financial barrier exists in executing health protective measures and elderly in apartments, most often social housing, experienced the heat as particularly strenuous. This group with a lower Socioeconomic Status could be targeted separately, when working together with the social housing agencies on informing their residents regarding cost effective health protective measures.

For now, elderly were mostly reachable via television and newspapers, which are effective channels for health protective measures. As such, the recommendation to Veiligheidsregio Twente would be to use both television and newspapers as communication channels. However, Veiligheidsregio Twente should test their communication formats with the target group and adjust the communication when necessary (Grothmann et al., 2017), and keep testing the format in the future as the population of elderly that use the internet for information keeps growing.

## **5. Conclusion**

In conclusion, elderly have different experiences with the heat, negative, neutral, as well as positive. Although elderly were mostly aware of some health threats that heat brings along, they did not necessarily deem themselves susceptible to these threats as they perceive others as more susceptible to negative health effects of heat than themselves. The awareness of health protective measures against the heat is high among elderly in Enschede, with all elderly engaging in at least one form of health protective behaviour. Financial barriers are prominent obstacles that can hinder elderly in executing health protective measures, indicating a need for cost effective measures against the heat that elderly appreciate. Channels that can be used to inform elderly are mostly television and newspapers. The health information should be tailored to different groups of elderly and should include both an appropriate fear appeal and health protective measures to decrease this threat. More research is needed on the levels of perceived threat elderly experience, as well as research in facilitators and barriers per health protective measure to further tailor risk communication regarding heat. Overall, circumstances between elderly differed causing them to experience and handle the heat differently, although the heat was not perceived as a threat by many.

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## Appendix A: Health risks for elderly caused by heat

**Table A1**

*Health risks due to heat exposure among elderly adults*

Category	Risk		Source
Heat illness	Hyperthermia	Caused by heat	(World Health Organisation, 2018)
	Heat stroke (extreme hyperthermia)	Caused by heat	(Meade et al., 2020)
	Heat cramps	Caused by heat	(World Health Organisation, 2018)
	Lack of concentration	Caused by heat	(Rijksinstituut voor Volksgezondheid en Milieu, 2015)
	Shortness of breath	Caused by heat	(Rijksinstituut voor Volksgezondheid en Milieu, 2015)
Cardiovascular disease	Cardiovascular disease	Heat is riskfactor for dying of CVD	(Meade et al., 2020)
	Cardiovascular disease morbidity	Associated with impaired caridovascular response to heat exposure (Meade), slightly higher risk for it with high heat (Liu)	(Liu et al., 2018)
	Hypertension	Common among heat wave victims.	(Meade et al., 2020)
	Trombosis	Increased risk during heat wave	(Meade et al., 2020)
	Embolism	Increased risk during heat wave	(Meade et al., 2020)
	Acute myocardial infarction	Increased risk during heat wave	(Meade et al., 2020)
	Ischemic stroke	Heat is risk factor for it	(Meade et al., 2020)
Fluid and electrolyte balance and kidney function	Fluid and electrolyte imbalance	Heat helps to cause it	(Meade et al., 2020)
	Acute kidney injury	Heat is a risk factor for it	(Meade et al., 2020)
	Chronic kidney disease	Risk factor in times of heat. Probably enhances heat stress.	(Meade et al., 2020)
	Renal disease (morbidity and mortality)	Higher temperature means an increase in renal disease	(Liu et al., 2018)
Other	Motor vehicle crashes	Caused by heat	(Basagaña et al., 2015)
	Increase in unintentional injuries (occupational accidents & increase in hospital trauma admissions e.g. Both fatal & non-fatal)	Heat increases the risk	(Otte Im Kampe et al., 2016)
	Fatigue	Caused by heat	(Rijksinstituut voor Volksgezondheid en Milieu, 2015)
	Worsening of chronic conditions	Caused by heat	(World Health Organisation, 2018)
	Death	Caused by heat	(World Health Organisation, 2018)

## Appendix B: Age impairment factors contributing to heat being a health risk for elderly

**Table B1**

*Age impairment factors contributing to elderly being at risk for heat related disease.*

<b>Category</b>	<b>Risk factor</b>
Thermoregulation	Reduced skin blood flow Reduced sweat rate Increased body heat storage Increased body temperature
Cardiovascular	Reduced cardiac output Increased chronotropic dependence Increased myocardial strain Blunted peripheral vascular responses Reduced central vascular responses Reduced cerebrovascular regulation
Fluid regulation	Increased coagulation Reduced renal function Reduced blood volume Reduced sensitivity to fluid regulatory hormones Reduced thirst sensation Reduced fluid conservation during dehydration

*Note.* Adapted from “Physiological factors characterizing heat-vulnerable older adults: A narrative review,” by R. D. Meade, A. P. Akerman, S. R. Notley, R. McGinn, P. Poirier, P. Gosselin, and G. P. Kenny, 2020, *Environment International*, 144.

## Appendix C: Informed consent

*“It is important that you willingly participate in this research. Your data, the data from this interview, is processed by me for this research. As soon as I will start analysing this, I will change the names used and remove the original names and contact data from the word-file. These will be kept in a separate file so I can contact you with a summary of the results of this research if you would like. When this research project is finished, the contact data will be deleted. The interview data will be handed in to the University of Twente, where it will be stored for 10 years. I will remove the raw data from my personal computer however. You can withdraw at any moment, you can ask to stop and/or to take a break whenever it is necessary for you.*

*Do you agree to this?”*

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*“Het is belangrijk dat u vrijwillig deelneemt aan dit onderzoek. Uw data, de data van dit onderzoek dus, wordt verwerkt door mij voor dit onderzoek. Wanneer ik deze data ga analyseren wordt het uitgetypt, daarbij zal ik de namen en contactgegevens uit het bestand halen en in een ander bestand plaatsen. Hiermee kan ik contact met u leggen mocht u een samenvatting van de resultaten van dit onderzoek willen ontvangen. Wanneer dit onderzoek is afgerond zullen uw naam en contactgegevens worden verwijderd. De data van dit interview zal ingeleverd worden bij de Universiteit Twente, waar dit 10 jaar bewaard zal blijven. De data op mijn computer zal wel verwijderd worden wanneer dit onderzoek afgerond is. U kunt uw deelname op elk moment stoppen, u kunt ook vragen om te stoppen of om een pauze te nemen wanneer dit nodig is voor u.*

*Gaat u hiermee akkoord?”*

## Appendix D: Codebook

**Table D1**

*Codebook*

Theme	Code	Found	Explanation
Awareness, and Beliefs	Experiences HPM: executed	Inductively	The health protective measures that the interviewee mentioned to have executed. Either knowing or unknowingly that it is a health protective measure. Meaning: also actions that could be mentioned or executed as a protective measure although not recognized by the interviewee as such.
Awareness	HPM: known	Inductively	Health protective measures the interviewee knows about. Both measures that the interviewee executed as well as measures that the interviewee did not execute.
Experiences	Perceived heat	Inductively	Any comments on how people experienced the heat.
	Perceived heat positive	Inductively	Any positive comments on how people experienced the heat.
	Perceived negative heat	Inductively	Any negative comments on how people experienced the heat.
	Previous experiences heat	Inductively	Previous experiences interviewee had with heat. Longer than 2 years ago. For example previous holidays to warm countries or jobs that included very warm circumstances.
	Effects of heat	Inductively	The interviewee mentions the effect the heat had on them, or anything the heat caused.
Beliefs	Activities on warm days	Inductively	Activities that interviewees did on warm days. What they actually did, how their days differed from days without heat.
	Perceived severity	Deductively	Conceptions people have regarding the severity of the health risk of heat.
	Perceived susceptibility	Deductively	Conceptions people have regarding their own susceptibility of the health risk of heat.
	Self-efficacy	Deductively	Conceptions people have about their own capability of executing health protective behaviours
	Response efficacy	Deductively	Conceptions people have regarding the effectiveness of health protective measures.
	Facilitators	Inductively	Factors, effects, thoughts or tools that help people execute health protective behaviours against the heat.
Reaching elderly	Barriers	Inductively	Factors, effects, thoughts or tools that prevent people from executing health protective behaviours against the heat.
	Communication: people	Inductively	What motivates people to execute health protective behaviours
	Communication: media	Inductively	Anything on how people (would like to) gain knowledge of health protective behaviours
	Thoughts on communication	Inductively	What people think about (potential) communication media, manners and deliverers of health protective measures against the heat
	Logical thinking	Inductively	The interviewee states that knowledge about certain health protective behaviours or how to handle the heat are general knowledge or is acquired by logical thinking.