

# Never too old to learn

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## Dissertation

to obtain the degree of Doctor at Maastricht University, on the authority of the Rector Magnificus, Prof.dr. Pamela Habibović in accordance with the decision of the Board of Deans, to be defended in public on Tuesday 4 June 2024, at 13.00 hours by Margo Karemaker

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# Chapter 1

## General introduction

## Older adults as a risk group

Older adults - in this thesis defined as people of 65 years or older - are overrepresented in statistics on fatal residential fires [1–5]. For example, where 20.1% of the population in the Netherlands was 65 years or older in 2022 [6], 50% of the victims of deadly domestic fires come from this age group [7]. The mortality rate among older adults increases even more with age, with a risk up to more than three times at 85 years or older compared with people younger than 65 years [4,8–11]. Common fire causes leading to fatalities in this age group are the ignition of clothes by an open flame, furniture being ignited by cigarettes, technical faults, inattention during cooking, and deliberately set fires (including fireplaces) [12]. Also, the risk of non-fatal injuries in the event of a fire increases with age [13–15].

The risk of getting injured in the event of a fire is also higher for older adults in comparison with other age groups. Injuries among older adults tend to be more severe and are often complicated by other medical conditions [16]. Cooking, smoking and heating-related injuries are common for older adults [17]. Many fires and resulting injuries among older people result from older adults being more likely to put themselves or their belongings close to a heat source [18]. Besides, injuries mostly occur among older adults in single occupancy housing, living in more deprived areas [17].

Several factors explain why older adults are at increased risk of becoming a victim in home fires. First, older adults have a higher chance of starting a fire combined with a reduced ability to recognize a fire on time or respond accurately in the event of a fire [3,18]. Second, factors such as physical and cognitive decline, reduced information processing capability, limited mobility, mental disorders and impaired ability to grasp crucial information, further amplifies the susceptibility to fire-related incidents [19–24]. Other factors contributing to an increased risk of fire-related injuries in older adults include physiological changes such as a decrease in visual acuity, thinner skin, and the use of medications [9,16]. These physiological changes can also hinder their alertness and responsiveness in fire-related emergencies [8].

The ageing population in high-income countries combined with the greater risk among older adults of becoming a victim in home fires [3,24–26] emphasize the need for preventive interventions to improve the fire safety in homes. For example, in the Netherlands in 2022, 20,1% of the population was 65 years or older [27]. The expectation is that this number will increase to more than 26% of the population by 2040 [11]. Also it is expected that more people will continue to live independently instead of moving to a nursing home [11]. Ageing in the home situation provides economic and social benefits in comparison

with living in an assisted living facility [28]. It also contributes to a sense of well-being and independence [16]. On the other hand, living independently creates a vulnerability when it comes to home fire safety.

Besides the overrepresentation of older adults in fire statistics and the ageing of the population, several policy-related decisions in the Netherlands further impact the home fire risk in this age group. First, since 2013, policy of the Dutch government has been aimed at gradually closing residential care homes, leading to almost none left at this moment. When there is a need for a residential care home, efforts are directed to realizing small-scale residential homes. For example, in the health care setting intervention programmes are being implemented to return home more quickly after a hospital stay, or postpone going to a nursing home for a longer period of time, such as the Housing and Care for Older Adults programme initiated by the Ministry of Health, Welfare and Sport [29]. Second, the Dutch government has indicated that it will not expand the number of places in nursing homes, and will even reduce it. These different policy-related decisions do not take into account the increase in home fire risks that accompany older adults living independently for a longer period of time. Therefore, the urgency of influencing fire safety behaviour is even greater.

### **Current home fire safety programmes**

To improve fire safety behaviour among older adults, numerous fire safety interventions are developed and implemented. In general, these fire prevention programmes focus on installing preventive measures in homes such as smoke alarms, carbon monoxide alarms, fire blankets or fire extinguishers [30–34]. Other prevention programmes focus on behaviour change by targeting social cognitive determinants of fire safety behaviour such as increasing general fire safety knowledge or strengthening risk perceptions [15,35–40]. To influence these cognitive determinants of behaviour, educational materials such as brochures, presentations, video's about fire safety, and home visits are generally used [15,33,39,41,42]. The rationale behind these programmes is that increasing people's awareness about the danger of home fires will provide sufficient motivation for people to take fire safety measures in their homes [15,33,35–37,39,42]. Although research has shown that people have insufficient fire safety knowledge and act dangerously (e.g. leaving cooking unattended or placing flammable materials too close to the heater), which puts them at risk of being involved in a home fire [43], just focusing on improving knowledge of fire safety measures and risk awareness will not necessarily lead to behaviour change. Stronger determinants of the motivation to enact on behavioural recommendations are people's positive evaluation of the

expected outcomes of the behaviour change, referred to as attitude, whether they think important others do and approve the behaviour change, respectively referred to as the injunctive and descriptive norm, and the extent to which they feel in control and confident of successfully executing the behaviour referred to as perceived behavioural control and self-efficacy [44]. Furthermore, fire prevention programmes are not always systematically developed while adopting a systematic approach using theoretical and empirical evidence can be advantageous [45–48]. In fact, only a few studies were found which describe the systematic development of an intervention [36,41] and/or included the target group in the development of the intervention [49]. These studies demonstrated to have a positive impact on either fire safety behaviour (e.g. giving space heaters space [41]), knowledge, or attitude towards fire safety. In the Netherlands, the Dutch Fire Service organizes fire safety meetings to educate older adults about home fire safety. Typically, the primary focus in these programmes is on increasing awareness about home fire safety. The programmes mostly involve presentations or home visits. The locations for these meetings are determined in collaboration with the organizations that request them, e.g. housing companies, municipalities or senior citizens associations. The meetings may occur at various venues, including fire stations, senior housing complexes or community centres. Little research has been identified about measuring the effect of these programmes. Only one study was found that reported an effect evaluation of home visits and a fire safety presentation and their effects on awareness and fire safety behaviour [50].

Summarized, current home fire safety programmes mostly focus on either taking preventive measures or planning escape routes. It is needed to develop home fire safety programmes that also focus on preventive safety behaviours, e.g. safe cooking, since these are behaviours that result from statistics as common fire causes among older adults. Furthermore, current programmes focus on the social cognitive determinants knowledge, awareness and risk perceptions. Research that examines which determinants are predictors of home fire safety behaviour is scarce.

### **Explaining fire safety behaviour**

In order to change people's behaviour, we must first understand how this behaviour arises. In this thesis, theories and psychological models that help explain human behaviour are applied, in particular the Reasoned Action Approach [44], which is complemented with the Protection Motivation Theory [51]. Due to the scarcity of literature on determinants of home fire safety behaviour, general behavioural theories are used to explain behaviour and the concepts within these models.

### *The Reasoned Action Approach*

The Reasoned Action Approach (RAA) is a social cognitive model that can help explain whether or not older adults perform fire-safe behaviours in their homes and what motivates their behaviour [44]. According to the RAA, intention is the most adjacent determinant of future behaviour [44]. Intention is determined by three social cognitive determinants: attitude, perceived norm, and perceived behavioural control.

*Attitude* refers to a person's a positive or negative evaluation of the desired behaviour [44]. Two types of attitude can be distinguished: instrumental attitude and experiential attitude. Instrumental attitude refers to cognitive aspects of attitude which include an evaluation of the outcomes of an intervention (e.g. useful or not useful) while experiential attitude refers to an affective evaluation of the outcomes of a certain behaviour (e.g. pleasant or unpleasant) [44]. *Perceived norm* refers to a person's beliefs about what significant people in the person's social environment (e.g., friends, peers, family) think about the desired behaviour. Two types of perceived norm are distinguished; injunctive and descriptive norms. Injunctive norm refers to perceptions on what should be done according to significant people in the person's social environment considering the desired behaviour. Descriptive norm refers to if others do or do not perform the desired behaviour [44]. *Perceived behavioural control* (PBC, similar to self-efficacy [52,53]) refers to a person's perceived capability to perform the desired behaviour [44]. Attitude, perceived norm and perceived behavioural control are informed by specific beliefs [54]. Especially by specific expectations about negative or positive outcomes of the behaviour (behavioural beliefs), beliefs about the opinions of an important person or group of people (normative beliefs), and perceived barriers and skills that hinder or facilitate the performance of the behaviour (control beliefs).

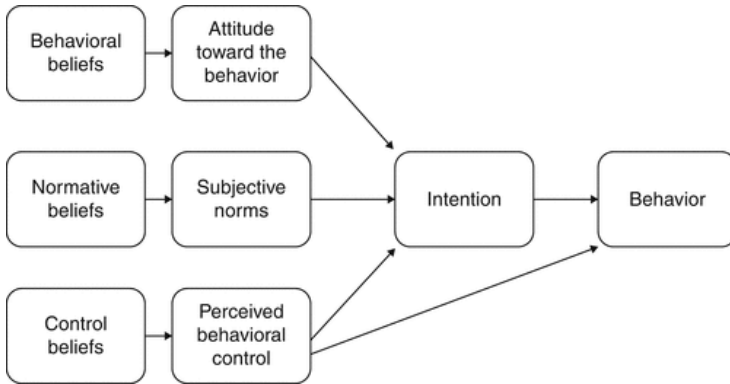


Figure 1. A schematic representation of the Reasoned Action Approach [44].

### Protection Motivation Theory

According to the Protection Motivation Theory (PMT, [51]) two cognitive processes, threat appraisal and coping appraisal, motivate protective actions. Threat appraisal includes an assessment of the seriousness of the threat and one's personal susceptibility to this. Coping appraisal includes an assessment of one's ability to perform potential responses (self-efficacy) and the effectiveness of these responses (response efficacy). The outcomes of these appraisal processes determine protection motivation, which is measured as an intention to adopt the recommended protective action. Furthermore, the PMT includes the following two constructs: rewards associated with maladaptive responses and costs associated with the adaptive responses [55].

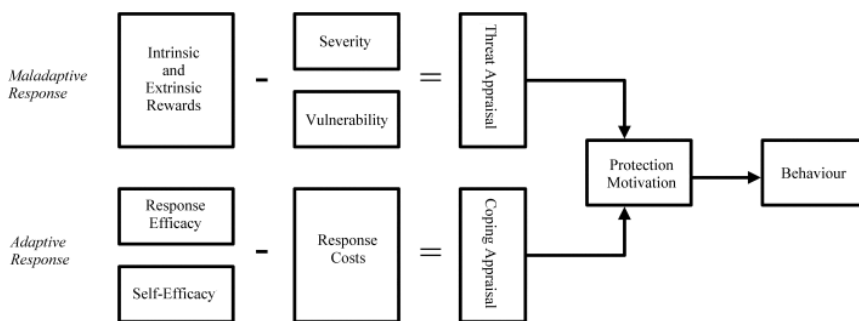


Figure 2. A schematic representation of the Protection Motivation Theory [56].

### *Determinants of fire safety behaviour*

Research about social cognitive determinants influencing fire safety behaviour is scarce. Some research focuses on the associations between fire safety behaviour and behavioural determinants such as knowledge, attitude, and social normative beliefs [57]. However, little research is known about fire safety behaviour and the underlying social cognitive determinants specifically among older adults.

Besides, research that is found and is targeting this age group is mostly descriptive instead of predictive. For example, older adults do not recognize cooking as a main cause of residential fires and many do not know how to protect themselves adequately [9]. Elsewhere it has been stated that older adults tend to be less capable of identifying fire risks in their homes in comparison to the general adult population. Furthermore, they are less likely to be alerted in the case of a fire or escape from a dangerous situation such as a fire [8]. Other research suggests two main themes that influence the home fire safety practices of older adults: risk perception and maintaining their independence [16]. According to knowledge about fire safety topics, the authors reported that older adults were unable to identify fire prevention measures or formulate a fire escape plan.

Theoretical models for predicting behaviour such as the RAA and PMT emphasize the importance of social cognitive determinants. In literature, little research was found that studies these determinants related to home fire safety behaviour. However, the identification of psychosocial constructs such as risk perception, attitude, perceived norms, perceived behaviour control and their underlying beliefs is important because these determinants together explain significant proportions of the variance in behaviour. Besides, they are susceptible to change so they can be targeted with educational interventions [58,59].

### **Intervention Mapping**

After determining the underlying determinants of fire safety behaviour, project teams can start thinking about the development of an intervention. However, the chance of developing an effective intervention is the highest if it is systematically developed. A protocol that can be used for this development of behavioural interventions is Intervention Mapping (IM) -a planning protocol which provides a detailed description of the intervention development-process and facilitates comparison between interventions [60]. IM describes six steps (see Figure 3) to develop a theory- and evidence-based intervention using a participatory approach and adopting a socio-ecological perspective. Each step consists of several tasks and the completion of these tasks creates a base



which is the guide for the next step. The six steps together create a plan for designing, implementing and evaluating an intervention based on theoretical, empirical and practical information [61]. Second, IM provides procedures for planning activities, and can help with matching theory-based determinants with appropriate methods for change [47,62]. IM is an iterative process in which programme planners move back and forward between the different steps. It is also a cumulative process as a subsequent step in the development of the interventions builds on the outcome of the previous step.

IM-step 1 focuses on performing a needs assessment in which the problem and the related behaviour and the associated determinants for the at-risk population are identified. To finalize this step, a description of a specific health problem, its impact on quality of life and behavioural and environmental causes and determinants are formulated. IM-step 2 focuses on formulating behavioural, performance and change objectives. The foundation for the intervention will be provided by specifying who and what will change when the intervention will be executed. Performance objectives are detailed descriptions of the desired sub-behaviours of the target group in order to achieve the desired programme outcomes [47]. Change objectives describe what needs to change for the target group in order to perform the performance objectives. Change objectives help planners with selecting intervention methods and translating methods into practical applications [47]. Being aware of the performance objectives, the most important en changeable determinants should be considered when defining the change objectives. IM-step 3 is about programme design. In this step, programme developers select theory-based intervention methods in order to influence the different change objectives that were formulated in step 2. These methods subsequently need to be translated into practical applications, which are the actual materials and/or activities that fit the context of the programme. In IM-step 4, the methods and practical applications are integrated into an organized programme. Plans are made for the production of materials and both the target group as well as implementers are consulted about the programme materials and protocols. In IM-step 5 the implementation of programme is planned. Involvement of the intended programme implementers is crucial in this step in order to create a plan for the programme to be implemented on a larger scale. These implementers can inform programme developers about what kind of support is needed during the implementation process. Finally, in step 6, an evaluation plan is created. This involves an assessment of whether the measurable performance- and change objectives have been met.

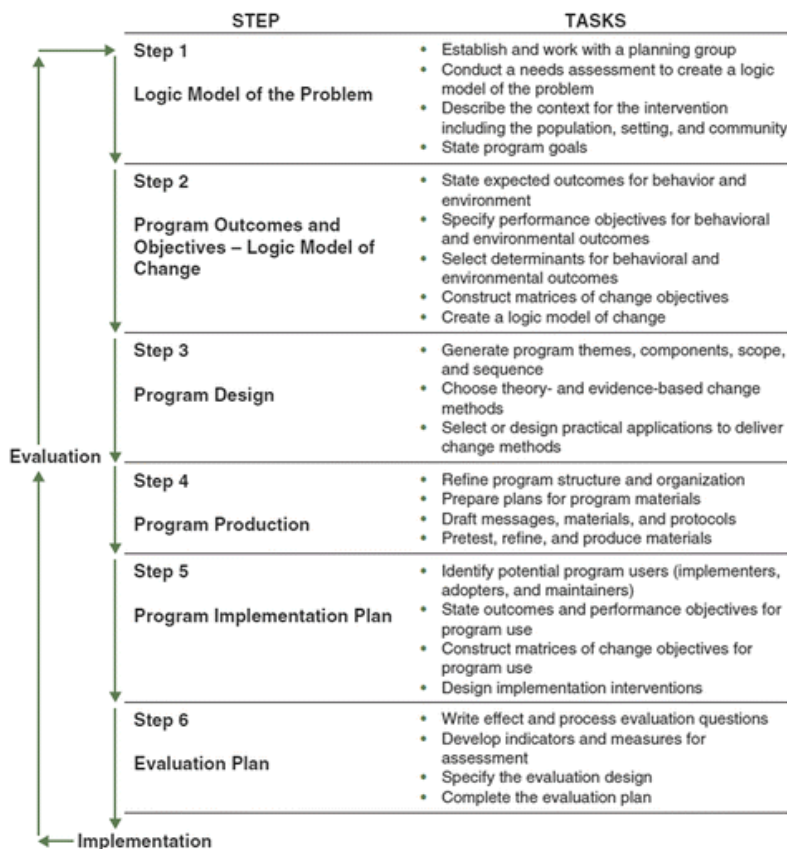


Figure 3. The six steps of Intervention Mapping (adapted from Bartholomew et al.)[47].

## Aim and outline of this thesis

The aim of this thesis is to develop a behavioural intervention to improve fire-safe behaviour at home among older adults. Using IM in the planning and design of an intervention, gives more insight in important issues regarding the development of interventions for this target group. The work to fulfil our objective is reported in Chapters 2-5.

In Chapter 2 we conducted a needs assessment regarding fire-safe behaviour to establish the perspectives of adults aged 65 years and older concerning fire-related topics. The main topics examined were home fire safety knowledge, (determinants of) fire-safe behaviour, and responsibility for fire safety. This needs assessment is needed to be able to develop personalized and tailored interventions and thus promote fire-safe behaviour among older adults. Qualitative interviews were conducted to provide a first insight into fire safety behaviours and the underlying factors that contribute to risky behavioural patterns.

Since the study as described in Chapter 2 was conducted among a relatively small group of participants (n=17), more (quantitative) research is needed to confirm these findings and assess the relative importance of fire safety behaviours and the underlying personal determinants. In Chapter 3 we aimed to identify the most important predictors of fire-safe behaviours among older adults and determined the relative importance of these predictors. A questionnaire was used to measure: 1) demographics and context specific information such as the presence of electrical devices and type of cooking device, 2) different fire-safe behaviours, 3) social cognitive variables, and 4) trustworthiness in sharing information about fire safety (i.e. who you trust as the source of information).

Based on the input of the needs assessment as described in Chapter 2 and 3, a home fire safety intervention was developed. In Chapter 4 the systematic development of the Fire Safety at Home programme is described. By following the IM protocol, insights about relevant determinants influencing the behaviour of older adults were combined with the systematic application of behavioural change methods leading to a programme targeting home fire safety behaviour.

In Chapter 5 the impact of the Fire Safety at Home programme is evaluated. A total of 433 participants (> 65 years) joined either the Fire Safety at Home programme (intervention group) or a fire safety programme as is given by the Dutch fire service (control group). Outcome measures assessed four fire safety behaviours (staying in the kitchen while cooking, not connecting power strips to each other, charging electrical devices, and cleaning the dryer lint filter after every cycle) and the key determinants attitude, self-efficacy and intention.

In Chapter 6, the major findings of this thesis are discussed. We discuss the importance and implications of the studies for the development of behavioural interventions targeting fire safe behaviour and professionals working in the field of community fire safety.

## Note

All chapters in this thesis are individual chapters that are submitted or published as journal papers. Therefore, each chapter can be read individually. However, this also causes overlapping parts within the introductions and terminology in different chapters can differ.

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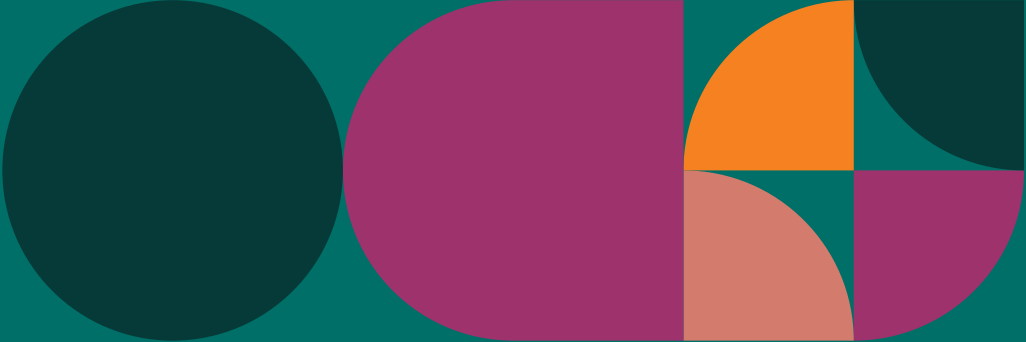
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# Chapter 2

## Elderly about home fire safety: a qualitative study into home fire safety knowledge and behaviour

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## Abstract

Elderly people are a high-risk group when it comes to fire in their homes and interventions are needed. A needs assessment regarding fire safe behaviour was conducted to 1) establish the perspectives of adults aged 65 years and older concerning fire-related topics, and 2) inform the design of fire safety programmes. Qualitative interviews were conducted to study fire safety knowledge and fire safe behaviour among elderly in their home situation. The findings showed that participants lack detailed knowledge about risk behaviours that might cause a fire and their knowledge is limited to sources of fire or moments at which a fire can occur. However, elderly people do take preventive measures such as installing smoke alarms and planning an escape route. Determinants that are found to influence fire safe behaviour among elderly people are risk perception, self-efficacy, habits, and perceived barriers such as physical disabilities. Elderly perceive the risk of home fires as low while feeling confident in their abilities to act in case of a fire. This study broadens the field of fire safety by focusing on behaviours of elderly people and the underlying determinants, but more (quantitative) research is needed to confirm our findings.

## 1. Introduction

### 1.1 Elderly as a risk group

Socially vulnerable groups such as elderly people (in this study people of 65 years of age and older) are found to be overrepresented in statistics on fire fatalities. Research into fatal residential fires shows that, in the Netherlands, almost half of the victims were 61 years and older and one in three victims in this group was 80 years or older [1]. International research shows that this mortality risk increases even more with age, up to more than three times the risk at >85 years, compared with the general population [2–6]. Fire-related injuries are also more common in those aged 65 years and older. They seem to have a higher risk of starting a fire but also have difficulties with identifying or evacuating from a fire [7,8]. In addition, the injuries older people present with tend to be more severe and are often complicated by other medical conditions [9].

Factors that put elderly people at risk for fire-related injuries and death include physical aspects such as a decrease of their physical health or vulnerability to injuries, mental aspects such as reduced cognitive capacities or social isolation, and behavioural aspects such as using below-standard electrical appliances [10]. Other contributing factors to an increased risk of fire-related injuries include physiological changes such as thinner skin, a decrease in visual acuity or the use of certain types of medication [4,9].

High-income countries, including the Netherlands, are confronted with an ageing population which means that the number of older people will continue to increase [8,10–12], partly due to improved health care. In 2019, 19.2% of the population in the Netherlands was 65 years and older [13]. The expectation is that this number will increase to more than 26% of the Dutch population by 2040 [6]. Besides, more elderly will continue to live independently instead of moving into a nursing home [6].

International research has shown that ageing in the home situation provides social and economic benefits compared with moving to assisted living [14] and contributes to a sense of independence and wellbeing [9]. But, ageing in the home situation creates a vulnerability that is especially acute when it comes to fire safety [8]. It is therefore that preventive interventions are needed to improve fire safety behaviours in their homes. As suggested by frameworks of planned behavioural change (e.g. [15,16]), these behavioural interventions should depend on the needs of the target population. In this needs assessment, current risk behaviour of the target group and its relevant determinants (e.g. attitude, social norm, self-efficacy) are identified and desired behavioural outcomes are determined. Furthermore, attention needs to be paid to the physical and social environment of elderly people.

## 1.2 Current research on fire safe behaviour

Current research in the field of fire safety is mainly quantitative and uses surveys or observations to collect data. Furthermore, current research mostly focuses on the observable response of people in the case of a fire including the movement of people during a fire [17] and observable preventive behaviours like the presence of smoke alarms or carbon monoxide-alarms [4,5]. However, focusing on quantitative data reduces the researchers' ability to fully understand the underlying determinants that are influencing the behaviour [17].

Some research shows significant associations between psychosocial concepts such as knowledge, attitude, and social normative beliefs and fire safety behaviour [18]. However, little research focuses on fire safe behaviour and the underlying determinants among elderly people. What has been written has tended to focus on risk perception, knowledge and preventive measures that are being taken and is mainly descriptive instead of predictive. For example, Shields et al. [4] have demonstrated that elderly people do not recognize cooking as a main cause of residential fires and that many do not know how to protect themselves adequately. Elsewhere it has been stated that elderly tend to be less capable of identifying fire risks in their homes in comparison to the general adult population and that elderly are less likely to be alerted in the

case of a fire or escape from a dangerous situation like a fire [3]. Other research suggests that two main themes influence the home fire safety practices of elderly people: risk perception and maintaining their independence [9]. When measuring knowledge about fire safety topics, the authors reported that elderly people were unable to identify fire prevention measures or formulate a fire escape plan.

### 1.3 The current study

Elderly form an important risk group for residential fires but fire safety among elderly people is a new focus in fire prevention education [9]. Interventions do take place but are not always based on extensive research into the underlying factors that cause risk behaviour; a proper needs assessment is missing. However, this research is needed to be able to develop personalized and tailored interventions and thus promote fire safe behaviour among elderly people [15]. Qualitative research can provide a first insight into the underlying factors that contribute to risky behavioural patterns. Here we report on a qualitative needs assessment regarding fire safe behaviour among elderly people that was conducted to establish the perspectives of elderly people concerning several fire related topics. The main topics examined were home fire safety knowledge, (determinants of) fire safe behaviour, and responsibility for fire safety.

## 2. Methods

### 2.1 Participants and recruitment

The perspectives of the participants were explored by means of semi-structured interviews. Respondents were recruited through a national association for senior citizens, the Algemene Nederlandse Bond voor Ouderen (ANBO). In one of its newsletters, a call for respondents was published that asked for people above 65 years old, living independently to sign up for an interview about fire safety. In total, 69 people responded after which twenty respondents were randomly chosen and invited for an interview. Three respondents withdrew before the interview without giving any reason. This resulted in interviews with seventeen respondents (12 females) from thirteen home addresses (eight participants lived alone, 9 with their partner). Their average age was 76.6 years, ranging from 68 to 86 years. Two of them did not tell their age. The interviews took place in the homes of the respondents between May-July 2019. After interviewing fifteen respondents no new information was coming forward after which two more interviews were conducted before it was decided that data saturation was reached.

## 2.2 Procedure, ethical considerations and interview topics

Approval for this research was granted by the Ethics Review Committee Psychology and Neuroscience at Maastricht University (ERCPN NR: OZL\_188\_10\_02\_2018\_S30).

Before the start of the interview the respondents were asked to sign an informed consent form. The researcher went through the information presented in the form before asking the respondents to sign it. The form explained the aim of the research and how the data would be analysed. The researcher also explained that the data would be treated confidentially and that the results would be published anonymously. The contact details of the researcher were shared with the respondents in case they thought of questions about the research after the interview.

To gather input for developing an intervention to improve fire safe behaviour among elderly people, this study explored fire safety knowledge, fire safe behaviours, and underlying determinants of these behaviours. The interviews were semi-structured. Based on the answers on the main questions (see Table 1), follow up questions were asked to identify underlying determinants (e.g. risk perceptions, self-efficacy). By asking respondents who they think is responsible for fire safety in their homes and from whom they want to receive information about fire safety, we explored which stakeholders might need to be involved in the planning-group for developing an intervention and its subsequent implementation.



Table 1. Interview topics and questions.

Topic	Main questions
Knowledge	What can cause a fire in or around your home?
Behaviour	What kind of behaviour can cause a fire in your home?
	What is being done in your home to prevent a fire from occurring?
	What is being done in your home to detect a fire if it occurs?
	What could you do to prevent a fire from occurring in your home?
	Do you know what to do (and not to do) in the event of a fire occurring in your house?
	Do you think you are able to reduce the risk of a fire occurring in your home?
Responsibility	Who do you think is responsible for fire safety in your home?
	Who can help in sharing information about fire safety?

### 2.3 Data processing and analysis

A digital voice recorder was used to record the interviews. The interviews were transcribed and imported into a software programme for qualitative data-analysis: ATLAS.ti (version 8.4.18). The coding scheme was similar to the topic list for the interviews and followed the nine main questions that guided the interviews: knowledge of causes of fire; knowledge of fire (un)safe behaviour; behaviour of the respondent; escaping in case of a fire; responsibility; reducing risks; determinants; sharing information about fire safety; and 'other'. These topics were analysed after the interviews had been coded.



### 3. Results

#### 3.1 Knowledge on causes of house fires

All participants were asked to describe what might cause a fire in their own homes. Potential causes of fire that were most commonly mentioned included: unattended candles, cooking, a fire place, and short circuits. Every respondent who mentioned candles as a potential cause of fire, acknowledged the risk they play. There was no such consensus, however, when it came to cooking as a potential cause of fire. Some respondents saw cooking as a possible risk of causing a fire regardless what type of cooking appliance is being used. However, others only considered cooking as a risk behaviour if it happened on a gas stove because of the open fire.

*"I think there is a higher risk cooking on a gas stove than cooking on an electric stove. I think. [...] if you have flames like that, [...] well I sometimes see it happening with my daughter. She is wearing a scarf and then she is cooking and then I see those flames [...] Then I say: take that scarf off. I think that's scary." (D11, female, 75yrs)*

Another reason why cooking on a gas stove is considered a possible cause of fire, appears to be because people can forget to turn off the stove. Respondents who mentioned that cooking on an electric stove reduced the risk of fire could generally not explain why they thought it reduced the risk of fire.

*"But I cook on an electric stove so that is not possible either. No idea. But that is always what I think: oh electricity, that is deep down somewhere, nothing can go wrong with that. Unless you leave it on and you put a coffee maker on it, for example. Well, then you have a problem." (D4, female, 81yrs)*

Half of the respondents viewed short circuits as a possible cause of fire. Interestingly, although the respondents considered it a possible cause of fire, they generally could not explain how it happens. They tended to have heard about this cause of fire either on the news or from relatives.

*"I don't know, don't you sometimes hear about that? A wire catching fire or breaking, I don't know. So um [...] inflammation. That sometimes happens. I don't know how but" [...] "Short circuit. That can cause a fire. Yes I am thinking of that now while we are talking." (D6, female, 74yrs)*

In general, respondents knew about causes of fire that start with an open flame. They acknowledged the risk of those causes (candles, cooking on a gas stove, fire place) but were less familiar with causes of fire that did not involve an open flame (short circuit, cooking on an electric stove, overheating

electrical devices). Besides fires starting with an open flame, the respondents also named charging electrical devices and explosions as potential causes of fire. External factors were also reported such as thunderstorms and arson. Half of the respondents considered smoking to be an unsafe behaviour in terms of fire. Other types of fire unsafe behaviour that respondents knew included: using matches, connecting power strips, forgetting to remove the plug from the socket when using an iron, forgetting to turn off the stove, and carelessness with fire in general.

To summarize, the results show that the level of home fire safety knowledge is limited. Most of the respondents can mention some causes of fire but they mostly focus on the source of a fire (e.g. candles) or a moment at which a fire might occur (e.g. cooking) instead of fire unsafe behaviour.

### 3.2 Fire safe behaviour

When asked what they did to prevent fire in their homes, some respondents said they had their gas boiler serviced annually. Respondents also mentioned candles and noted that they either did not use them in their homes, or were aware of blowing them out before going to bed, put them on a solid surface, or used battery-powered candles instead.

*"At most, that makes me a little more alert: did I blow out the candles? So after dinner, blow out the candles, things like that." (D8, female, 73yrs)*

Some respondents were also conscious of their behaviour when using electrical devices. They turned them off when leaving the house and did not charge devices when leaving the house or during the night.

Other measures that respondents took to prevent fire included: not cooking on a gas stove, not using a fireplace, being careful with using matches, and not smoking.

When asked what more they could do to prevent a fire from occurring, some responded that they could use an alarm clock while cooking. Doing so would remind them that there was something on the stove when they had left the kitchen. One of the respondent noted that there was a candle close to a curtain that she might relocate.

*"But there is a candle, the one over there [...] But the wind is not blowing so it can [...] That curtain cannot touch it." (D4, female, 81yrs)*

Most respondents had installed smoke alarms in their homes to alert them in the event of a fire. Only one of the respondents mentioned that he had tested the smoke alarm. Two respondents said their smoke alarms had not been tested and in the other cases, the subject of 'testing smoke alarms' was not discussed.

Some respondents who did not have a smoke alarm reported that they had had 'negative experiences' with them. In the past, the alarm went off for no reason according to the respondent. Such past experiences might influence the motivation to install smoke alarms in the future.

*"Well I can't remember if they both went off at the same time, because it has been a different situation for a while now. And, I don't think there's anything on the ceiling anymore. No. But I find it annoying because the alarm started beeping just because of the hot air. Well, I think that is stupid and then you get nervous and you can't make it stop. Then you stand on a chair trying to reach it, you want to do something but it keeps beeping. It only stops when you take the mess off, right?" (D7, female, 82yrs)*

When asked how to react in the event of a fire in their own homes, five respondents said they would call the emergency services, though only one of the respondents knew the number by heart. None of the other respondents mentioned calling the emergency services.

*"I've never thought about that. There must be a phone number you can call?" [...] "Yes, the fire service, police.. No, I know I have written it down somewhere, but where?"(D9, female, 86 years)*

Many respondents noted that they would initially try to extinguish the fire by themselves. They generally thought the fire would start small and would take time to spread, giving them enough time to extinguish it.

*"Well if I could see that I could put it out, yes something always starts small .. and I don't think that something suddenly lights up here somewhere and that I don't know it at all and then it is suddenly a blaze . Because I don't believe such things." (D7, female, 82yrs)*

Most respondents had thought about an escape route in case of a fire. They planned to escape by the front door, the backdoor, through a window, or via the balcony. In some cases, respondents mentioned that their physical disabilities might prevent them from escaping: they would not be able to escape using the stairs, not be able to climb through a window or climb over a fence that would allow them to escape via their balcony. Furthermore, in some cases where respondents reported that they had thought about an escape route, it was

questionable whether these escape routes were feasible. Some respondents mentioned that they will/would escape via their balcony using a rope or the drainpipe.

*"Well, from the old days, I have a very thick cable rope, which I keep on the balcony. But then you first have to tie it up very well [...] Normally I also wear a brace and my hands are no longer optimal at my age so"[...] "But I thought oh, I'll go via the downspout." [...] "I think you can do it in the event of a fire." [...] "Yes, some sort of primal force." [...] "I know sometimes it will surprise you how I would cope. I surprise myself as well. That's why I know I would go down that downspout without hesitation." (D6, female, 74yrs)*

Waiting on their balcony for the fire service to rescue them did not seem to be an option for some. They felt that leaving the house, even if it was only a possibility of escaping to the balcony, was necessary in the event of a fire.

*"Waiting on the balcony, and then? No I would not [...] I won't go on the balcony. Because then I'm still in my house. I can get out of the house completely using the front door." (D9, female, 86yrs)*

### 3.3 Responsibility for fire safety

All respondents noted that fire safety in their homes was their responsibility. When asked who they thought was trustworthy and could help with sharing information about home fire safety, most respondents mentioned that this could be a task for the fire service. The fire service was seen as trustworthy because "they know what they are talking about". Some respondents also reported the uniform as a sign of expertise.

*"Yes there is certainly a difference because a firefighter knows what he is talking about, home care does not." [...] "Yes, if it is a good one. [...] That's something I don't know. But that's what you assume when a fire fighter enters your house wearing his uniform." (D9, female, 86yrs)*

Other organizations that could help in sharing information about home fire safety and that were noted by more than three respondents included: the housing corporation, the municipality, and the association of property owners.

### 3.4 Determinants influencing the fire safe behaviour of respondents

Most respondents perceived the risk of house fires as low. They did not consider themselves as vulnerable or susceptible to the risk of a fire in their homes. Many respondents reported that nothing had ever happened and that they were careful when it came to risky behaviour.

Many respondents expressed high self-efficacy towards taking measures to preventing home fires. They felt able to extinguish a small fire, use a fire extinguisher or fire blanket, extinguish a pan fire, or install smoke alarms. On the contrary, some respondents expressed low self-efficacy and therefore did not feel able to use fire extinguishers or fire blankets, install smoke alarms, remove a smoke alarm from the ceiling when it was beeping unnecessarily (according to the respondent), and/or escaping from their home.

Some respondents mentioned that their behaviour had become a habit of which they were not aware. In some cases, this behaviour concerned fire safe behaviour such as keeping keys in a set place in the house or checking whether they had switched off electrical devices before leaving the house. Charging electrical devices at night was reported as a habit regarding unsafe behaviour.

Some respondents perceived barriers when taking preventive measures or escaping in the event of a fire. In regards to taking preventive measures, some considered smoke alarms as unattractive and possibly causing disturbance because it could start beeping while unnecessary. Others reported a lack of knowledge as a perceived barrier to taking preventive measures. In respect to escaping from their homes, respondents noted physical disabilities, a lack of time, and feelings of panic as perceived barriers.

None of the respondents mentioned home fire safety as a subject they discussed with their family, friends, or neighbours. They did not know what preventive measures people in their social network were taking.

#### **4. Discussion**

The objective of this study was to establish the perspectives of elderly people on three fire related topics: home fire safety knowledge, fire safe behaviour, and responsibility for fire safety.

Elderly are overrepresented in dying in fires caused by failures in the electrical system [19]. In this research, respondents mentioned short circuits as a possible cause of fire. Electrical causes of fires need more attention in educational programmes directing the fire safety knowledge of elderly people. Work presented by Shields et al. [4] confirms that the majority of elderly people lacks knowledge about leading causes of fire and ways to protect themselves adequately. In their study, only 19% of elderly people knew that cooking was the most common cause of residential fires. In comparison, our study shows that half of the respondents know that cooking is a cause of fire, although many elderly think this is only relevant when cooking on a gas stove. This also

demonstrates that some of the answers that are given by respondents are factually wrong. Some respondents think cooking on an electric stove cannot cause a fire, think their smoke alarm can give an alarm because of hot air and think a fire will start small and will take time to spread, giving them enough time to extinguish it themselves. Some respondents also believe they are capable to escape from a fire via their balcony using a rope or the drainpipe. Overall, the results of this research show that home fire safety knowledge among elderly people is limited and there is a need for elderly to be provided with more information on this topic. Additionally, this information needs to make clear that the risks are relevant to the target group thus increase perceptions of vulnerability rather than increasing perceived severity, which is already high [4]. It is expected that an increase in knowledge will improve the preparedness of elderly people to undertake fire safety precautions [20].

Elderly are also found to be in need of improvements in home fire safety practices [4]. Literature suggests that there is a positive relationship between knowledge and fire safe behaviour [18]. However, it is unclear in what way these concepts interact; taking preventive measures might lead to greater knowledge on fire safety but on the contrary fire safety knowledge might influence the probability of taking preventive measures[4]. The association between knowledge and fire safe behaviour was not assessed in this study. Besides, from a psychological perspective, it is known that knowledge often does not influence behaviour directly[21]. People summarize interpretations, perceptions and/or variances of their knowledge in concepts such as perceived severity, vulnerability, and response efficacy that are more proximal determinants of behavioural motivation and action.

The presence of smoke alarms in the Netherlands is significantly lower in the age group of 65 years and older compared with younger inhabitants [22]. Installing smoke alarms is one of the preventive measures that was taken by most of the respondents. Testing these alarms and therefore the activity of smoke alarms was only discussed in three interviews but this topic needs greater focus. Firstly because smoke alarms are often deactivated because of an empty battery or after an unnecessary alarm according to the occupant [7]. Secondly, working smoke alarms are associated with a significant decrease in the amount of residential fire deaths [23]. However, literature also shows that, despite the presence of smoke alarms, it still happens that elderly become a victim of house fires due to factors such as hearing impairments or reduced mobility. Therefore, a working smoke alarm is no guarantee for a safe escape and passing the alarm to family members, neighbours or care staff might be necessary [24].

Another preventive measure that was measured in this study is planning an escape route. Escaping in case of a fire is not a simple reaction but a result of a complex psychological process [25]. Tancogne-Dejean et al. [25] describe different biases in risk perceptions of laypersons that might influence decision making in the escaping process. Their study identifies six different biases in risk perception of laypersons: "bias of overconfidence", "bias of control", "bias of fatalism", "bias of affect", "bias of social withdrawal", and "bias of non-vigilance". The first three biases are also found in our study. This can be illustrated by quotes from this research: "I know sometimes it will surprise you how I would cope. I surprise myself as well." (bias of overconfidence); "But there is a candle, the one over there [...] But the wind is not blowing so it can [...] That curtain cannot touch it." (bias of control); "I have to die because of something, don't I?" (bias of fatalism). The other types of biases were not found in this study but might play a role in planning an escape route.

Research by Coty et al. [9] shows that social support networks play an important role in home fire safety. In their study, most elderly people noted that they rely on their social support network in terms of maintaining fire preventive measures and escaping in case of a house fire. Other research suggests to engage health practitioners or home care in sharing knowledge and injury prevention programmes [4]. By contrast, the importance of social support networks was not found in our study. Most respondents in this research mentioned the fire service as being trustworthy and knowledgeable. Social support networks such as family members or neighbours were only mentioned by a few respondents as being helpful in sharing information about fire safety. Furthermore home care was mentioned by some respondents as being not knowledgeable. "I think I know more about fire safety than they do." (D9, female, 86yrs). Since this research consists of a small convenience sample, more research is needed into which stakeholders need to be involved in fire prevention programmes targeting elderly people.

Literature shows that individuals use their own resources to deal with dangerous situations such as a fire [25]. Using Witte's [26] extended parallel process model, Rimal et al. [27] classified the combination of an individual's low risk perception and high self-efficacy as a proactive attitude. Individuals with a proactive attitude will actively seek information to protect themselves from health issues, inclining a positive result of low risk perception and high self-efficacy. In our research, the combination of an individual's low risk perception and high self-efficacy seems to form an undesirable combination. Elderly do not see themselves susceptible to the risk of a fire but mostly express high self-efficacy towards acting in case of a fire. Moreover, it is questionable whether their planned escape routes are feasible. Elderly experience more



physical and cognitive limitations than younger persons and are therefore more likely to experience difficulties during the escape from a fire in their homes than people in younger age groups [7].

#### 4.1 Limitations

Respondents signed up for this research themselves after which seventeen respondents were selected to participate. This self-selection bias is a limitation of this research. It is possible that elderly with an increased interest in fire safety have been more likely to participate in this research than those who do not. To reduce this bias, we randomly selected 20 participants out of the 69 applications.

Correspondingly to the research of Shields et al. (2013)[4], this research measured home fire safety knowledge at an individual level and preventive measures, like the presence of smoke alarms, at household level. This limited the ability to measure to what extent knowledge predicts taking preventive measures because home fire safety knowledge of other people in the same household was not always measured. In some cases, other members of the household decided not to participate in this study but taking preventive measures might be influenced by their knowledge as well. Quantitative research could help in further exploring this relationship between fire safety knowledge and fire safe behaviour.

Furthermore, some results of this explorative, qualitative study are based upon presumed behaviour (act in case of a fire) instead of experienced behaviour. Respondents felt able to extinguish a small fire, use a fire extinguisher or fire blanket, or extinguish a pan fire. Most respondents also felt able to escape from their house in case of a fire. We do not know if the respondents have ever had to extinguish a fire or had to escape from a fire so it is questionable if they are really capable or if they overestimate themselves. In addition, there was no check on the presence of preventive measures in the homes of the participants. The interviewer only observed the presence of preventive measures in the room where the interview was taken. In some cases, respondents asked for a home fire safety check. In those cases, the interviewer could check if the preventive measures noted by the respondent were actually present. Nevertheless, data on presumed behaviour might indicate which determinants influence the behaviour of the respondents.

## 5. Conclusion

The current study broadens the field of fire safety by focusing on fire preventive behaviours of elderly people and the underlying determinants. Overall, our research showed that elderly have limited knowledge about home fire safety. Their knowledge mostly focuses on the source of a fire or the moment at which a fire can occur. The respondents did not express much knowledge about certain behaviours that might cause a fire. However, elderly do take preventive measures in the form of installing smoke alarms and planning an escape route.

Furthermore, this research showed that, when developing an intervention to improve fire safe behaviour, it is important to keep in mind which stakeholders are being seen as trustworthy by the target group. Elderly people seem to prefer the fire service in sharing information about fire safety. Risk perception, self-efficacy, habits and perceived barriers are found to have an influence on fire safe behaviour of elderly people. Elderly express a low risk perception towards home fires and feel confident in their abilities to act in case of a fire. However, more research is needed to explore the relationship between different determinants and fire safe behaviour in further depth.

## 6. Acknowledgments

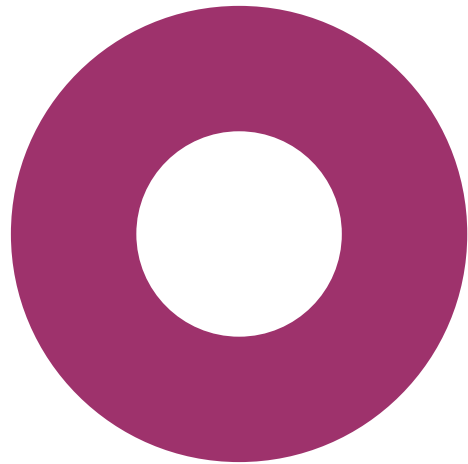
The authors would like to thank the Algemene Nederlandse Bond voor Ouderen, a Dutch association for senior citizens, for helping with the recruitment of respondents and we thank everyone who consented to participate in this research, for their trust and for sharing.

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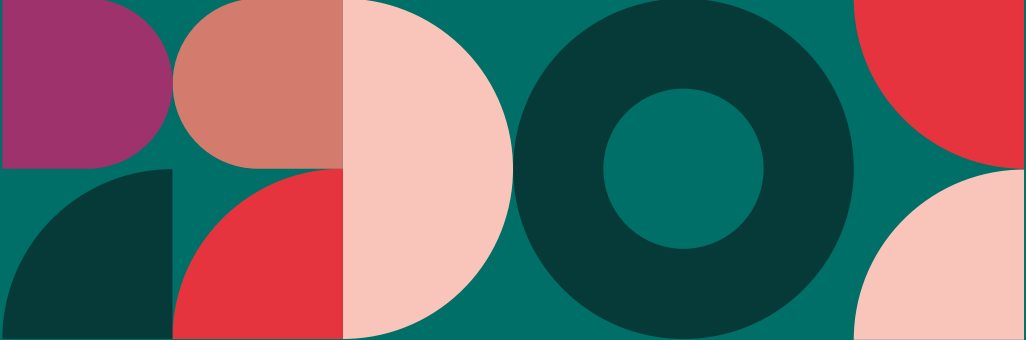
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# Chapter 3

## Social cognitive determinants of fire safe behaviour in older adults

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## Abstract

**Background.** Older adults are a high-risk group when it comes to fire in their homes. In this study we aimed to identify the most important predictors of fire safe behaviours among older adults.

**Methods.** A questionnaire, consisting of 42 questions, was used to measure social cognitive determinants of fire safe behaviours.

**Findings.** The findings showed that most respondents reported performing fire safe behaviours in their homes, in particular not connecting power strips to each other and cleaning the dryer lint filter. However, older adults do not feel very susceptible to the risk of residential fires as indicated by low scores on risk perception and susceptibility. Perceived behavioural control, attitude and response efficacy were found to be determinants that have unique contributions to the explanation of fire safe behaviours. In addition, this research showed that older adults perceive the emergency services, people who have experienced a house fire themselves, the municipality, and housing companies as reliable sources of communications about home fire prevention.

**Conclusion.** The findings suggest that perceived behavioural control, attitude and response efficacy are important target variables for future interventions promoting fire safe behaviour among older adults.

## 1. Introduction

Older adults (here referred to as people aged 65 and over) are a high-risk group when it comes to fire in their homes [1–5]. They are overrepresented in fire fatality statistics [6] and tend to suffer from more severe injuries in house fires [7]. For example, research into fatal residential fires shows that, in the Netherlands, almost half of the victims were 61 years and older and one in three victims was 80 years or older [8]. International research shows that this mortality risk increases up to more than three times the risk at >85 years, compared with the general population [1–3,9,10]. Fire-related injuries are also more common in those aged 65 years and older. Compared to the general population, older adults appear to have a higher risk of both causing a fire as well as having more difficulty in identifying an escape route and successfully evacuating from a fire [4,11]. Furthermore, physical and mental disabilities can be a major contributor to the risk of a fire-related death when age progresses because this might limit the ability of recognizing a fire or responding quickly in the event of a fire [12].

High-income countries, including the Netherlands, are confronted with an ageing population [4,13–15]. In addition, older adults tend to continue to live independently in their own homes up to an older age [10]. Ageing in the home situation has benefits (e.g. social benefits, economic benefits [16] as it promotes a sense of independence and wellbeing [7]). At the same time, both mental and physiological changes related to ageing increase the risk of fire-related injuries and deaths [4,7,9,13]. Therefore, interventions are needed to improve fire safe behaviour in the homes of older adults.

To be able to develop effective interventions that target relevant causes of risky behaviour, it is recommended that the current (risk) behaviours of the target group and the most important and changeable determinants influencing those behaviours are identified in what is called a needs assessment or problem diagnosis [17–19]. However, information about fire safe behaviour among older adults and its determinants in the scientific literature is scarce. In our earlier qualitative study [20], key issues of fire safe behaviour relevant to older adults were identified by asking older adults about their current knowledge of fire safety and current fire safe behaviour. This previous study examined beliefs that inform the social cognitive determinants of behaviour such as attitude, subjective norm and self-efficacy, which are broad evaluations of behaviour in terms of outcomes, social approval, and feasibility. The current, quantitative study focuses on identifying the relevance of these broad evaluations in explaining fire safety behaviour. The findings inform future educational interventions by identifying targets for enhancing older adults's motivation to engage in fire safety behaviours.

In this study theories and psychological models that help explain human behaviour are applied, in particular the Reasoned Action Approach [21], which is complemented with the Protection Motivation Theory [22]. We used general behavioural theories to identify the most important and changeable determinants of the five specific behaviours. Literature on for example disaster preparedness (e.g. wildfires) shows significant associations between preparedness behaviour and social cognitive determinants such as self-efficacy and risk perception [23–26]. Due to the scarcity of literature on determinants of home fire safety, we addressed the most prevalent models to explain behaviour (Protection Motivation Theory, Theory of Planned Behaviour) and the concepts within these models.

### Reasoned Action Approach

The Reasoned Action Approach (RAA) is a social cognitive model that is used to predict and understand intentional behaviour [21] and can help explain why older adults perform or fail to perform fire safe behaviours in their homes. According to the RAA, intention is the most proximal determinant of future behaviour [21]. Intention, in turn, is determined by attitude, perceived norm, and perceived behavioural control. Attitude refers to a person's a positive or negative evaluation of the desired behaviour [21, p76]. Literature distinguishes two types of attitude [21]. Instrumental attitude refers to cognitive aspects of attitude which include an evaluation of the outcomes of an intervention (e.g. useful or not useful). Experiential attitude refers to an affective evaluation of the outcomes of a certain behaviour (e.g. pleasant or unpleasant) [21, p82]. Perceived norm refers to a person's beliefs about what significant people in the person's social environment (e.g., peers, friends, children) think about the desired behaviour. Two types of perceived norm are distinguished; injunctive and descriptive norms. Injunctive norm refers to perceptions on what should be done considering the desired behaviour. Descriptive norm refers to whether others do or do not perform the desired behaviour [21, p.131]. Perceived behavioural control (PBC, similar to self-efficacy [27,28]) refers to a person's perceived capability to perform the desired behaviour [21, p.154],

Attitude, perceived norm and perceived behavioural control include overall evaluations of the behaviour. These evaluations are driven by specific beliefs [19]. In particular specific expectations about the negative and positive outcomes of the behaviour, beliefs about the opinions of an important person or group of people and their approval, and perceived barriers and skills that hinder or facilitate the performance of the behaviour, referred to as behavioural, normative and control beliefs respectively.

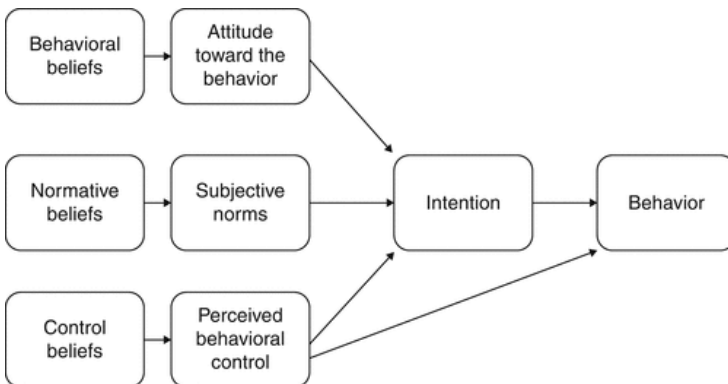


Figure 3. A schematic representation of the Reasoned Action Approach [21].

### Protection Motivation Theory

Protection Motivation Theory (PMT, [22]) suggests that threat appraisal and coping appraisal are two cognitive processes that are instigated by threat messages. Threat appraisal includes an assessment of the seriousness of the threat and one's personal susceptibility to the threat. Coping appraisal includes an assessment of the effectiveness of potential responses (response efficacy) and one's ability to perform these responses (perceived behaviour control). The outcomes of these appraisal processes determine protection motivation, which is measured as an intention to adopt the recommended protective action [22].

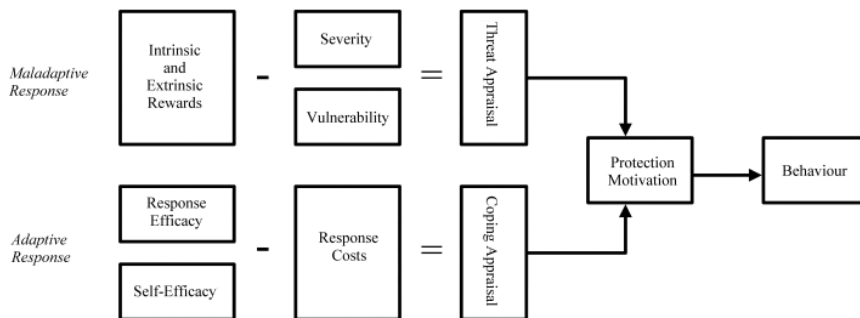


Figure 4. A schematic representation of the Protection Motivation Theory [29].

### Current study

Most literature on the relationship between behavioural determinants and fire safety focuses on preventive measures: smoke alarms (e.g.[30]), fire blankets or fire extinguishers (e.g. [31], or escape routes (e.g. [32]). To our knowledge, apart from our previous study [20], no scientific literature is available that studies the social cognitive factors that determine fire safe behaviour. However, identifying psychosocial constructs such as risk perception, attitude, perceived norms, perceived behaviour control and their underlying beliefs is important because these determinants together explain significant proportions of the variance in behaviour and are amenable for change and thus can be targeted with educational interventions [33,34]. Therefore, this research aims to identify the most important social cognitive determinants of a range of fire safe behaviours among older adults to inform personalized and tailored interventions to promote fire safe behaviour. In order to further inform future interventions, we explored which stakeholders are being seen as trustworthy in sharing information about fire safety.

## 2. Methods

Ethics approval for this research was granted by the Ethics Review Committee Psychology and Neuroscience at Maastricht University (ERCPN NR: OZL\_188\_10\_02\_2018\_S30).

### 2.1 Participants and recruitment

Respondents were recruited through a Dutch association for senior citizens, the Algemene Nederlandse Bond voor Ouderen (ANBO) which has 68.000 members throughout the whole country. In their digital newsletter, a call for respondents was published that asked for people above 65 years old, living independently to fill in a digital questionnaire. The call for respondents was sent to approximately 60.000 subscribers of the ANBO-newsletter and 5766 people participated. After exclusion (all respondents with missing data, n=992 or being younger than 65 years old, n=360) a total of 4414 respondents completed the study (41% female).

### 2.2 Questionnaire

Fire safe behaviour and underlying determinants of the participants were assessed using a questionnaire consisting of four parts: 1) demographics and context specific questions such as the presence of electronical devices and type of cooking device, 2) questions about fire safe behaviours, 3) social cognitive variables, and 4) questions about trustworthiness in sharing information about fire safety (i.e. who you trust as the source of information). Gaining insight in which stakeholders are being seen as trustworthy by the target group can help with identifying stakeholders that are needed in the implementation process of interventions. Next to the project-team, four older adults were asked to check the questionnaire on ambiguity, understandability and length. The pilot showed that the questions were understandable and that respondents were able to fill in the questionnaire, which took about 25 minutes to complete. After making very minor changes (mostly typo's), the final questionnaire was distributed to 60,000 subscribers of the ANBO-newsletter.

#### 2.2.1 Demographics and context specific variables

In the first part, demographics and context specific variables (i.e. sex, age, living situation, homeownership (rented vs. owned home), physical or cognitive impairments, experience with home fires, presence of smoke alarms and escape routes) were collected.

#### 2.2.2 Fire safe behaviours

Based on our prior study [20] and available data (unpublished data from the Dutch Fire safety regions) on common fire causes in the Netherlands, questions about five types of the most prevalent fire safe behaviours were

asked in the second part: 1) staying in the kitchen while cooking, 2) not connecting power strips to each other, 3) charging a phone, iPad, electric bike or mobility scooter only during day time, 4) cleaning the dryer lint filter after every cycle, and 5) not smoking inside the house. Questions were “Do you [perform behaviour]?” and these could be answered by a 5-point Likert scale ranging from (1) never to (5) always.

### 2.2.3 Social cognitive variables

The third part measured five social cognitive constructs with in total 35 items. The constructs were derived from both the RAA and the PMT. The following constructs were questioned for all five fire safe behaviours: intention, risk perception, attitude, perceived behavioural control (PBC), perceived norm (both injunctive- as well as descriptive perceived norm), and response-efficacy (for an overview, see Table 1; for all items, see the questionnaire in Appendix A). All items were measured on a 5-point Likert scale ranging from (1) completely disagree to (5) completely agree, unless otherwise stated. Item scores measuring the same theoretical construct were averaged into one scale when internal consistency was sufficient ( $\alpha > .60$ ).

*Intention.* Intention was measured by the following question for all five types of fire safe behaviour: “I plan to [perform behaviour]”.

*Risk perception.* Risk perception was measured for all five types of fire safe behaviour. Questions were: “How great is the likelihood of a fire starting if you [perform behaviour]”. Items were measured on a 5-point Likert scale ranging from (1) not likely at all to (5) very likely.

*Attitude.* Both instrumental as well as experiential attitude were measured. Instrumental attitude was measured by the following question: “I find [perform behaviour]...”. Items were measured on a 5-point Likert scale ranging from (1) not necessary at all to (5) very necessary. Experiential attitude was measured by the following question: “I find [perform behaviour]...”. Items were measured on a 5-point Likert scale ranging from (1) very unpleasant to (5) very pleasant. For example, there is the chance that people think it is very unpleasant to stay in the kitchen while cooking for all kind of reasons (e.g. not able to interact with others, waste of time) or think it is pleasant because of the possible danger.

*Perceived Behavioural Control (PBC).* Perceived behavioural control was measured for all five types of fire safe behaviour. Questions were: “I think I am able to [perform behaviour]”.

*Perceived norm.* Both injunctive- as well as descriptive perceived norms were measured. Injunctive perceived norms were measured by the following question: “People from my direct environment think that it is important to [perform behaviour]”. Descriptive perceived norms were measured by the following question: “People from my direct environment [perform behaviour]”.

*Barriers and Skills.* Barriers were measured for the following fire safe behaviours: not connecting power strips; only charging a phone, iPad, electric bike or mobility scooter during day time; cleaning the dryer lint filter after every cycle. Skills were measured for cleaning the dryer lint filter after every cycle. The items measuring barriers and skills are based on results of a prior study in which interviews with older adults were conducted [20]. In these interviews no barriers for staying in the kitchen and smoking were mentioned. Therefore, in this research, barriers were not questioned for these behaviours.

*Additional questions.* Additional questions about severity and susceptibility addressed fire safety in general. Susceptibility measured both the absolute risk (susceptibility AR) as well as the relative risk (susceptibility RR) of a fire.

Table 1. Questionnaire with social cognitive determinants.

Determinant	Number of items		Pearson correlations	Example question*	Rating [1-7]
	Total	Items per behaviour type			
Intention	5	1	-	I plan to stay in the kitchen while cooking	‘completely disagree – completely agree’
Susceptibility AR	1	N/A	-	How great is the likelihood of a fire starting in your own home?	‘very small-very great’
Susceptibility RR	1	N/A	-	How great is the likelihood of a fire starting in your own home compared to other people of your age/gender?	‘much smaller-much greater’
Severity	1	N/A	-	How bad are the consequences if a fire occurs in your home?	‘not bad-very bad’
Risk perception	5	1	-	How great is the likelihood of a fire starting if you connect power strips?	‘very small-very great’

Determinant	Number of items		Pearson correlations	Example question*	Rating [1-7]
Attitude	10	2	Cooking: r=.55(N=4332) Power strips: r=.68 (N=4414) Charging devices: r=.63 (N=4294) Dryer lint: r=.67(N=2566) Smoking: r=.80 (N=301)	I find staying in the kitchen while cooking.	'very unnecessary-very necessary' and 'very unpleasant-very pleasant'
Perceived norm	10	2	Cooking: r=.56 (N=2046) Power strips: r=.48 (N=1958) Charging devices: r=.60 (N=1987) Dryer lint: r=.58 (N=1048) Smoking: r=.42 (N=170)	People from my direct environment think that it is important to only charge a phone, iPad, electric bike or mobility scooter during day time	'completely disagree – completely agree'
PBC	5	1	-	I feel able to clean the dryer lint filter after every cycle	'completely disagree – completely agree'
Response efficacy	5	1	-	Not connecting power strips can help in preventing a fire	'completely disagree – completely agree'
Barriers	3	1 <sup>1</sup>		The number of sockets in the house makes it necessary to connect power strips	'completely disagree – completely agree'
Skills	1	1 <sup>2</sup>		I don't know how to clean the dryer lint	'agree' or 'disagree'

\* Every variable was questioned for every behaviour type by adjusting the behaviour in the items measuring the variables. For all items, see the questionnaire in Appendix A

<sup>1</sup> This question was only asked for the following fire safe behaviours: not connecting power strips; only charging a phone, iPad, electric bike or mobility scooter during the day; cleaning the dryer lint filter after every cycle.

<sup>2</sup> This question was only asked for the following fire safe behaviour: cleaning the dryer lint filter after every cycle.

### 2.2.4 Trustworthiness

In the fourth part of the questionnaire, respondents were asked about who they think is responsible for fire safety in their homes and who they think is trustworthy in sharing information about fire safety.

### 2.3 Analysis

In this study, we examined which determinants are important (that is: correlate with the behaviour; Table 4) and are changeable (i.e. there is room for improvements; Table 3). Additionally, we examined to what extent behavioural intentions are predicted by the underlying determinants (Table 4).



The questionnaires responses were analyzed using IBM SPSS Statistics 26. Scores were recoded such that a higher score reflected a higher value of the variable. When calculating mean scores for the determinant perceived norm, the answers 'I don't know' and 'not applicable' were recoded into missing values to exclude them from the analyses. Then, descriptive analyses, bivariate correlations, and regression analyses were conducted. Although regression analyses are commonly used for selecting determinants to target in an intervention, this research also includes correlation analyses to select determinants. According to Crutzen & Peters [35], relying only on the outcomes of the regression analyses in selecting determinants has the risk of missing out on determinants that have a strong univariate association with intention but come out as less relevant in the final the regression model due to high intercorrelations with other determinants, which may lead to interventions that are targeting determinants that are less relevant and have less impact on behaviour change.

### **3. Results**

Characteristics of the final sample are summarized in Table 2. The age of the respondents was mostly 65-80 years old (82%), and the majority of the respondents were married and living together with their partner (56%), mostly in a home they owned (59%) instead of rented. Some respondents mentioned having impairments with 20% reporting reduced mobility, 90% using glasses or contact lenses, 25% using a hearing aid, and 2% mentioned memory loss or dementia. Most respondents did not experience a fire in their own homes nor did they know anyone who had a fire in their home (77%). Most respondents also noted having smoke alarms installed in their home (83%) or knowing an escape route from their home in case of a fire (95%).

Table 2. Demographics.

Gender	N (%)
Female	1801 (41%)
Male	2566 (59%)
Age	
65-80yrs	3605 (82%)
>80yrs	809 (18%)
Living situation	
Living together, married	2452 (56%)
Living together, not married	168 (4%)
Living alone, married	231 (5%)
Living alone, not married	1563 (35%)
Homeownership	
Rented home	1684 (38%)
Owned home	2616 (59%)
Impairments	
Reduced mobility	865 (20%)
Loss of memory and/or dementia	101 (2%)
Use of hearing aid	1088 (25%)
Not hearing well despite hearing aid	135 (12%)
Use of glasses or contact lenses	3990 (90%)
Not seeing well despite glasses or contact lenses	87 (2%)
Experience with home fires	
In own home	226 (5%)
In home of family or friends	185 (4%)
In neighbourhood	415 (9%)
Somewhere else in environment	276 (6%)
Smoke alarm installed in home	3609 (82%)
Planned escape route	4191 (95%)

Note: some respondents reported their homeownership as 'different'. Therefore 3% of the answers was coded as 'missing'.

### *Fire safe behaviour and determinants*

Most respondents reported performing fire safe behaviour in their homes (Table 3). Especially using one power strip at a time (M =4.24; SD = .87) and cleaning the dryer lint filter after every cycle (M =4.22; SD = 1.06) were scored as 'often' or 'always' by the respondents. Overall, the results show that there is room for improvement in performing fire safe behaviour. Especially not smoking inside the house (M=3.02), only charging devices during daytime (M=3.71) and staying in the kitchen while cooking (M=3.88) are behaviours that can be improved.

The mean scores on the different determinants give a general overview of how respondents think about fire safety and the questioned fire safe behaviours. Based on the theories as described in the introduction, relevant social cognitive determinants were included in the analysis. Susceptibility scores (M =1.85-2.47) and scores on risk perception (M =2.01-3.19) are on the lower side (scores lower than 3.5). Respondents do not feel very susceptible to the risk of fire in general. They also express moderate scores on risk perception towards the risk of a fire due to the questioned behaviours. The scores on the other determinants are higher (all 3.5 or above on a scale from 1-5).



Table 3. Scores on measures of fire safe behaviour (M<sup>1</sup>, SD, N).

	General fire safety (M, SD, N)	I stay in the kitchen while cooking	I use one power strip at a time	I only charge my phone, iPad, electric bike or mobility scooter during day time	I clean the dryer lint filter after every cycle	I do not smoke inside my house
<b>Behaviour</b>	4.00 (0.63) (N=4414)	3.88 (0.79) (n=4382 <sup>2</sup> )	4.24 (0.87) (n=4414)	3.71 (1.37) (n=4304 <sup>3</sup> )	4.22 (1.06) (n=2568 <sup>4</sup> )	3.02 (1.56) (n=301 <sup>5</sup> )
<b>Intention</b>	3.74 (0.76) (N=4414)	3.59 (1.01) (n=4370)	3.76 (1.01) (n=4414)	3.70 (1.08) (n=4304)	4.12 (1.02) (n=2562)	2.99 (1.43) (n=302)
<b>Susceptibility AR</b>	1.85 (0.75) (N=4414)	-	-	-	-	-
<b>Susceptibility RR</b>	2.47 (0.78) (N=4414)	-	-	-	-	-
<b>Severity</b>	4.00 (0.86) (N=4414)	-	-	-	-	-
<b>Risk perception</b>	2.61 (0.78) (N=4414)	2.01 (0.90) (n=4349)	2.93 (1.09) (n=4414)	2.62 (1.09) (n=4299)	3.19 (1.06) (n=2568)	2.09 (1.08) (n=302)
<b>Attitude</b>	3.60 (0.55) (N=4414)	3.39 (0.72) (n=4390)	3.87 (0.87) (n=4414)	3.44 (0.90) (n=4317)	3.85 (0.90) (n=2574)	3.18 (1.23) (n=302)
<b>Perceived norm*</b>	3.50 (0.83) (N=3867)	3.27 (0.90) (n=3248)	3.40 (0.92) (n=3176)	3.30 (0.97) (n=3225)	3.51 (1.04) (n=2399)	3.95 (1.16) (n=2611)
<b>PBC</b>	3.89 (0.70) (N=4414)	3.80 (0.91) (n=4382)	3.91 (0.98) (n=4414)	3.86 (1.05) (n=4309)	4.20 (0.94) (n=2568)	2.98 (1.43) (n=301)
<b>Response efficacy</b>	3.97 (0.62) (N=4414)	3.86 (0.87) (n=4414)	3.95 (0.84) (n=4414)	3.84 (0.89) (n=4414)	3.97 (0.90) (n=4414)	4.25 (0.83) (n=4414)
<b>Barriers</b>	3.65 (0.86) (N=4414)	-	3.41(1.25) (n=4414)	3.65 (1.10) (n=4298)	4.15 (0.95) (n=2566)	-
<b>Skills</b>	-	-	-	-	4.38 (0.91) (n=2558)	-

<sup>1</sup> Scale range 1-5.

<sup>2</sup> 21 respondents reported not cooking themselves, 11 values are missing.

<sup>3</sup> 97 respondents reported not having a phone, iPad, electric bike or mobility scooter, 13 values are missing.

<sup>4</sup> 1637 respondents reported not having a dryer, 205 respondents reported not using their dryer and 8 values are missing.

<sup>5</sup> 4112 respondents do not smoke, 1 value is missing.

\* Respondents who reported 'I don't know' or 'not applicable' were excluded from this analysis (see Appendix B).

- When cells are empty this means that the determinant was not questioned for that type of fire safe behaviour.

### Correlations with behaviour and intentions

Pearson's correlations were reported for the univariate association of intention with the social cognitive determinants, see Table 4. We distinguish between strong associations ( $r \geq .50$ ), moderate associations ( $.30 \leq r < .50$ ), and weak associations ( $.10 \leq r < .30$ ) [36]. The results show that the strong positive correlations with intention were found for PBC (range:  $r = .67 - r = .85$ ), attitude ( $r = .58 - r = .85$ ), and response efficacy ( $r = .62 - r = .70$ ). Modest positive correlations were found for perceived norm ( $r = .38 - r = .54$ ) and for risk perception weak-to-moderate positive correlation scores were found ( $r = .19 - r = .41$ ). Modest negative correlations were found for barriers ( $r = -.36 - r = -.56$ ) The other associations were reflected by weak correlations.

### Multivariate analyses

To examine the amount of variance we were able to explain intention to perform the fire safe behaviour, only the social cognitive measures that showed a significant univariate relationship with intention ( $p < .001$ ) were added as predictors to the linear regression model for each fire safe behaviour. The outcome variable of the model was intention. We report both correlations and regressions coefficients in Table 4, because the standardized regression coefficients ( $\beta$ ) are sensitive to intercorrelations among the predictors.

*General fire safe behaviour.* Linear regressions showed that perceived behavioural control,  $\beta = .33$  ( $r = .73$ ), attitude,  $\beta = .29$  ( $r = .71$ ), response efficacy,  $\beta = .27$  ( $r = .68$ ), and perceived norm,  $\beta = .06$  ( $r = .38$ ) had a significant contribution in predicting general fire safety intentions. With these determinants, 68 % of the variance in intention could be explained.

*Staying in the kitchen while cooking.* The variance of staying in the kitchen while cooking has unique contributions of attitude,  $\beta = .32$  ( $r = .71$ ), perceived behavioural control,  $\beta = .29$  ( $r = .68$ ) response efficacy,  $\beta = .26$  ( $r = .62$ ), and perceived norm,  $\beta = .12$  ( $r = .54$ ). With these determinants, 66 % of the variance in intention could be explained.

*Using one power strip at a time.* The variance of using one power strip at a time has unique contributions of perceived behavioural control,  $\beta = .37$  ( $r = .67$ ), response efficacy,  $\beta = .30$  ( $r = .62$ ), attitude,  $\beta = .10$  ( $r = .58$ ), barriers,  $\beta = .10$  ( $r = -.51$ ), and perceived norm,  $\beta = .06$  ( $r = .38$ ). With these determinants, 58 % of the variance in the intention could be explained.

*Only charging electrical devices during the day.* The variance of only charging electrical devices during the day has unique contributions of perceived behavioural control,  $\beta = .35$  ( $r = .74$ ), response efficacy,  $\beta = .29$  ( $r = .68$ ), attitude,

$\beta = .20$  ( $r = .69$ ), perceived norm,  $\beta = .09$  ( $r = .51$ ) and risk perception,  $\beta = .06$  ( $r = .39$ ). With these determinants, 68 % of the variance in intention could be explained.

*Cleaning the dryer lint after every cycle.* The variance of cleaning the dryer lint after every cycle has unique contributions of perceived behavioural control,  $\beta = .33$  ( $r = .76$ ), response efficacy,  $\beta = .24$  ( $r = .70$ ), attitude,  $\beta = .23$  ( $r = .72$ ), barriers,  $\beta = .08$  ( $r = -.56$ ), and perceived norm,  $\beta = .07$  ( $r = .51$ ). With these determinants, 70 % of the variance in intention could be explained.

*Not smoking inside the house.* The variance of not smoking inside the house has unique contributions of attitude,  $\beta = .43$  ( $r = .85$ ), perceived behavioural control,  $\beta = .38$  ( $r = .85$ ) and response efficacy,  $\beta = .16$  ( $r = .65$ ). With these determinants, 83 % of the variance in intention could be explained.

Table 4. Univariate associations (Pearson correlations) and regression analyses of determinants of intention.

	Intention											
	General fire safe behaviour		I stay in the kitchen while cooking		I use one power strip at a time		I only charge my phone, iPad, electric bike or mobility scooter during day time		I clean the dryer lint filter after every cycle		I do not smoke inside my house	
Determinant	r	B	r	B	r	B	r	B	r	B	r	B
Susceptibility AR	-.07*	-.004	-.07*	-.002	-.06*	.040	-.03		-.01		-.03	
Susceptibility RR	-.04	-	-.04	-	-.07*	-.040	.00		.03		-.14	
Severity	.09*	.025	.07*	.003	.05	-	-.08*	.010	.10*	.027	-.06	
Risk perception	.32*	.031	.19*	.040	.33*	.039	.39*	.059*	.41*	.032	.30*	.052
Attitude	.71*	.393*	.71*	.441*	.58*	.118*	.69*	.237*	.72*	.263*	.85*	.489*
Perceived norm <sup>1</sup>	.38*	.051*	.54*	.134*	.38*	.062*	.51*	.104*	.51*	.071*	.52*	.054
PBC	.73*	.365*	.68*	.324*	.67*	.377*	.74*	.364*	.76*	.362*	.85*	.379*
Response efficacy	.68*	.319*	.62*	.292*	.62*	.361*	.68*	.347*	.70*	.283*	.65*	.207*
Barriers <sup>2</sup>	-.40*	.001	-	-	-.51*	.076*	-.36*	.019	-.56*	.086*	-	-
Skills <sup>3</sup>	.22*	.012	-	-	-	-	-		.32*	.037	-	-
<b>R<sup>2</sup></b>	<b>.679</b>		<b>.655</b>		<b>.578</b>		<b>.675</b>		<b>.701</b>		<b>.825</b>	

\* Significant correlations at  $p < .001$

<sup>1</sup> Respondents who reported 'I don't know' or 'not applicable' were excluded from the analysis.

<sup>2</sup> Barriers was not questioned for cooking and smoking.

<sup>3</sup> Skills was only questioned for the behaviour type 'cleaning the dryer lint filter'.

### *Trustworthiness*

Almost all respondents (99%) noted that fire safety in their homes was their responsibility. Furthermore, some respondents mentioned that, in their opinion, the housing company (23%), the fire service (4%), the municipality (3%), and their partner with whom they live together (3%) were also responsible for the fire safety in their homes.

When asked who they thought was trustworthy when sharing information about home fire safety, most respondents mentioned that this would be the fire service (93%). Other parties that were seen as trustworthy by more than 50% of the respondents were: the police (74%), people who have experienced a fire in their home (67%), the municipality (66%), and housing companies (55%). Home care (46%), family (40%), and neighbours (32%) were seen as less trustworthy.

## **4. Discussion**

The objective of this study was to identify the most important predictors that influence preventive behaviours among older adults to be able to develop personalized and tailored interventions to promote fire safe behaviour. First, the findings showed that, on average, respondents reported performing fire safe behaviours in their homes. Specifically, not connecting power strips to each other and cleaning the dryer lint filter are performed by most of the respondents.

Second, this study shows that strong positive correlations with intention were found for perceived behavioural control, attitude, and response efficacy. Other social cognitive determinants such as perceived norm, barriers and risk perception showed moderate correlations with intention and for severity and susceptibility, weak correlations were found. Linear regressions showed that perceived behavioural control, attitude, response efficacy, and perceived norm had a significant contribution in predicting general fire safety intentions. With these determinants, on average 69 % of the variance in intention could be explained.

The results of this study provide a better understanding of which social cognitive determinants influence behaviour of older adults. So far, the focus in field of fire safety was mostly on the (observable) response of people in the event of a fire [37] or preventive measures [3,9]. Some research show significant associations between fire safe behaviour and psychosocial concepts such as knowledge, attitude, and social normative beliefs [38]. Other research is mainly descriptive instead of predictive and focused on risk perception, knowledge

and preventive measures [9] or suggests that risk perception is one of the main influencers of home fire safety practices of older adults [7]. Our study contributes to a deeper insight into social cognitive determinants influencing fire safe intentions of older adults which provides valuable knowledge when developing behavioural interventions.

Our study outcomes have several implications. First, the findings of this research have implications for interventions targeting older adults in order to improve their fire safe behaviour. This study shows that a change in focus is needed. Fire safety interventions in the Netherlands often focus on risk perception and risk communication. The results of this study show that risk perception has weak associations with the intention to perform fire safe behaviour in comparison with other determinants. For future interventions it would be valuable if attitude, perceived behaviour control and response-efficacy would be addressed in these interventions. However, the psychological beliefs underlying the social cognitive determinants are based on were not questioned in this research. Earlier qualitative research we performed [20] provides a first insight in these beliefs and therefore the results of both studies could help in formulating change objectives in order to develop effective interventions.

A second implication of this study is that, when developing interventions in order to improve fire safety among older adults, it is important to find out which stakeholders are being seen as trustworthy by the target group in sharing information about fire safety. Research shows that social supporting networks play an important role in home fire safety and that most older adults rely on their social networks in terms of maintaining fire preventive measures or escaping in the event of a fire. [7]. Other research recommends to engage health practitioners or home care in sharing knowledge [9]. In accordance with international research [39,40], our research shows that the fire service is being seen as trustworthy by the public. The results of this study show that older adults see the fire service as most trustworthy in sharing information about fire safety. Social supporting networks such as home care, family of neighbours were seen as less trustworthy.

In the Netherlands, there is national legislation for residential buildings and national policy for community fire safety. The national legislation for residential buildings should ensure that a fire will not spread to another dwelling. With regard to national legislation there is no- and with regard to national policies hardly any distinction is made between older and younger people. Fire safety inside the house is the responsibility of the occupant. Since 2003, smoke



detectors are mandatory in newbuild homes and as of 1 July 2022, they will be mandatory in existing buildings as well. The fire service uses education, campaigns and fire safety checklists to spread information about fire safety. In order to assess if the findings of this study are applicable to other countries, this information needs to be taken into account.

Strengths of this research are that a large number of respondents participated in this study. Furthermore, the questionnaire that was used in this study was developed based on psychological theories and prior qualitative research into fire safe behaviour amongst older adults [20]. A limitation of this research is that it examined intended behaviour which is not always a good predictor of actual behaviour [41]. Although future behaviour is predicted by current behaviour (which was measured in this study), we could not measure future behaviour (as is done in for example Joffe et al.[42]). Therefore, the decision was made to focus on intention as the outcome variable.

Another limitation of this research is the self-selection bias. The questionnaire was sent to all 65+ members of a national association for senior citizens after which they decided to participate in this research or not. It is possible that older adults who have an increased interest in fire safety have been more likely to participate in this research. It is unknown if there is a good geographical spread among the respondents. The ANBO distributed the questionnaire among their 68.000 members throughout the country but it is unknown where respondents live. A second limitation is that only older adults who have internet access were able to participate in this study because the questionnaire was sent to them via a digital newsletter. To include older adults who do not have internet access in order to get a clearer view of determinants influencing the fire safe behaviour of older adults, it would be valuable to repeat the same kind of research using a questionnaire on paper. Also, older adults who suffer from symptoms of dementia, who are a risk group in themselves, are probably not involved in this research. This has some implications for the measures to improve safety, as such groups would be harder to target by information measures. Another limitation is that this study focused on five fire prevention behaviours. Although these behaviours are based on the most common fire causes among older people in the Netherlands, it would be useful to include other types of actions as well in future research (e.g. incorrect use of electrical appliances, playing with fire). Besides, intention was questioned as follows: "I plan to [perform behaviour]". It would have been better to have included a specific time-interval for the intention, e.g. "in the near future."

## 5. Conclusion

The current study broadens the field of fire safety by focusing on determinants that predict fire preventive intentions of older adults. Overall, our research showed that most respondents reported performing fire safe behaviour in their homes. Using one power strip at a time and cleaning the dryer lint filter after every cycle are fire safe behaviours which are performed by most of the respondents. However, the results also show that there is room for improvement according to performing fire safe behaviour.

Scores on the different social cognitive determinants showed that, in general, older adults do not feel very susceptible to the risk of a fire caused by one of the questioned behaviours. They also express a moderate risk perception towards the risk of a fire caused by these behaviours. Especially, perceived behavioural control, attitude and response efficacy are determinants that have unique contributions to the five fire safe behaviours. Therefore we strongly recommend to use these determinants as targets for future interventions for older adults.

Lastly, this research showed that, when developing an intervention to improve fire safe behaviour among older adults, it is important to keep in mind which stakeholders might be helpful and are being seen as trustworthy by the target group. Older adults seem to prefer the emergency services (both fire service as well as police), people who have experienced a house fire themselves, the municipality and housing companies in sharing information about fire safety.

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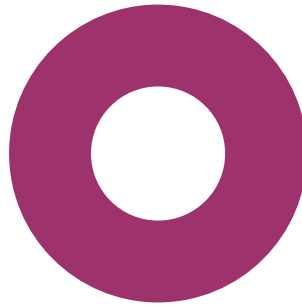
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# Chapter 4

## Using Intervention Mapping to systematically develop a fire safety intervention for older adults

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# Chapter 5

## The effects of the Fire Safety at Home programme on four fire safety behaviours among older adults

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safety behaviours.

## Abstract

**Background.** Older adults face an increased risk of injury or fatality in domestic home fires, emphasizing the need to focus on promoting fire safety behaviours within this demographic group.

**Methods.** A total of 433 participants older than 65 years of age participated in this study. Participants in the intervention group received a systematically developed fire safety programme, while the control group received a fire safety programme as is given by the Dutch fire service (standard care). Outcome measures assessed four fire safety behaviours (i.e., staying in the kitchen while cooking, not connecting power strips to each other, charging electronic devices, and cleaning the dryer lint filter after every cycle) and key behavioural determinants (attitude, self-efficacy, and risk perception). A measure of behavioural intention was added as a proxy indicator of future fire safety behaviours.

**Results.** Where improvements over time were found for all behaviours in both conditions, compared to the control group, the new intervention yielded significant improvement in three out of the four fire safety behaviours (connecting power strips, putting a phone or iPad on a couch or chair while charging, and cleaning the dryer lint filter). Additionally, the intervention positively influenced the social cognitive determinant attitude towards fire safety behaviour, and risk perception towards cleaning the dryer lint filter after every cycle.

**Discussion.** Effectively instigating changes in fire safety behaviour among older adults can be done by specifically and intensively targeting these specific behaviours and their determinants in an intervention.

## 1. Introduction

In the context of domestic home fires, older adults face a heightened vulnerability to both injury [1–6] and fatalities [7–13], in stark contrast to those below the age of 65 years. Statistics from 2022 reveal that over 50% of fatal domestic fire victims in the Netherlands were 65 years or older [14] despite this age group representing only 20.1% of the Dutch population [15]. Moreover, the likelihood of non-fatal injuries in the event of a fire also increases with age [13,16,17]. Notably, older adults frequently experience injuries related to cooking, smoking, and heating [4]. It is therefore that older adults over the age of 65 years are an important target group for programmes to promote fire safety behaviours [10–12,18,19].

A common approach in fire safety programmes is to enhance overall fire safety awareness and encourage individuals to implement fire safety measures in

their homes. These programmes operate under the assumption that this heightened awareness automatically translates into fire safety behaviours [6,17,20–24]. However, risk communication theory and frameworks for theory- and evidence-based intervention development make it uncertain whether these programmes are sufficiently effective in reducing the incidence of fires and mitigate the consequences of home fires [6,17,23–25].

To increase the potential effectiveness of fire safety programmes, adopting a systematic and participatory approach in programme development can be advantageous [26–29]. Only a limited number of studies have been identified that systematically developed home fire safety programmes [21,25] or engaged the target group in the programme's development [30]. These studies demonstrated positive effects on fire prevention behaviour and its underlying cognitive determinants, in particular risk awareness and attitude towards fire safety. Moreover, limited attention has been given to the exploration of other social cognitive determinants of behaviour change, such as perceived susceptibility and self-efficacy, which are recognized as stronger predictors of behaviour change compared to mere knowledge of preventive measures and the adverse health consequences of fire hazards [10,25,30–32]. Indeed, psychosocial determinants such as risk perception, attitude, perceived norms, perceived behaviour control and their underlying beliefs account for significant proportions of the variance in behavioural decision making and, importantly, can be effectively targeted through educational interventions due to their susceptibility to change through educational interventions [33,34].

In the Netherlands, the Dutch Fire Service organizes fire safety meetings aimed at educating older adults on home fire safety. Typically, these programmes involve presentations or home visits, with a primary focus on enhancing awareness about fire safety. These meetings may occur at various venues, including fire stations, senior housing complexes or at community centres. In a literature search, only one study was found that reported a systematic evaluation of the effectiveness of home visits and fire safety presentations by the Dutch Fire Service to promote fire safety behaviour [35].

### 1.1 Intervention Mapping

Intervention Mapping is a protocol for the systematic development of theory- and evidence-based behaviour change programmes or interventions. Intervention Mapping consists of six steps starting with an in-depth analysis of the problem at hand (fire safety), the behaviours causing the problem and the underlying personal determinants within the at-risk population that explain the risk behaviours. The second step focuses on formulating behavioural, performance and change objectives. In this step, the foundation for the

intervention will be provided by specifying who and what will change when the intervention will be executed. To achieve the desired programme outcomes, performance objectives are formulated: detailed descriptions of the desired sub-behaviours of the target group [28]. Change objectives describe what needs to change for the target group to perform the performance objectives. When formulating change objectives, the most important and changeable determinants should be taken into account, keeping the performance objectives in mind [36]. Change objectives help planners with selecting theory-based behaviour change methods and translating these methods into practical applications, which is described in IM-step 3 [28]. Next, the methods and practical applications are integrated into an organized programme in IM-step 4. In IM-step 5 a plan for implementation of the intervention is developed and finally, in IM-step 6, an evaluation plan is created.

In the current study a fire safety programme is developed using Intervention Mapping and experimentally pilot tested on its effects on fire safety behaviours (effect evaluation). The intervention development process is described in more detail in [37]. The intervention is based on a needs assessment study in which we identified social cognitive determinants of fire safety behaviours among 4414 older adults. This study showed that, in general, older adults do not feel very susceptible to the risk of a fire caused by one of the questioned behaviours. They also express a moderate risk perception towards the risk of a fire caused by these behaviours. In particular, self-efficacy, attitude and response efficacy showed strong and unique contributions to the prediction of fire safe behaviours [38]. The present study describes the effect evaluation of the Fire Safety at Home programme. The intervention aims to promote different fire safety behaviours (staying in the kitchen while cooking, not connecting power strips to each other, charging electronical devices, and cleaning the dryer lint filter after every cycle) by targeting their underlying determinants, in particular attitude, self-efficacy, and risk perception. A measure of behavioural intention was added as a proxy indicator of future fire safety behaviours next to measures of actual fire safe behaviours at pretest and posttest.

## 2. Methods

### 2.1 Study design

A pretest-posttest one-factorial experimental design was used with an intervention and control group. In the intervention group, participants received the Fire Safety at Home programme. In the control group, participants joined a standard fire safety information meeting as provided by the fire service in different safety regions across the Netherlands (control group).

In both the intervention group as well as the control group, after signing up, participants received either a link to an online questionnaire or received a questionnaire on paper at their home address (referred to as the baseline questionnaire). Participants were instructed to complete this questionnaire before the day of participating in the intervention programme. Those who received a hard copy questionnaire were asked to return it to the research team on the day of the intervention. Participants who did not complete the questionnaire in advance, were provided the opportunity to do so on the day of the intervention before the start of the meeting.

Two weeks after the programme, participants received a second questionnaire (referred to as follow-up questionnaire) via email or by post, depending on their preferred method. For completing both the baseline- and follow-up questionnaire and to reimburse for travel time and expenses (in total they spent 4-5 hours for participating in the study), participants were rewarded with a 50 euro-gift voucher. To facilitate programme attendance, transportation arrangements could be made when requested in both the intervention as well as the control group. After exclusion (respondents younger than 65 years or respondents who did not complete more than 5% of the baseline- and follow-up questionnaire) a total of 433 respondents completed the questionnaires. In the intervention group, 219 respondents completed the baseline and 221 respondents completed the follow-up questionnaire. In the control group, 214 respondents completed the baseline, while 78 respondents completed the follow-up questionnaire.

For this study and procedures, ethics approval was granted by the Ethics Review Committee of the Faculty of Psychology and Neuroscience, Maastricht University the Netherlands [188\_11\_02\_2018\_S33].

## 2.2 Participants and recruitment procedure

Participants being 65 years or older and living independently were recruited through various channels, including the fire service, senior citizen associations, housing companies, organizations focusing on older adults. The invitation was shared through websites, social media, newsletters, or local newspapers. Furthermore, informational flyers were distributed in residential areas or complexes where many older adults live.

For the Fire Safety at Home programme, participants were required to sign up for the programme in advance, allowing the research team to manage attendance and ensure it did not exceed capacity. On the invitation contact details of the research team (email and telephone number) were mentioned that could be used for signing up. Because of the limited space of the different



rooms in which the exercises were performed, and the possibility to have group discussions with everyone involved, a maximum of 25 participants per shift were accepted (7-8 participants in each room).

For the control group, some trainers followed a similar sign-up procedure by distributing the invitation among organizations that are in contact with older adults, allowing them to sign up in advance by emailing. Other trainers permitted open attendance without prior registration. In the control group, depending on the location of the fire safety meeting, it was decided by the trainers if the number of participants was limited to a certain number. In the control group, the data resulted from fire safety meetings conducted in nine different safety regions, led by fourteen different trainers. The Netherlands is divided into 25 safety regions. Each safety region is committed to the safety of the residents and visitors of that area. Therefore, the safety region ensures that there is a fire brigade and protocols are in place to tackle disasters and crises.

## 2.3 Questionnaire

Fire safety behaviours and underlying determinants were assessed using a baseline- and a follow-up questionnaire both consisting of three parts: 1) demographics and questions about the home setting (e.g., the type of cooking device used at home), 2) fire safety behaviours, and 3) social cognitive determinants. Furthermore, the follow-up questionnaire included questions to evaluate the content of the programme the participants attended (see Appendix F). Before finalizing the research instruments, the project team and a group of five older adults who were about to attend a presentation about home fire safety by the fire service checked the questionnaire on ambiguity, understandability, and length. This pretesting showed that the questionnaire was understandable and took about 15 minutes to complete. Only minor changes were implemented.

### 2.3.1 Demographics and context-specific variables

In the first part, demographics and context-specific variables (gender, year of birth and living situation (living alone or together with a partner) were collected.

### 2.3.2 Fire safety behaviours

Based on the topics which are addressed in the Fire Safety at Home programme, four fire safety behaviours were surveyed: 1) staying in the kitchen while cooking, 2) not connecting power strips to each other, 3) charging electronical devices (measured by two items), and 4) cleaning the dryer lint filter after every cycle. The questions about charging electronical devices include questions about putting them on upholstered furniture while charging,

which is unsafe behaviour. Questions are “Do you [perform behaviour]?” which can be answered by a 5-point Likert scale ranging from (1) never to (5) always.

Besides questions about specific fire safety behaviours: the questionnaire contained three items about fire safety beliefs in general. These items could be answered by scoring from 0 (completely disagree) to 100 (completely agree) on a visual analogue scale (VAS scale). For example: “Fire safety is an important topic in my daily life.”

### 2.3.3 Social cognitive variables

Four social cognitive constructs were measured with in total 25 items. These constructs were derived from both the Reasoned Action Approach [39] and the Protection Motivation Theory [40]. For all four fire safety behaviours the following socio-cognitive constructs were measured: intention, risk perception, attitude, and self-efficacy. Items were scored on a Visual Analogue Scale (VAS). Risk perception was scored from 0 (very small) to 100 (very high). The other items could be answered by scoring from 0 (completely disagree) to 100 (completely agree). For an overview of the measures and exam items, see Table 1. For the full study instrument, see Appendix F)

Table 1. Questionnaire with social cognitive determinants.

Determinant	Number of items	Example question*	Rating [0-100]
Attitude	8	If I charge electrical devices, it is important that I stay close to them.	'completely disagree – completely agree'
Self-efficacy	5	I feel able to clean the dryer lint filter after every cycle	'completely disagree – completely agree'
Risk perception	7	How great is the likelihood of a fire starting if you connect power strips?	'very small-very high'

\* Every variable was questioned for every behaviour type by adjusting the behaviour in the items measuring the variables. For all items, see the questionnaire in Appendix F.

### 2.3.4 Evaluation of the programme

After attending the fire safety programme in either the intervention or control group, respondents were asked to evaluate the content of the programme. Their evaluation was measured by questions asking whether they enjoyed the programme, if they thought the information was understandable and useful, and if they would recommend the programme to their peers. See Appendix F for the full set of evaluation measures.

## 2.4 Process evaluation

The way in which the programme is executed and how this was experienced by the trainers was evaluated in three different ways. First, in the intervention group, a member of the research team observed both participants as well as the trainers during the programme to see if the assignments were executed according to the protocol. Since the programme in the control group consisted of a presentation instead of assignments, no such check was included. Second, after all programme sessions were completed, an evaluation session together with the trainers and the fire service was held to evaluate the implementation process. Third, all trainers received a questionnaire after conducting the programme. This questionnaire asked if the programme was executed according to plan, what the trainers think about the programme (strong vs. weaker points), if the programme reaches the interest of the target group and if they think the programme will lead to a change in behaviour among the target group. For all items, see Appendix G.

## 2.5 Analysis

In this study, we examined the current fire safety behaviours and beliefs of older adults who join/participate in a fire safety programme (Table 2). Additionally, we examined the effects of the Fire Safety at Home programme (intervention-group) on the measures of determinants and intention by comparing the intervention to the fire safety meetings provided by the fire service in the different safety regions in the Netherlands (control-group) (Table 3).

To connect baseline- and follow-up questionnaire data from the respondents, they were asked to create a personalized code, combining the first two letters of their street name, the two numbers of their day of birth, and the first two letters of their mothers name. Three members of the research team entered the responses from the paper questionnaires into the digital dataset. In case of any doubt about a response (score) on a certain item, all three members checked the score until consensus was reached.

The questionnaire responses were analyzed using IBM SPSS Statistics v26. Outcome variables were the four fire safety behaviours and their underlying determinants attitude, self-efficacy, and risk perception. A measure of behavioural intention was added as a proxy indicator of future fire safety behaviours. When calculating mean scores for these determinants, missing values were listwise excluded.

T-tests were used to identify baseline differences between the two conditions on each of the measures. To test the effectiveness of the intervention, mixed regression was used for each outcome variable, using the pretest and post test as repeated outcome measures, and using time (0 = pretest, 1 = post test) and condition (0 = control, 1 =intervention) as predictors. The mixed model contained time effects, condition effects and two-way interactions of time\*condition. All tests were carried out using alpha = 0.05 two-tailed. Non-identifiable data, syntax and output of the analyses are fully disclosed.

### 3. Results

The demographics at baseline are summarized in Table 2. The majority of the respondents was female (60%) and the mean age was 76 years old. The majority of the respondents were living together with their partner (59%). Most respondents reported cooking on an electric stove (60%) instead of a gas stove (39%). Furthermore, many respondents own a dryer (72%) of which most also use the dryer (87%).



Table 2. Demographics at baseline.

	Total	Control	Intervention
<b>N</b>	433	214	219
<b>Gender<sup>1</sup></b>			
Female, N (%)	258 (60%)	132 (62%)	126 (58%)
Male, N (%)	174 (40%)	81 (38%)	93 (43%)
<b>Age (year of birth), M (SD)</b>	1946 (6.2)	1946 (6.3)	1946 (6.2)
<b>Living situation, N (%)</b>			
Living together	253 (59%)	124 (58%)	129 (59%)
Living alone	177 (41%)	88 (41%)	89 (41%)
Other	3 (1%)	2 (1%)	1 (1%)
<b>Type of cooking device<sup>2</sup></b>			
Gas stove	169 (39%)	73 (34%)	96 (44%)
Electronical cooking device	258 (60%)	138 (65%)	120 (55%)
N/A I don't cook in my own home	5 (1%)	2 (1%)	3 (1%)
<b>Owning a dryer</b>			
Yes	313 (72%)	156 (73%)	157 (72%)
No	120 (28%)	58 (27%)	62 (28%)
<b>Using the dryer</b>	281 (87%)	146 (87%)	135 (86%)

<sup>1</sup> Missing = 1

<sup>2</sup> Missing in control group = 1

### 3.1 Fire safety behaviour and determinants

At baseline ( $T=0$ ), in both the intervention and the control group, scores on attitude ( $M_{\text{total}} = 78.9$ ;  $SD = 17.4$ ), self-efficacy ( $M_{\text{total}} = 81.0$ ;  $SD = 17.4$ ) and intention ( $M_{\text{total}} = 79.9$ ;  $SD = 19.0$ ) were relatively high. Furthermore, most respondents reported performing fire safe behaviour in their homes. Especially cleaning the dryer lint filter after every cycle ( $M_{\text{intervention}}=4.0$ ;  $SD=1.4$  and  $M_{\text{control}}=4.2$ ;  $SD=1.2$ , respectively) and putting the heat down when leaving the kitchen ( $M_{\text{intervention}}=3.8$ ;  $SD=1.4$  and  $M_{\text{control}}=3.8$ ;  $SD=1.4$ ) were scored as 'often' or 'always' by the respondents. In contrast, unsafe behaviours such as putting a phone or iPad while charging on a sofa or chair ( $M_{\text{intervention}}=1.4$ ;  $SD=1.0$  and  $M_{\text{control}}=1.5$ ;  $SD=1.1$ ), connecting power strips ( $M_{\text{intervention}} = 1.7$ ;  $SD=1.0$  and  $M_{\text{control}} = 1.7$ ;  $SD = 1.0$ ) and charging electronical devices at night ( $M_{\text{intervention}}=2.4$ ;  $SD=1.5$  and  $M_{\text{control}} = 2.2$ ;  $SD=1.5$ ) were scored as

'rarely' or 'never' by the respondents. Leaving the kitchen while cooking when the doorbell rings, a possible unsafe behaviour, was scored as 'regularly' ( $M_{\text{intervention}} = 3.2$ ;  $SD = 1.5$  and  $M_{\text{control}} = 3.4$ ;  $SD = 1.5$ ). Furthermore, scores on the likelihood of a fire starting by different fire causes were scored from 13% up to 46% and scores on general fire safety beliefs were at baseline  $M_{\text{intervention}} = 83.6$ ;  $SD = 18.1$  and  $M_{\text{control}} = 80.5$ ;  $SD = 19.5$ . These mean scores on the different determinants give a general overview of how respondents think about fire safety and the questioned fire safety behaviours and determinants.

No differences at baseline were found between intervention and control group, except for the item that measured risk perception for cooking on an electric stove. An overview of the results of the t-tests can be found in Appendix H.



Table 3. Behaviours and determinants.

	Control M (SD)		Intervention M (SD)	
	T=0 <sup>1</sup>	T=1	T=0	T=1
<b>Attitude</b>	79.07 (15.84) n = 214	80.02 (20.36) (n=75)	78.77 (18.89) n = 215	84.93 (16.13) n = 221
<b>Self-efficacy</b>	80.83 (14.83) n = 199	88.01 (15.46) n = 74	81.17 (19.47) n = 211	84.10 (15.61) n = 219
<b>Intention</b>	78.24 (19.34) n = 204	86.14 (18.07) n = 74	81.47 (18.63) n = 216	86.19 (16.65) n = 221
<b>Behaviour</b>				
When I am cooking and the telephone rings, I put the heat low before leaving the kitchen	3.82 (1.36) n = 182	4.43 (1.22) n = 77	3.75 (1.40) n = 196	4.40 (1.01) n = 212
When I am cooking and someone rings the doorbell, I leave the kitchen	3.42 (1.48) n = 185	3.53 (1.53) n = 76	3.24 (1.49) n = 204	3.41 (1.58) n = 212
I connect power strips to each other	1.72 (.97) n = 208	1.88 (1.27) n = 78	1.70 (1.04) n = 216	1.63 (.90) n = 218
At night time I charge my phone, iPad, electric bike or mobility scooter	2.21 (1.50) n = 206	2.05 (1.43) n = 77	2.24 (1.51) n = 217	1.98 (1.36) n = 219
When I am charging my phone or iPad, I put it on the sofa or on a chair	1.51 (1.11) n = 204	1.79 (1.45) n = 76	1.40 (.96) n = 216	1.21 (.77) n = 220
I clean the dryer lint filter after every cycle	4.20 (1.19) n = 149	4.26 (1.37) n = 62	3.97 (1.35) n = 154	4.93 (.90) n = 177
<b>Risk perception</b>				
Cooking on a gas stove	35.42 (31.90) n = 107	49.52 (33.36) n = 70	40.60 (30.41) n = 161	46.96 (31.41) n = 190
Cooking on an electric stove	13.38 (18.16)* n = 139	17.85 (21.24) n = 72	18.76 (18.89)* n = 170	27.54 (25.68) n = 180
Leaving the stove while cooking	35.00 (35.74) n = 135	47.44 (35.57) n = 72	41.01 (32.40) n = 173	54.27 (33.49) n = 190
Connecting power strips	39.77 (34.17) n = 140	49.03 (35.78) n = 73	43.19 (32.84) n = 180	59.90 (34.17) n = 198
Charging devices at night time	32.22 (32.43) n = 139	43.78 (33.17) n = 73	35.64 (30.78) n = 179	48.34 (34.07) n = 201
Laying a phone or iPad on a sofa or chair while charging	43.73 (33.70) n = 128	48.92 (34.40) n = 72	45.66 (32.22) n = 174	58.27 (33.85) n = 199
Not cleaning the dryer lint filter after every cycle	43.23 (31.88) n = 112	50.47 (34.42) n = 59	43.57 (30.94) n = 141	60.91 (32.73) n = 152
<b>General fire safety beliefs</b>				
I can decrease the chance of a fire in my own home	83.21 (21.46) n = 196	90.99 (16.43) n = 75	82.26 (21.02) n = 211	90.39 (14.90) n = 218
Fire safety is an important theme for me	79.58 (24.00) n = 196	85.25 (21.80) n = 75	80.93 (25.45) n = 214	84.79 (20.02) n = 219
I feel able to prevent a fire from occurring in my home	78.94 (23.25) n = 195	87.05 (19.30) n = 75	82.96 (22.23) n = 213	87.73 (15.71) n = 218
General fire safety_total	80.49 (19.54) n = 200	87.76 (16.02) n = 75	83.58 (18.11) n = 216	87.67 (13.63) n = 219

<sup>1</sup> T=0: pre-programme; T=1: post-programme

\* Significant difference in score at baseline (see Appendix H)

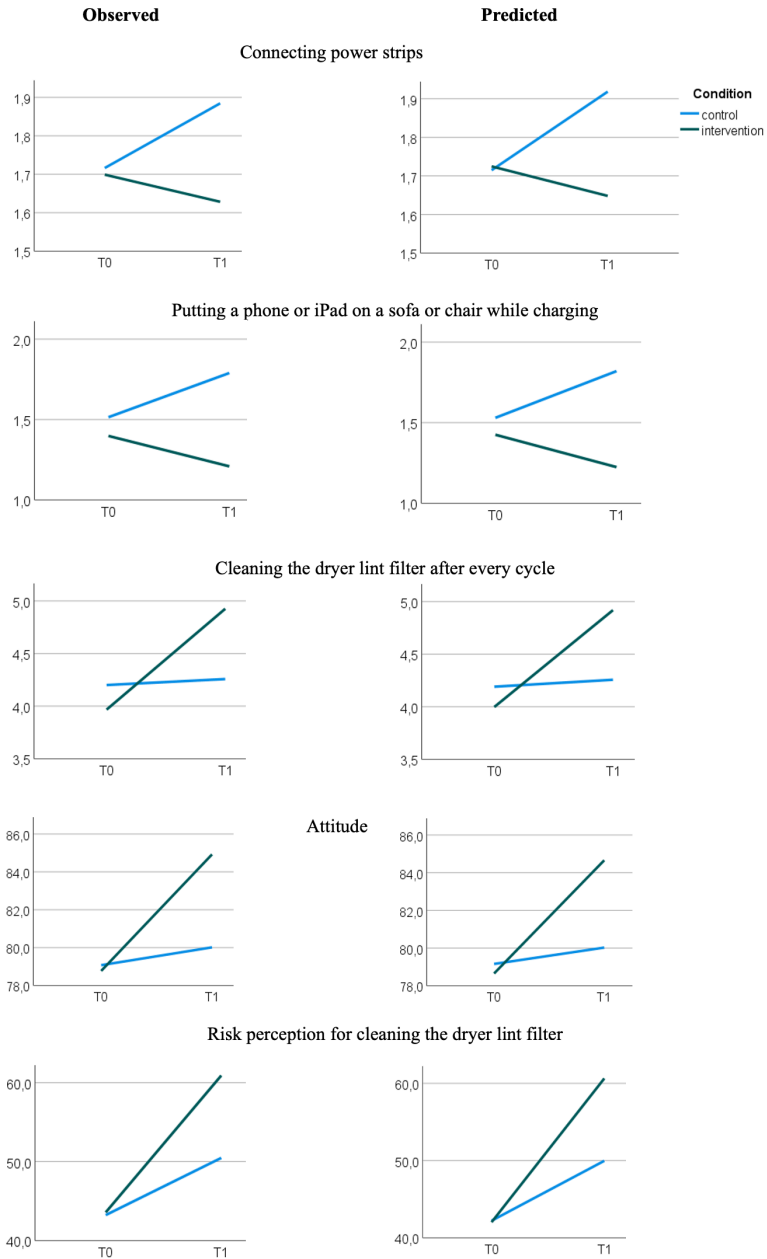
### *Intervention effects*

Positive effects of the intervention on three out of the four behaviours were found as indicated by significant time\*condition interaction terms ( $p$ 's < .01): connecting power strips (control:  $M_{pre}=1.7$ ,  $M_{post} = 1.9$ , intervention:  $M_{pre}= 1.7$ ,  $M_{post} = 1.6$ ), putting a phone or iPad on a sofa or chair while charging (control:  $M_{pre}= 1.5$ ,  $M_{post} = 1.8$ , intervention:  $M_{pre}= 1.4$ ,  $M_{post} = 1.2$ ) and cleaning the dryer lint filter (control:  $M_{pre}= 4.2$ ,  $M_{post} = 4.3$ , intervention:  $M_{pre}= 4.0$ ,  $M_{post} = 4.9$ ).

Further significant time\*condition interaction effects were found on the determinant attitude towards home fire safety behaviour (control:  $M_{pre}=79.0$ ,  $M_{post}= 80.0$ , intervention:  $M_{pre}=78.8$ ,  $M_{post}=84.9$ , time\*condition:  $p = .04$ ) and risk perception towards cleaning the dryer lint filter after every cycle (control:  $M_{pre}= 43.2$ ,  $M_{post} = 50.5$ , intervention:  $M_{pre}= 43.6$ ,  $M_{post} = 60.9$ , time\*condition:  $p = .037$ ). A marginal effect was found for risk perception towards putting a phone or iPad on a sofa or chair while charging (control:  $M_{pre}= 43.7$ ,  $M_{post} = 48.9$ , intervention:  $M_{pre}= 45.7$ ,  $M_{post} = 58.3$ , time\*condition:  $p=.06$ ). For an overview of all time\*condition effects, see Figure 1 and Table 4.







Scores on fire safety behaviours and determinants for which intervention effects are found. Observed data (left panel) and predicted means based on the mixed regression (right panel).

Figure 1. Intervention-effects on behaviours and determinants.

Table 4. Effect measurements.

		Intercept	Time	Condition	Time*condition
<b>Attitude</b>	Estimate (SE) 95 % CI	79.2 (1.2)*** 76.8 – 81.5	.9 (2.1) -3.2 – 5.0	-5 (1.7) -3.8 – 2.8	5.1 (2.5)* .2 – 10.1
<b>Self-efficacy</b>	Estimate (SE) 95 % CI	80.8 (1.2)*** 78.4 – 83.3	6.6 (1.9)*** 2.9 – 10.2	.3 (1.7) -3.1 – 3.7	-3.6 (2.3) -8.1 – .8
<b>Intention</b>	Estimate (SE) 95 % CI	78.4 (1.3)*** 75.7 – 81.0	7.0 (1.9)*** 3.3 – 10.8	3.0 (1.9) -7 – 6.6	-2.3 (2.3) -6.8 – 2.2
<b>Behaviour 1</b>					
"If I am cooking and the telephone rings, I put the heat low or down before I leave the kitchen"	Estimate (SE) 95 % CI	3.8 (.1)*** 3.6 – 4.0	.6 (.2)*** .3 – .9	-1 (.1) -4 – 1.0	.1 (.2) -3 – 4
<b>Behaviour 2</b>					
"If I am cooking and the doorbell rings, I leave the kitchen"	Estimate (SE) 95 % CI	3.4 (.1)*** 3.2 – 3.6	.1 (.2) -3 – 5	-2 (.2) -5 – 1	.1 (.2) -4 – 6
<b>Behaviour 3</b>					
"I connect multiple power strips"	Estimate (SE) 95 % CI	1.7 (.1)*** 1.6 – 1.9	.2 (.1)* .0 – 4	.0 (.1) -2 – 2	-3 (.1)** -5 – -1
<b>Behaviour 4</b>					
"I charge my phone, iPad, electrical bike or mobility scooter during the night"	Estimate (SE) 95 % CI	2.2 (.1)*** 2.0 – 2.4	-.2 (.1) -.5 – 0	.2 (.1) -1 – 5	-.2 (.2) -.5 – 1
<b>Behaviour 5</b>					
"If I charge my phone or iPad, I put it on a sofa or chair"	Estimate (SE) 95 % CI	1.5 (.1)*** 1.4 – 1.7	.3 (.1)** .1 – 5	-1 (.1) -3 – 1	-.5 (.1)*** -8 – -2
<b>Behaviour 6</b>					
"I clean the dryer lint filter after every cycle"	Estimate (SE) 95 % CI	4.2 (.1)*** 4.0 – 4.4	.1 (.2) -2 – 4	-2 (.2) -5 – 1	.9 (.2)*** .5 – 1.2
<b>Risk perception 1</b>					
"How great is the likelihood of a fire starting if you use a gas stove?"	Estimate (SE) 95 % CI	34.9 (2.9)*** 29.1 – 40.7	13.7 (4.0)*** 5.8 – 21.6	5.4 (3.8) -2.1 – 12.8	-7.4 (4.7) -16.7 – 1.9
<b>Risk perception 2</b>					
"How great is the likelihood of a fire starting if you use an electrical cooking device?"	Estimate (SE) 95 % CI	13.2 (1.6)*** 10.1 – 16.3	4.7 (3.0) -1.3 – 10.6	5.4 (2.1)* 1.2 – 9.5	4.8 (3.6) -2.4 – 11.9
<b>Risk perception 3</b>					
"How great is the likelihood of a fire starting if you walk away from the stove while cooking?"	Estimate (SE) 95 % CI	34.5 (2.9)*** 28.9 – 40.2	13.5 (4.3)** 5.1 – 21.9	5.7 (3.9) -1.9 – 13.3	.1 (5.1) -10.0 – 10.2

		Intercept	Time	Condition	Time*condition
<b>Risk perception 4</b>					
“How great is the likelihood of a fire starting if you connect power strips?”	Estimate (SE) 95 % CI	39.3 (2.8)*** 33.8 – 44.8	7.4 (4.1) -6 – 15.4	2.8 (3.7) -4.6 – 10.1	5.1 (4.9) -4.5 – 14.6
<b>Risk perception 5</b>					
“How great is the likelihood of a fire starting if you charge your phone, iPad, electrical bike or mobility scooter during the night?”	Estimate (SE) 95 % CI	31.5 (2.6)*** 26.3 – 36.6	12.4 (3.5)*** 5.4 – 19.3	3.0 (3.5) -3.9 – 9.9	1.6 (4.2) -6.6 – 9.8
<b>Risk perception 6</b>					
“How great is the likelihood of a fire starting if you put your phone or iPad on a sofa or chair while charging it?”	Estimate (SE) 95 % CI	42.2 (2.9)*** 36.5 – 47.9	5.2 (3.9) -2.6 – 12.9	1.7 (3.8) -5.8 – 9.1	8.9 (4.7) (p=.06) -3 – 18.1
<b>Risk perception 7</b>					
“How great is the likelihood of a fire starting if you do not clean the dryer lint filter after every cycle?”	Estimate (SE) 95 % CI	42.2 (3.0)*** 36.4 – 48.1	7.8 (4.3) -8 – 16.3	-2 (4.0) -8.0 – 7.6	10.9 (5.2)* 7 – 21.1
<b>General fire safety 1</b>	Estimate (SE) 95 % CI	83.3 (1.5)*** 80.3 – 86.3	7.6 (2.1)*** 3.4 – 11.7	2.9 (2.1) -1.3 – 7.0	-3.4 (2.6) -8.5 – 1.7
<b>General fire safety 2</b>	Estimate (SE) 95 % CI	79.4 (1.8)*** 75.9 – 82.9	6.5 (2.4)** 1.8 – 11.1	1.5 (2.4) -3.4 – 6.2	-2.5 (2.9) -8.1 – 3.1
<b>General fire safety 3</b>	Estimate (SE) 95 % CI	79.0 (1.6)*** 75.8 – 82.2	8.0 (2.4)*** 3.3 – 12.6	4.0 (2.3) -4 – 8.4	-3.3 (2.9) -9.1 – 2.4

\* p < .05; \*\* p < .01; \*\*\*p < .001

### 3.2 Intervention acceptance by respondents

In both the intervention group as well as the control group, respondents were positive about the programme. Overall, respondents expressed having enjoyed the programme and would recommend peers to follow this programme. Besides, they felt the information was understandable, useful and applicable to their daily life. However, scores from respondents in the intervention group were significantly more positive on all items compared to the control group. For details, see Table 5.

Table 5. Evaluation of the programme.

	Control group M (SD)	Intervention group M (SD)	T-test t(df)
I enjoyed the programme	4.2 (.89)	4.5 (.74)	$t(297)=-3.4, p<.001^{***}$
The information from the programme was understandable	4.2 (1.00)	4.7 (.70)	Mann-Witney U=11401, $p<.001^{***}$
The information and exercises were useful	4.3 (.77)	4.6 (.73)	$t(297)= -2.9, p=.003^{**}$
I feel able to apply the information from the programme into my daily life	4.2 (.75)	4.5 (.70)	$t(297)= -3.0, p=.003^{**}$
I would recommend peers to follow this programme	4.3 (.77)	4.6 (.76)	$t(295)= -2.4, p=.017^*$
If I should rate this programme between 1-10, I would give it a...	8 (.73)	9 (.90)	$t(207)= -2.5, p=.014^*$

### 3.3 Process evaluation

According to both the members of the research team as well as the trainers, all programmes were executed as intended. Trainers who were part of the control group mentioned that the strong points of their programme was that they were able to share a lot of information about fire safety, reach many people, and adjust the presentation to the living situation of the participants (e.g. use pictures of the building they live in). Also, they needed only one trainer to organize this programme. A weak point mentioned was that they felt participants can be overwhelmed by the amount of information.

Trainers who were part of the intervention group mentioned as strong points that working in small groups provides the opportunity to respond to the personal situation of respondents and makes it easier to start a group discussion, especially in groups where participants were acquainted. They also noticed that participants became more confident when they could practice certain behaviours. As a weaker point they mentioned that this type of programme is more intense, you need multiple trainers, and more time. Most trainers from the intervention group believed that the programme could lead to actual behaviour change.

## 4. Discussion

The objective of this study was to assess the impact of the Fire Safety at Home programme on various fire safety behaviours and social cognitive determinants among older adults, in comparison to standard fire safety meetings organized by the fire service.

In comparison to the control group, the Fire Safety at Home programme had a significant positive effect on several home fire safety behaviours. Specifically, intervention effects were observed for the behaviours with regards to connecting power strips, placing a phone or iPad on a sofa or chair while charging, and cleaning the dryer lint filter. Additionally, positive intervention-effects were also found for the social cognitive determinants attitude towards fire safety behaviour, and risk perception towards cleaning the dryer lint filter after every cycle.

This study fills a significant gap in the literature, as previous research mainly focused on measuring the impact of fire safety programmes on knowledge, leaving other determinants and behaviours understudied [10,21,25,30,41]. Our findings underscore the importance of setting clear performance objectives within a specific intervention: the intervention-effects found in this study were found for three fire safety behaviours that were specifically targeted in the Fire Safety at Home programme. Therefore, it is essential for educators to target particular performance objectives and determinants during interventions for effective behaviour change [28].

An unexpected finding were the adverse time-effects which were found in the control group: after the programme, more respondents reported engaging in more unsafe behaviours, such as connecting power strips and putting a phone or iPad on a sofa or chair while charging. This could indicate that programme content inadvertently led to an increase in unsafe behaviour. Other possible explanations include an overload of information causing confusion among participants or increased awareness leading to the acknowledgment of previously unreported unsafe behaviours.

### *Strengths and limitations*

A strength of this research includes that we had the opportunity to organize the Fire Safety at Home programme at a fixed location whereby an environment was created that was standardized across respondents in the intervention group. Furthermore, the questionnaire that was used in this study was developed based on psychological theories [39,40] and prior research into fire safe behaviour amongst older adults [38,42]. A potential limitation of this research is the self-selection bias. In both the control as well as the

intervention group, older adults were recruited through several organizations and the distribution of flyers with an invitation for the programme. The results showed that, at baseline, participants in both the intervention and control group scored relatively high on several fire safety behaviours and determinants. This could imply that older adults who have an increased interest in fire safety have been more likely to participate in this research. Another possible limitation is the use of hard-copy questionnaires when requested by participants. When entering their responses into the digital dataset, it was noticed that they often chose 0 or 100 as an answer while the VAS-scale allowed them to choose any option between 0-100. Possibly this has led to a large variance in scores and standard deviations. Nevertheless, additionally conducted t-tests showed only marginal and mostly insignificant differences between questionnaires filled out on paper or digitally in baseline- and follow-up questionnaires ([see appendix I Output t-tests digital vs. paper](#)), while giving us the advantage of including a wider range of older adults.

### *Implications and future recommendations*

Several implications for educators targeting fire safety behaviour among older adults were identified. First, to effectively influence the behaviour of older adults, it is important to target specific performance objectives and determinants in the intervention. Information about which performance objectives and determinants to focus on can be collected by performing a needs assessment before the development of an intervention [28].

A second implication is that an intervention targeting different fire safety behaviours in an intervention does not automatically cause a translational effect. This means that the effect of the intervention on specific behaviours does not automatically lead to an effect on other fire safety behaviours. Literature describes that people who are involved in a particular health behaviour are more likely to also be or become involved in other health behaviours due to the fact that interventions usually address similar concepts such as knowledge, attitudinal beliefs or skills [43,44]. However, in this study no such an effect was found. The effect on fire safety behaviours such as putting a phone or iPad on a sofa or chair while charging or cleaning the dryer lint filter, does not automatically lead to a change in other home fire safety behaviours as well.

For future implementation of the Fire Safety at Home programme, it is important to further develop the programme in such a way that it can be organized at different locations (e.g. fire stations, senior housing complexes, community centres). A method that can help in this development is Implementation Mapping [45]. Furthermore, in order to reach older adults who

are not able to join a fire safety intervention at an external location, it would be helpful to further develop the programme in such a way that this could be implemented in home visits. Literature shows that home visits can be effective in increasing emergency preparedness or knowledge about home fire safety [6,17,22,25].

A final recommendation would be to measure effects of the Fire Safety at Home programme on the longer term. First, this would give insight into the long term effect/ whether the positive effects of the intervention are maintained. Second, some studies say that improvement efforts are being evaluated too soon and are therefore being judged as ineffective [46,47]. A follow up evaluation study could help in giving insight if this also applies to this programme.

## **5. Conclusion**

In summary, this study evaluated the impact of the Fire Safety at Home programme on home fire safety behaviours among older adults. The results highlight the programme's effectiveness in positively influencing specific fire safety behaviours, attitude, and risk perceptions. This underscores the importance of targeting specific behaviours and determinants in interventions for meaningful change in fire safety practices.

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# Chapter 6

## General discussion

In this dissertation, we describe how we used Intervention Mapping to systematically develop a home fire safety intervention tailored to the needs of older adults. We measured the short term effects of this intervention on fire safety behaviours and the underlying social cognitive determinants. We demonstrated that this intervention positively impacted fire safety behaviours and some of the determinants. In this chapter, the selected approach to the issue of older adults and home fire safety and the results of our work will be discussed.

### **Fire safety among older adults**

Statistics on fatal residential fires [1–5] and injuries [6–8] show that the risk of becoming a victim of a residential fire or getting injured in the event of a fire increases with age [2,4,9–14]. Common causes of fire among older adults aged 65 and over include the ignition of clothing by an open flame, smoking-related incidents (e.g. furniture, mattresses and bedding being ignited by cigarettes), technical faults, cooking mishaps, and intentionally set fires (including those in fireplaces) [15–17]. Furthermore, injuries mostly occur among older adults in single occupancy housing, living in more deprived areas [17].

Several factors contribute to the heightened vulnerability of older adults to home fires. Firstly, there is an increased likelihood of them inadvertently starting a fire [3,16]. Secondly, age-related physical, cognitive and physiological deterioration further amplifies the chance of becoming a victim because these changes result in a reduced ability to promptly recognize or respond to such incidents [10,13,14,18–22]. Knowing that older adults are a risk group further increases the challenges societies already face due to their ageing populations (e.g., increased health care costs), especially seen in high-income countries [3,13,23,24]. The trend towards older adults living independently instead of in a residential care home or nursing home [12] further increases concerns about home fire safety. In short, there is a pressing need for preventive interventions to address these risks.

#### *Current home fire safety programmes*

Current fire safety programmes often lack a systematic approach and may neglect involving the target group in the development of the programme, despite the potential advantages of such inclusion [25–28]. The majority of existing fire prevention programmes predominantly utilize educational materials such as brochures, presentations, and fire safety videos, or involve home visits [8,29–32]. These programmes typically focus on raising awareness about home fire safety under the assumption that heightened awareness will automatically strengthen the motivation to take fire safety measures [8,29,31–35]. In the Netherlands, for instance, the Dutch Fire Service organizes

fire safety meetings at various locations to educate older adults about home fire safety. In their programmes, they often emphasize the severity and consequences of home fires and address many fire safety topics. Nonetheless, there is a recognized need for a more systematic and participatory approach in the development and execution of these programmes that also provide more action-oriented instructions rather than risk-oriented information.

### **A newly developed intervention**

In this thesis, the systematic development and evaluation of the Fire Safety at Home programme is described. The programme was developed using the Intervention Mapping approach [27,36]. The intervention specifically aims to promote fire safe behaviours concerning cooking, using power strips, charging electronic devices and cleaning the dryer lint filter through targeting the underlying social cognitive determinants that explain these behaviours. The intervention was held at the Twente Safety Campus in Enschede, the Netherlands, and was compared with current fire safety programmes organized by the Dutch Fire Service. A total of 433 participants joined either the intervention or a regular fire safety meeting organized by the fire service.

### **Main findings**

To be able to develop personalized and tailored interventions for older adults, we conducted a needs assessment regarding fire-safe behaviour and underlying social cognitive determinants in our first two studies. In a qualitative study (Chapter 2) we found that older adults have limited knowledge about fire, including when and how fires can occur (risk perception) (n=17). Their knowledge mostly focuses on the source of a fire or on the moment at which a fire can occur. Knowledge about certain behaviours that might cause a fire is limited. Identified determinants that seem to influence home fire safety behaviour included risk perception, self-efficacy, habits and perceived barriers. Furthermore, older adults considered the fire service the most trustworthy for fire safety information. However, further research was needed to confirm the most relevant determinants of fire safety behaviours, and to explore the relationship between different social cognitive determinants and fire safety behaviour in further depth.

Therefore, in a subsequent quantitative study involving 4414 older adults, the most important predictors of fire safety behaviours were identified and the relative importance of these predictors was determined (Chapter 3). We found that most older adults reported engaging in fire safety behaviours in their homes, in particular not connecting power strips to each other and cleaning the dryer lint filter. However, they do not feel very susceptible to the risk of residential fires as indicated by low scores on risk perception and



susceptibility. Determinants that showed strong associations with fire safety behaviours were perceived behavioural control or self-efficacy, attitude and response efficacy and are therefore important target variables for future interventions promoting fire safety behaviour among older adults. In addition, this research confirmed that older adults perceive the emergency services, people who have experienced a house fire themselves, the municipality, and housing companies as credible sources for communicating about home fire prevention.

Based on the results of the needs assessment (Chapter 2 and 3), we developed the Fire Safety at Home programme (Chapter 4). The programme starts with a 15-minute general introduction, outlining the programme's structure and emphasizing the theme of fire safety. Next, participants are then divided into three groups each assigned to different rooms where they engage in activities aimed at understanding and practicing fire safety behaviour. After 25 minutes, the groups rotate through the rooms. After attending each of the three rooms, all participants convene in a general meeting room for a comprehensive discussion about their experiences with the programme and practical steps to enhance fire safety at home. At the end of the meeting, participants receive a flyer summarizing the programme and advice on improving fire safety behaviour at home, the contact details of the research team in case they have questions about the programme, and space to write down personal notes and implementation intentions. By following Intervention Mapping, we aimed to increase the likelihood of the programme being effective in promoting fire safe behaviours following successful implementation.

In an effect and process evaluation (Chapter 5), we measured the short-term effects of the Fire Safety at Home programme on the previously identified fire safe behaviours, namely cooking (especially not leaving the kitchen when there is a distraction, e.g. the doorbell rings), safe charging of electronic devices, not connecting power strips and cleaning the dryer lint filter, and the determinants self-efficacy, attitude and risk perception. A measure of behavioural intention was added as a proxy indicator of future fire safety behaviours. A total of 433 participants (> 65 years) participated in this study and received either the Fire Safety at Home programme (intervention group) or a fire safety programme as is currently given by the Dutch Fire Service (control group). The results showed that intervention effects were observed for three of the four measured fire safety behaviours (connecting power strips, placing a phone or iPad on a sofa or chair while charging, and cleaning the dryer lint filter). Additionally, positive intervention-effects were found for the social cognitive determinant attitude, and risk perception towards cleaning the dryer lint filter after every cycle. These findings underscore the importance of setting clear performance

objectives within a specific intervention: the intervention had positive effects on three out of four fire safety behaviours that targeted by the Fire Safety at Home programme.

## Theoretical considerations

### *Intervention Mapping*

An intervention developed through a systematic approach is expected to lead to better outcomes [25–27]. Therefore, we used the Intervention Mapping (IM)-protocol [27] to develop the Fire Safety at Home programme. IM describes six steps to develop a theory- and evidence-based intervention while adopting a participatory approach in programme planning. Each step consists of several tasks and the completion of these tasks creates a base which is the guide for the next step. All six steps together create a plan for designing, implementing and evaluating an intervention based on theoretical, empirical and practical information [36]. Furthermore, IM provides specific procedures for planning activities and can help with matching theory-based determinants to appropriate methods for change [27,37].

### *Focus on human behaviour and social cognitive determinants*

The primary focus of this study was on the individual by focusing on fire safety behaviours. Previous studies have examined technical solutions such as the presence of smoke detectors, carbon monoxide alarms, fire blankets, or fire extinguishers [29,38–41] and explored how older adults respond in the event of a fire (e.g., planning escape routes) [29,40,42]. However, a seldom-addressed aspect in fire prevention studies among older adults is proactive, preventive fire safety behaviour. In addition to enhancing fire safety through technical provisions within a building. This study uniquely concentrates on the older resident by specifically targeting and addressing fire safety behaviours through an educational intervention.

Identifying psychosocial constructs such as attitude, self-efficacy, perceived norms, risk perception, and their underlying beliefs is important. These determinants together account for significant proportions of the variance in behaviour and are susceptible for change, making them suitable targets for educational interventions [43,44]. Therefore, the most important social cognitive determinants of a range of fire safety behaviours among older adults were identified and used as the focus point for the development of the intervention. The needs assessment showed that the intervention should focus on the determinants attitude, self-efficacy and response efficacy. Since older adults have low risk perceptions towards home fire safety at this moment (Chapter 3), this will also be addressed in the intervention. Combined with the

correct systematic application of behavioural change methods to target these causal behavioural factors, we developed the Fire Safety at Home programme. This approach ensures a tailored and effective intervention, addressing the specific cognitive elements influencing fire safety behaviours among older adults.

### *Theoretical frameworks*

In this study, we applied theories and psychological models to explain human behaviour, in particular the Reasoned Action Approach (RAA) [45], complemented by the Protection Motivation Theory (PMT) [46]. Although most fire safety programmes aim to increase knowledge about fire risks and awareness of the occurrence of unsafe situations [29–31,33,35], the RAA and PMT identify other determinants such as attitude, perceived social norms, and estimates of personal control and ability as more proximal (and stronger) determinants of the motivation to perform safety behaviour. As the quantitative study (Chapter 3) showed, attitude, self-efficacy and response-efficacy are important predictors of fire safety behaviours and risk-emphasizing determinants such as severity and susceptibility showed weaker associations with fire safety behaviour. This confirms our assumptions that the RAA and PMT are the most suitable theories for this research.

The interviews conducted in the needs assessment (Chapter 2), resulted in a broad range of beliefs underlying fire safety behaviour, aligning with concepts of important theoretical frameworks for explaining human behaviour such as RAA and PMT. To identify the most important predictors of fire safety behaviours and determine the relative importance of these predictors, these determinants and other elements of the mentioned theoretical frameworks were questioned in the quantitative study (Chapter 3). This comprehensive approach allows us to draw upon the strengths of various theories, providing a more nuanced understanding of the factors influencing fire safety behaviours in older adults.

### *Emphasize action*

Instead of emphasizing determinants such as risk perception, severity and susceptibility by sharing information and knowledge, the Fire Safety at Home programme focused on active learning. This decision followed the results of the quantitative study in which the most important predictors of fire safety behaviours were identified (Chapter 3). That study highlighted that risk perception, severity and susceptibility are less important predictors of fire safety behaviour among older adults than suggested in current fire safety interventions. Instead, we shifted the focus toward determinants such as attitude and self-efficacy to emphasize a more action-oriented approach

towards promoting fire safe behaviours. Consequently, the programme incorporated methods specifically designed to address these determinants centring around active learning principles (see Chapter 4). This approach ensures alignment with the identified predictors and resulted in the intervention resonating more effectively with the key influences on fire safety behaviours in older adults.

## **Methodological considerations**

During the process of developing and measuring the effect of the intervention, several choices were made that influenced additional IM steps. These choices will be addressed in the following paragraphs.

### *Older adults*

Our study specifically targeted older adults (65 years or older) who are living independently. In the existing literature, the term “older adults” is defined in numerous ways. Some studies define older adults as those 50 years or older [47], some as 60 years or older [2,10,48], some as 65 years or older [13,49,50] and some as 70 years or older [41]. Others did not give a specific definition of older adults [17] or only mentioned the age of their respondents [22,51]. To align our research with the definition of “older adults” as is commonly used in the Netherlands [5,12], we chose to define older adults as people 65 years or older. Additionally, considering the trend of more people continue to live independently rather than moving to residential care homes [12] our decision to concentrate on older adults living independently was motivated by the vulnerability this group faces in terms of home fire safety. As a result of only focusing on people 65 years or older, we miss a specific (younger) population in our study. For the time being this is not an issue since older adults are an important risk group. Nevertheless, for future research, it would be recommended to include other age groups and address a broader demographic spectrum.

### *Behavioural focus*

While the literature highlights multiple common behavioural causes of fire in the general population such as open flames, technical faults, unsafe cooking, and deliberately set fires (including fireplaces), and smoking [15,17], our intervention focuses on four specific fire causes relevant for the target population of older adults: cooking, charging devices, connecting power strips, and management of the dryer lint filter. This selection is informed by a synthesis of existing literature and data obtained from fire investigation teams of several Dutch fire safety regions. By concentrating on a limited number of fire causes, we can effectively target and address these specific behaviours in an educational intervention. This focused approach not only allows for a

more intensive examination but also facilitates a clearer evaluation of the programme's effectiveness. Indeed, a broad, general intervention covering numerous fire safety topics could present challenges in evaluation. To enhance the relevance of the intervention for all participants, certain topics, such as smoking, were intentionally excluded. This strategic decision ensures that the programme remains tightly focused, maximizing its impact on the identified key fire safety behaviours among older adults.

### *Recruitment and selection*

To reach as many older adults as possible with representative demographics, participants for the different studies were recruited through various ways: senior citizen associations, the fire service, housing companies, and organizations focusing on older adults. In addition, for the effect study, we decided to distribute flyers in neighbourhoods and buildings with relatively many older people.

Although the recruitment procedures were the same for both the intervention and control groups, this might have led to a self-selection bias: older adults who have an increased interest in fire safety might have been more likely in general to participate in this research. However, no differences at baseline were found between participants in the intervention and control group, which made both groups comparable in the effect study and findings (i.e., differences between the intervention and control group) can be attributed to the Fire Safety at Home programme.

### *Intervention location*

The Fire Safety at Home programme was conducted at a fixed location, ensuring a consistent environment for all participants in the intervention group. In contrast, the control group attended various fire safety meetings organized by the Dutch Fire Service, held at different locations such as fire stations, senior housing complexes or community centres. This decision was made to align data collection for the control group with current practices. The benefits of this decision are that the experimental setting was the same for the participants in the intervention group, whereas the programme in the control group exactly resembled current fire safety education in practice. A possible disadvantage of this decision is that it cannot be excluded that a location effect (the intervention setting was in a remote and therefore difficult-to-reach location) determined the differences between the findings of the intervention and control group. However, to accommodate less- or immobile older adults in both the intervention and control group, transport to the locations was organized upon request. Nevertheless, we recognize that some older adults might have faced challenges attending the intervention location or might not have received invitations, particularly those in social isolation.

For the intervention group, the location was the same for all participants. This location was quite remote, could not be reached by public transport and was hard to reach by bike. People who wanted to join the programme had to come by car. To attract people to join the intervention, a financial compensation (a 50 Euro gift voucher) was introduced for completing both the pretest as well as the posttest questionnaire and compensating travel time and travel expenses. This was approved by the ethics committee of Maastricht University. Another reason for introducing this reward was that this might also tempt older adults who do not have an interest in fire safety, and therefore would not join a fire safety meeting as organized by the fire service, to join the intervention. While it might be perceived that participants joined the intervention solely for the reward, the experience demonstrated that, in general, this was not the case. Many participants expressed that they did not expect to receive the financial reward or believed they were obligated to purchase smoke detectors to qualify for the award.

It can be discussed if the difference in setting between the intervention and control group has an impact on the effect measurements. Although both groups of participants were comparable at the pre-measurement, subsequently the location and type of intervention varied. Since the intervention is based on empirical preliminary research and the use of theories, we assume that the effects of the Fire Safety at Home programme can be attributed to the intervention itself. Furthermore, using Intervention Mapping has forced us to choose the right content which we believe has increased the chance that the content itself leads to effects on fire safety behaviours and determinants.

### *Measurement considerations*

The questionnaires used in this study were based on psychological theories and self-collected empirical data [45,46]. They were distributed either digitally or, upon request by participants, as hard copies. The use of hard-copy questionnaires, especially where questions are measured with a VAS-scale might have resulted in a large variance in scores and standard-deviations. When entering the responses of the hard copy questionnaires into the digital dataset, it was noticed that participants often chose 0 or 100 as an answer while the VAS-scale allowed them to choose any option between 0-100. Nevertheless, additional t-tests showed only marginal and mostly insignificant differences between questionnaires filled in on paper or digitally in baseline- and follow-up questionnaires. Therefore it can be concluded that, despite the method of entry, participants can be seen as comparable, thus confirming the advantage of including a wider range of older adults by also using hard-copy questionnaires.

In both the cross-sectional quantitative study in the needs assessment as well as the pre-measurement in the effect study, we noticed that a questionnaire may already function as a first intervention. In the quantitative study, after finishing the online questionnaire, some participants called the research team to receive more information about how to improve fire safety in their homes. In the pre-measurement in the effect study, participants received a questionnaire that questioned specific fire safety behaviours (formulated as performance objectives) and were instructed to complete this before the day of the programme. These performance objectives were described in detail in the questionnaire to be able to see if the intervention has any effect on these behaviours. Due to this detailed description of the fire safety behaviours, participants may have been triggered and realized what the desired behaviour would be. In fact, during the Fire Safety at Home programme (intervention group) in which participants had to execute different assignments, multiple participants mentioned that they now knew what the desired behaviour was thanks to the pre-questionnaire. It has to be taken into account that using a questionnaire in a pre measurement can already be the first step of an intervention, possibly leading to awareness and/or behaviour change. Described in the literature as the mere-measurement effect, some will argue that a pre-questionnaire can be a first step in changing people's behaviour [52,53], possibly leading to slightly smaller intervention effects. However, other studies challenge this assumption [54].

While this research examined both current fire safety behaviour and intended fire safety behaviour, it is acknowledged that intended behaviour is not always a good predictor of actual behaviour [55]. Although future behaviour is predicted by current behaviour (which was measured in this study), we were not able to measure future behaviour (as is done in for example Joffe et al. [56]). Therefore, the decision was made to focus on intention as the outcome variable.

### *Building support for future implementation*

In anticipation of implementing the programme at a larger scale, during the entire process of the development of the Fire Safety at Home programme we collaborated with the Fire Service (e.g. policy makers, people working in the community fire safety teams), the Dutch Burns Foundation and housing corporations. This collaborative approach allowed for the exploration of implementation possibilities in different fire safety regions, provided insights into motivating programme implementers, and yielded valuable lessons for a smooth implementation process. For example, we involved them in the needs assessment by discussing and attending their current fire safety programmes to exchange experience and opinions about the contents and ways of

organizing these programmes. Furthermore, during the development of the Fire Safety at Home programme, possible barriers in applying this programme in practice were discussed with stakeholders (e.g. location, trainers who have to change their ways of fire safety education, and capacity) and were taken into account in the programme development.

Furthermore, during the process of the development of the intervention, an online brainstorm session with educators from all 25 safety regions was organized. These educators represent the future implementers of the Fire Safety at Home programme. In this session, the results of the needs assessment were presented which were well received by the educators. In addition, the brainstorm session focused on generating ideas together with the educators for methods and practical applications to address determinants such as attitude and self-efficacy within a fire safety programme. This collaborative brainstorming session proved instrumental in gathering crucial information regarding the motivations and capabilities of educators to implement behavioural sciences in fire safety programmes, fostering co-creation, and building a sense of community engagement. The exchange of ideas and perspectives from educators across safety regions enriched the programme's development and, by being able to motivate trainers and tackling perceived barriers, laid the foundation for its successful implementation on a larger scale. Furthermore, this session made clear that a new way of educating people (targeting social cognitive determinants by active learning instead of passively listening to a presentation and receiving information) can be perceived as a challenge by the educators. It is therefore important to keep in mind that when implementing the Fire Safety at Home programme on a larger scale there is a need for educators to be trained in this new way of fire safety education.





## Future research

Future research on the Fire Safety at Home programme could consider the following areas:

### *Long-term effects*

It is recommended to measure the effects of the Fire Safety at Home programme on longer terms. This will give insight into the long-term effects and whether the positive effects of the intervention are maintained. Some studies notice that improvement efforts are being evaluated too soon and are therefore being judged as ineffective [57,58]. A follow-up evaluation study could help in giving insight if this also applies to this programme.

### *Programme Generalization*

The Fire Safety at Home programme was developed for older adults and thus focused on fire causes and determinants relevant for this target group. To measure whether the current programme would be applicable to other target groups, and if not, which aspects of the programme need change (e.g. the addressed fire causes, determinants or used methods for behaviour change), it is advised to perform needs assessments for different target groups of current fire safety programmes. Furthermore, it is advised to further develop the Fire Safety at Home programme for other fire safety behaviours as well. A protocol that could support this development is the IM-Adapt framework [27].

## Implementation

For successful future implementation, it is important to further develop the Fire Safety at Home programme in such a way that it can be organized at different locations (e.g. fire stations or senior housing complexes). A method that could be used for this implementation process is Implementation Mapping [59]. Parallel to the effect study, we tested if the content of the Fire Safety at Home programme, namely the different assignments, could also be given at a local fire station. Members of the fire service, working in the Community Fire Safety team, organised several fire safety meetings in which the Fire Safety at Home programme was given. These tests showed that the programme could be executed as planned. Room for improvement is in adjusting the technical aspects of the intervention, smoking machines, and a pan in which a pan fire can be demonstrated, to make it easier to transport the programme to different locations. Furthermore, previous studies demonstrated that home visits can be effective in increasing emergency preparedness or knowledge about home fire safety [8,30,31,35]. It would be desirable to explore the possibilities of integrating the Fire Safety at Home programme with home visits to reach older adults who are not able to join an intervention

at an external location. Important to keep in mind is that, if the Fire Safety at Home programme is integrated with home visits, the information is shared by someone recognizable as working for the fire service since Fire Safety personnel are being seen as most trustworthy in sharing fire safety information by older adults.

In the intervention group, some groups of participants consisted of older adults who had signed up for the programme individually or with their partner, and other groups consisted of participants who all knew each other, for example because they live in the same residential building. While performing the Fire Safety at Home programme, trainers noticed that in the groups in which the participants knew each other, the discussions during the assignments were more vibrant. Participants who knew each other seemed to be more comfortable in starting a discussion with their fellow participants and were not afraid of commenting on unsafe behaviour. Therefore, a recommendation would be to actively recruit groups of people who know each other for fire safety meetings. Furthermore, this could possibly strengthen perceived social norms about home fire safety.

### **Implications for practice**

The results from the different studies regarding home fire safety programmes for older adults provide professionals working in the field of fire safety education and developers of fire safety intervention tools for improvement.

#### *Systematically develop interventions*

The likelihood of developing an effective intervention is the highest if it is systematically developed [25–28]. At this moment, fire prevention programmes are not always systematically developed. It is recommended to use protocols such as Intervention Mapping that can create a plan for designing, implementing and evaluating an intervention based on theoretical, empirical and practical information [36].

#### *Set programme goals*

Current fire safety programmes in the Netherlands often focus on risk perception and risk communication. This study shows that risk perception has weak associations with the intention to perform fire safety behaviour in comparison with other determinants (Chapter 3). For future programmes, it is important to determine the goals of these programmes at the level of the factors that determine or motivate behaviour change. Typically these factors should be related to the behaviour and amenable for change [60]. Programme goals can be informing people, raising awareness about a certain risk or behaviour change. However, if behaviour change is the goal of the programme,

other social cognitive determinants than just knowledge or risk perceptions are often stronger determinants of change [63]. Merely emphasizing risks and thereby increasing awareness is not sufficient for behaviour change.

### *Needs assessment*

In contrast to other studies [61,62], this study (Chapter 5) shows that the effect of a fire safety programme on specific fire safety behaviours does not automatically lead to an effect on other fire safety behaviours as well. For example, the effect on fire safety behaviours such as putting a phone or iPad on a sofa or chair while charging or cleaning the dryer lint filter, does not automatically lead to a change in for instance not smoking in bed. Therefore, it is important to decide which behaviours need to be addressed in a fire safety programme. A needs assessment gives input for these decisions by examining what the target group already knows and what common fire causes among the target group are. Furthermore, this study underscores the importance of targeting clear performance objectives and determinants within a specific intervention for effective behaviour change. By conducting a needs assessment before the development of an intervention, information about which performance objectives and determinants to focus on can be collected [27].

### *Involve target group and relevant stakeholders*

It is important to include relevant populations such as the target group, educators and implementers in the different stages of the development of an intervention [27]. In the studies as described in this dissertation, the target population (older adults) were intensively involved in the needs assessment to garner essential information about needs that have to be addressed in the Fire Safety at Home programme. The target group piloted tested the questionnaires that were used in the studies on ambiguity and understandability. Furthermore, educators and implementers were involved in the development process to increase the feasibility of the Fire Safety at Home programme for sustainable implementation in the future. It is recommended to include these stakeholders in the planning group since they are important for conducting a proper needs assessment and setting programme goals.

In addition, when developing a fire safety programme for a specific target group, it is important to find out which stakeholders are being seen as trustworthy in sharing information about fire safety. Although some research encourages the use of social network approaches in sharing knowledge in fire safety [10,22], this study shows, following other research [63,64], that the fire service is seen as the most trustworthy by the public. It is therefore recommended to make sure the fire service plays an important role in the

implementation of fire safety programmes, either as being the educators themselves or making sure the fire service is engaged in the systematic development of fire safety programmes.

### *Active learning*

In current fire safety programmes in the Netherlands, the primary focus is on increasing awareness about home fire safety by giving presentations or performing home visits. This study shows that a shift in the method of education is necessary: the focus should be on determinants such as attitude and self-efficacy (chapter 3). Where current programmes are mostly instructor-centered (passive learning), they should be more student-centered (active learning). Active learning provides the opportunity to target different social cognitive determinants by hands-on and interactive engagement [65]. Furthermore, interventions that focus on active learning have a greater impact on behaviour change than passive interventions [66]. Moreover, the focus of evaluation should be more on the behavioural goals of fire safety programmes, that is measuring the effects of the programme on behaviour and determinants of participants, next to running a process evaluation to determine the reach of the intervention and implementation completeness [70].

### **Conclusion**

In this dissertation, we used Intervention Mapping to develop an educational programme to promote home fire safety behaviour in older adults. The different chapters describe the development, implementation and evaluation of this programme. The studies showed that using Intervention Mapping can increase the effectiveness of a fire safety programme. Although the developed Fire Safety at Home programme does not influence all types of fire safety behaviour and determinants, it has a significant, positive impact on those that were specifically and intensively addressed in the programme. This underscores the importance of targeting specific behaviours and determinants in interventions for meaningful change in fire safety practices.

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# Appendices



## Appendix A. Questionnaire: Social Cognitive Determinants of Fire Safe Behaviour in Older Adults

*[English Translation – original questionnaire is in Dutch]*

### General questions

1. Wat is your gender?
  - Male
  - Female
  
2. Wat is your age?
  - Younger than 50
  - 50-60
  - 65-80
  - Older than 80
  
3. What is your living situation?
  - Living together, married
  - Living together, not married
  - Living by myself, married
  - Living by myself, not married
  
4. Which type of house do you live in?
  - Rented home
  - Own home
  - Other: ...

Some questions about your independence

5.
  - a. Is there with you a matter of less mobility? Yes/No
  - b. ... memory loss or dementia?
  - c. ... a hearing aid? – Is your hearing fine when you use that? Yes/No
  - d. ... glasses or lenses? – can you see fine with your glasses or lenses?  
Yes/No
  
6. Do you have any experience with fire in a home? (More than 1 answer is possible)
  - Yes, I had a fire in my own home
  - Yes, there was a fire in the home of family/friends
  - Yes, there was a fire in my close neighbourhood
  - No, there has never been any fire in my neighbourhood
  - Yes, there has been a fire in my environment, namely: .....

7. If you have answered 'Yes' with question 6:  
How long ago was your last experience with a fire? .....
8. Do you smoke? (if 'No', than you may skip the questions about smoking later in this questionnaire)
  - Yes
  - No
9. Which type of cooking apparatus do you have in your home?
  - Gas appliance
  - Electric cooker
  - Ceramic cooker
  - Induction cooker
  - Not applicable, I don't cook for myself (*in that case you may skip the questions about smoking later in this questionnaire*)
  - Other, namely: .....
10. Do you have an (open) fireplace in your home?
  - Yes
  - No
11. Do you have a tumble dryer in your home? (If 'yes', go to Q12)
  - Yes
  - No
12. Do you use the tumble dryer in your home?
  - Yes
  - No (*if: 'No', you may skip the questions about the tumble dryer in your home*)
13. Do you use a mobile phone, iPad, electric bike or scoot mobile?
  - (*If 'No', skip the questions about recharging*)

### Smoke detectors

14. Do you have smoke detectors in your home?
  - Yes
  - No
  - Don't know

15. *If 'No', why not? (More than 1 answer is possible)*
- Never thought of
  - Not necessary
  - Don't know where to buy smoke detectors
  - Don't know how to install the detectors
  - I find smoke detectors ugly
  - I find smoke detectors too expensive
  - I find smoke detectors disruptive (they may go off unnecessarily)
  - Other, namely: .....
16. If you answered 'Yes' to question 14, do you test your smoke detector?
- Yes, once a year
  - Yes, a few time per year
  - Yes, every month
  - Yes, every week
  - No, never

### **In case of fire**

17. Do you know the route to safely get out of your home in case of fire?
- Yes
  - No
18. If you answered 'Yes' to question 17, what is this escape route exactly?  
*(More than 1 answer is possible)*
- I go outside through the front door
  - I go outside through the backdoor
  - I go outside through a window at the ground floor
  - I go outside through a sliding front
  - I wait on my balcony till the fire brigade comes to rescue me
  - I jump down from my balcony
  - I jump down from a window at my floor
  - I go down from my floor via an escape ladder
  - Other, namely: .....

## Your own behaviour

19. In how far do the following behaviours apply to you?
- a. I leave the kitchen while cooking
  - b. I connect power strips to each other
  - c. I charge my phone, iPad, electric bike or scoot mobile at night
  - d. I clean the filter of my dryer after every wash
  - e. I smoke in my home  
All:  never  rarely  regularly  often  always
  - f. If you answered that you smoke at home, where do you smoke?  
(More than 1 answer is possible)
    - On the couch
    - In my easy chair
    - In bed
    - At the dining table
    - Under the extractor hood
    - Outside, in the garden or on the balcony
    - Other, namely: .....

## About how fires start

20. How, do you think, could a fire start in your home? (More than 1 answer is possible)  
.....
21. How great is the likelihood of a fire starting in your home?  
 very small  small  not small/not great  great  very great
22. How great is the likelihood of a fire starting in your home, compared to other people of your age and gender?  
 much smaller  smaller  the same  larger  much larger
23. How bad are the consequences if a fire would occur in your home?  
 not bad at all  not bad  neutral  bad  very bad



## About the likelihood of fire

24. How great is the likelihood of a fire starting in your own home, if you ...
- a. ... leave the kitchen during cooking
  - b. ... connect power strips to each other
  - c. ... charge your phone, iPad, electric bike or scoot mobile at night  
 very small  small  not small/not great  great  very great
  - d. ... do not clean the filter of my dryer after every wash
  - e. ... smoke in my home  
 very small  small  not small/not great  great  very great  
 I don't have a dryer .../don't smoke ...
25. Complete this sentence – please indicate which word you would place on the dots
- a. Staying in the kitchen while cooking, is in my view ...
  - b. Not connecting power strips to each other, is in my view ...
  - c. Only charging my phone, iPad, electric bike or scoot mobile during the day, is in my view ...
  - d. Cleaning the filter of my dryer after every wash, is in my view ...
  - e. Not smoking in my home, is in my view  
 Very unnecessary  Unnecessary  Neutral  Necessary  
 Very necessary  
 I don't have a dryer .../smoke ...
  - f. Staying in the kitchen during cooking, is in my view ...
  - g. Not connecting power strips to each other, is in my view ...
  - h. Only charging my phone, iPad, electric bike or scoot mobile during the day, is in my view ...
  - i. Cleaning the filter of my dryer after every wash, is in my view ...
  - j. Not smoking in my home, is in my view  
 Very unpleasant  Unpleasant  Neutral  Pleasant  Very pleasant  
 I don't have a dryer .../smoke ...

26. Statements – please indicate to what extent you agree or disagree  
People in my direct environment (family, friends, neighbours) think that it is important that I:

- a. ... stay in the kitchen during cooking
- b. ... do not connect power strips to each other
- c. ... only charge my phone, iPad, electric bike or scoot mobile during the day
- d. ... clean the filter of my dryer after every wash
- e. ... do not smoke in my home
  - Completely disagree  Disagree  Neutral  Agree  Completely agree
  - I don't have a dryer .../smoke ...

27. Statements – please indicate to what extent you agree or disagree  
People in my direct environment (family, friends, neighbours):

- a. ... stay in their kitchen during cooking
- b. ... connect power strips to each other
- c. ... only charge their phone, iPad, electric bike or scoot mobile during the day
- d. ... clean the filter of their dryer after every wash
- e. ... do not smoke in their homes
  - Completely disagree  Disagree  Neutral  Agree
  - Completely agree
  - I don't have a dryer .../smoke ...

### Your own behaviour

28. This question is about your feeling able to perform certain behaviours - please indicate to what extent you agree or disagree  
I feel able to ...:

- a. ... staying in the kitchen during cooking
- b. ... not connecting power strips to each other
- c. ... only charging my phone, iPad, electric bike or scoot mobile during the day
- d. ... cleaning the filter of my dryer after every wash
- e. ... not smoking in my home
  - Completely disagree  Disagree  Neutral  Agree
  - Completely agree
  - I don't have a dryer .../smoke ...

*To what extent you agree or disagree with the following statements*

29. Staying in the kitchen during cooking can help in preventing a fire

30. Not connecting power strips to each other can help in preventing a fire
31. Only charging my phone, iPad, electric bike/scoot mobile during the day can help in preventing a fire
32. Cleaning the filter of my dryer after every wash can help in preventing a fire
33. Not smoking in my home can help in preventing a fire  
 Completely disagree  Disagree  Neutral  Agree  Completely agree  
 I don't have a dryer .../smoke ...
34. The number of sockets in the house makes it necessary to connect power strips
35. Because I am not at home during the day, I don't have enough time to charge my phone, iPad, electric bike/scoot mobile when I am home
36. Cleaning the filter of my dryer after every wash takes too much time
37. I know how to clean the filter of my dryer  
 Completely disagree  Disagree  Neutral  Agree  Completely agree  
 I don't have a dryer .../smoke ...

*To what extent you agree or disagree with the following statements*

- 38.
- a. I plan to stay in the kitchen during cooking
  - b. I plan to only use one power strips at the time
  - c. I plan to only charge my phone, iPad, electric bike or scoot mobile during the day
  - d. I plan to clean the filter of my dryer after every wash
  - e. I plan not to smoke in my home  
 Completely disagree  Disagree  Neutral  Agree  
 Completely agree  
 I don't have a dryer .../smoke ...

## Responsibility

39. Who do you think is responsible for the fire safety in your home?

- I am
- the Municipality
- the Building Association
- Home care
- the Fire Service
- Someone else, namely ....

## Trustworthiness of information

40/41.

How trustworthy do you find information about fire prevention when that is provided by

- the Municipality
- the Building association
- the Home care
- the Police
- the Fire service
- Family
- Neighbours
- People who have suffered from a fire
  - Totally not reliable
  - Not reliable
  - Neutral
  - reliable
  - Totally reliable

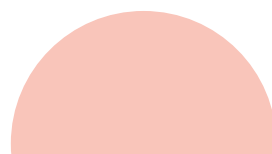
42. How would you like to be informed about fire safety at your home? (More than 1 answer is possible)

- through the Internet
- through a brochure
- by phone
- through an information meeting
- through a face-to-face meeting with an expert in my home
- an other way, namely ...

Thank you very much for answering these questions - If you have any questions or remarks, you can put those below:

## Appendix B. Respondents who were excluded from the analyses on perceived norm

Determinant	Missings
Injunctive social norm cooking	I don't know = 1414, Missing = 34
Descriptive social norm cooking	I don't know = 2086, Missing = 0
Injunctive social norm using power strips	I don't know = 1424, Missing = 0
Descriptive social norm using power strips	I don't know = 2270, Missing = 0
Injunctive social norm charging devices	I don't know = 1317, Missing = 115
Descriptive social norm charging devices	I don't know = 2184, Missing = 0
Injunctive social norm cleaning dryer lint filter	I don't know = 769, Missing = 1846
Descriptive social norm cleaning dryer lint filter	I don't know = 2347, N.A. (they do not own a dryer)= 419 Missing = 0
Injunctive social norm smoking	I don't know = 50, Missing = 4113
Descriptive social norm smoking	I don't know = 927, N.A. (they do not smoke) = 957 Missing = 0



## Appendix C. Methods and practical applications

Performance objective	Determinants and change objectives	Methods	Parameters for use	Applications
Stay in the kitchen while cooking	Risk perception	<p>Scenario-based risk information (Precaution-Adoption process Model [46])</p> <p>Consciousness raising (Health Belief Model; Precaution-adoption Process Model; Trans-Theoretical Model [47–49])</p>	<p>Plausible scenario with a cause and an outcome; imagery. Most effective when people generate their own scenario or when multiple scenarios are provided</p> <p>Can use feedback and confrontation; however, raising awareness must be quickly followed by increase in problem-solving ability and (collective) self-efficacy</p>	Image of a risk situation in the kitchen → what is the risk? Why is it a risk? What are fire safe solutions?
	Attitude	<p>Self-reevaluation (Trans-Theoretical Model [48])</p> <p>Arguments (Communication-Persuasion Matrix; Elaboration likelihood Model [50,51])</p>	<p>Stimulation of both cognitive and affective appraisal of self-image. Can use feedback and confrontation; however, raising awareness must be quickly followed by increase in problem-solving ability and self-efficacy</p> <p>For central processing of arguments they need to be new to the message receiver</p>	<p>Let participants imagine what they (can) do when they are cooking and the telephone or doorbell rings. Possible combination with self-efficacy: implementation-intentions</p> <p>Discussion about benefits of staying in the kitchen. Please note: must be a new argument to convince them</p>
	Skills & self-efficacy	<p>Planning coping responses (Attribution Theory and Relapse Prevention Theory; Theories of Self-Regulation [52])</p> <p>Cue altering (theories of Automatic, Impulsive, and Habitual Behaviour; Theories of Self-Regulation [53])</p>	<p>Identification of high-risk situations and practice of coping response</p> <p>Existing positive intention</p>	<p>Discussion about tips on what to do if there are distractions while cooking. Let participants think about how they can act.</p> <p>Discussion or role play → Let participants think about certain cues that they can use to remind them that they were cooking (kitchen timer, take something with you when you answer the phone, sound of the doorbell = trigger for turning the gas on/off).</p>
	Habitual behaviour	Implementation-intentions (Theories of Goal directed Behaviour; Theories of automatic, Impulse and Habitual Behaviour [54,55])	Existing positive intention	Form: let participants write down implementation intentions for how they can behave when the telephone or doorbell rings when they are cooking.

Performance objective	Determinants and change objectives	Methods	Parameters for use	Applications
	Skills & self-efficacy	Guided practice (Social cognitive Theory; Theories of Self-Regulation [56])	Subskill demonstration, instruction, and enactment with individual feedback; requires supervision by an experienced person; some environmental changes cannot be rehearsed	Let participants practice in a scenario on how to behave while cooking when the telephone rings. Also practice extinguishing a pan that caught fire.
	Social norms			Image of a risk situation in the kitchen → what is the risk? Why is it a risk? What are fire safe solutions?
Charge electronic devices only during day time	Attitude	Self-reevaluation (Trans-Theoretical Model [48])  Arguments (Communication-Persuasion Matrix; Elaboration likelihood Model [50,51])	Stimulation of both cognitive and affective appraisal of self-image. Can use feedback and confrontation; however, raising awareness must be quickly followed by increase in problem-solving ability and self-efficacy  For central processing of arguments they need to be new to the message receiver	Discussion or written assignment. Let the participants think about their own home and let them identify what are (un) safe places for charging?  Identify the benefits of charging during the day. Please note: must be a new argument to convince them
	Skills & self-efficacy	Goal setting (Goal Setting Theory; Theories of Self-Regulation [57])  Planning coping responses (Attribution Theory and Relapse Prevention Theory; Theories of Self-Regulation [52])	Commitment to the goal; goals that are difficult but available within the individual's skill level  Identification of high-risk situations and practice of coping response	Let participants make a plan about when they will charge their devices  Discussion: let participants identify barriers and think about how these could be removed.
	Social norms			Let participants discuss in groups about when they charge their devices at home.
	Habitual behaviour	Implementation-intentions (Theories of Goal directed Behaviour; Theories of automatic, Impulse and Habitual Behaviour [54,55])	Existing positive intention	Form: let participants write down implementation intentions for charging their devices. When and where will they charge them?

Performance objective	Determinants and change objectives	Methods	Parameters for use	Applications
Not connecting power strips	Attitude	Arguments (Communication-Persuasion Matrix; Elaboration likelihood Model [50,51])	For central processing of arguments they need to be new to the message receiver	Discussion: mentioning the advantages of using one power strip at a time. Please note: must be a new argument to convince them.
		Self-reevaluation (Trans-Theoretical Model [48])	Stimulation of both cognitive and affective appraisal of self-image. Can use feedback and confrontation; however, raising awareness must be quickly followed by increase in problem-solving ability and self-efficacy	Discussion or written assignment. Let participants think about their own home situation: how can they make sure they do not have to connect power strips?
	Skills & self-efficacy	Goal setting (Goal Setting Theory; Theories of Self-Regulation [57])  Planning coping responses (Attribution Theory and Relapse Prevention Theory; Theories of Self-Regulation [52])	Commitment to the goal; goals that are difficult but available within the individual's skill level  Identification of high-risk situations and practice of coping response	Discussion: let participants think about the number of sockets in their home and, if too little, make a plan for what they need. Let them also think about who can help them with this.  Discussion: identify what you can do yourself or who can help if there are not enough sockets in your home.
	Social norms			Have participants discuss in groups how they use power strips at home.
Cleaning the dryer lint filter after every cycle	Attitude	Arguments (Communication-Persuasion Matrix; Elaboration likelihood Model [50,51])	For central processing of arguments they need to be new to the message receiver	List the advantages of cleaning the filter after each drying cycle.
	Self-efficacy	Guided practice (Social cognitive Theory; Theories of Self-Regulation [56])	Subskill demonstration, instruction, and enactment with individual feedback; requires supervision by an experienced person; some environmental changes cannot be rehearsed	Let participants practice cleaning the filter. Do people know where to find the filter? And do they know how to clean it?



# Appendix D. Flyer

## WAT ALS ER TOCH BRAND UITBREEKT?

Wanneer een brand uitbreekt heeft u vaak maar drie minuten de tijd om uw woning veilig te verlaten. Zorg daarom dat u weet wat u moet doen bij brand.



Wat te doen?

- Probeer kalme te blijven.
- Waardevol en veilig ontsnomen.
- Niet aan de lift gaan, via de kortste weg de woning.
- Staat deuren dicht en raammeer u de woning verlaat.
- Blijf bij rookwaaier dicht bij de vloer.
- Ga naar een vooraf afgesproken verzamelplaats en controleer of iedereen veilig is.
- Bel 112.
- Mocht u op een veilige plek op de brandweer.

## VRAGEN?

Mocht u na afloop van de voorlichtingsbijeenkomst nog vragen hebben, dan kunt u deze stellen door contact op te nemen met Margo Karemaker, een van de organisatoren van de bijeenkomst.

Dit kan via [margo.karemaker@nlv.nl](mailto:margo.karemaker@nlv.nl) of door te bellen naar 026 - 355 24 00.



Deze folder is een uitgave van:



## HOE GAAT U UW WONING BRANDVEILIGER MAKEN?

Wij hopen dat u gedurende de voorlichting van vandaag geleerd heeft hoe u uw woning brandveiliger kunt maken. Bij het verbeteren van de brandveiligheid in uw woning kunt u deze folder als geheugensteunje gebruiken. Vul voor uzelf in op welke wijze u de brandveiligheid in uw woning kunt verbeteren.

Een voorbeeld: U kunt het volgende voor uzelf noteren: "Als de deurbel gaat tijdens het koken, dan zet ik het fornuis of de kookplaat uit voordat ik naar voordeur loop."

### HET HERKENNEN VAN BRANDRISICO'S

Als..... dan.....  
 Als..... dan.....  
 Als..... dan.....

### BRANDVEILIGHEID IN DE WOONKAMER

Als..... dan.....  
 Als..... dan.....  
 Als..... dan.....

### BRANDVEILIGHEID IN DE KEUKEN

Als..... dan.....  
 Als..... dan.....  
 Als..... dan.....

### ROOKMELDERS

Voor advies over waar u het beste een rookmelder kunt plaatsen, kunt u kijken op [www.rookmelder.nl](http://www.rookmelder.nl)

Voor andere vragen over rookmelders of hulp bij het plaatsen hiervan kunt u contact opnemen met het Rookmelders team van de Nederlandse Brandveiligheids Stichting. Bel naar de Nederlandse Brandveiligheids Stichting op 0261 - 27 55 55, meld u aan en geef uw adresgegevens door. Vervolgens wordt u gebeld welke rookmelder bij u in de buurt is. Het moet omringd u de contactgegevens van de vrijwilliger, met wie u daarna zelf telefonisch een afspraak kunt maken.

De vrijwilliger komt op de afgesproken tijd bij u langs, plaatst de rookmelder(s) en geeft een aantal handige tips. De plaatsing door de vrijwilliger is gratis. De rookmelders betaalt u zelf.

## BRANDVEILIGHEID IN UW WONING

Tips om uw huis een stukje brandveiliger te maken



## BRANDVEILIGHEID

Bedenk voor uw deelname aan de voorlichtingsbijeenkomst om de brandveiligheid bij u thuis te verbeteren.

In deze folder vindt u een controlelijst met tips om het bij u thuis brandveiliger te maken.

### BRANDVEILIGHEID IN UW WOONKAMER

Tijdens de voorlichtingsbijeenkomst hebben we gesproken over veilig opslaan en het gebruik van stekkerdozen. Bij deze enkele tips om dit thuis veilig te doen:

- Gebruik niet te veel stekkerdozen tegelijkertijd op één plek.
- Controleer of de stekkerdozen goed aansluiten op de stopcontacten. Leg de niet onder een laagje stof of een stukje papier.
- Niet te veel stekkerdozen op één plek. Ook het snoer van de stopzorgel altijd helemaal uit voordat u ze gebruikt. Gebruide haspels of snoeren kunnen oververhit raken en brand veroorzaken.

### ROKEN?

Rookt u? Maak sigaretten dan uit op een veilige plaats. Gebruik asbakken en leeg deze niet te laat op. Zo voorkomt een kwartier na het uitdoen van de laatste sigaret. Zet ook de asbak op een veilige plaats. Zet deze op tafel en niet op de leuning van een stoel of bank of op bed.

## VEILIG GEBRUIK VAN KAARSEN

Bij het gebruik van kaarsen is het van belang dat deze in een veilig standpunt en op een veilige plaats gebruikt worden.



- Gebruik onbrandbare standplaats voor kaarsen. Hou ook brandbare materialen uit de buurt van kaarsen en waxinelichtjes. Plaats kaarsen en waxinelichtjes niet te dicht bij elkaar of op de hoek van een tafel en maak ze ook uit de kamer vertakt.
- Kaarsen met lampjes in plaats van echte kaarsen zijn veel veiliger en blijven stevig meer op echte kaarsen, dit is een veilig alternatief.
- Steek kaarsen in kerststaljes nooit aan; het kerststalje kan makkelijk in brand raken.

### BRANDVEILIGHEID IN UW SLAAPKAMER

Ook in uw slaapkamer kunt u maatregelen treffen om de brandveiligheid te verhogen. Bij deze twee tips:

- Als u een elektrische deken heeft, berg deze dan opgerold op wanneer u deze niet gebruikt. Wanneer u de deken opvouwt beschadigt mogelijk de bedrading.
- Rook nooit in uw slaapkamer. Als u in slaap valt, kan een brandende sigaret snel brand veroorzaken.

## BRANDVEILIGHEID BIJ HET KOKEN

Tijdens de voorlichtingsbijeenkomst hebben we gesproken over veilig koken. Hieronder volgen enkele tips waarmee u in uw woning de brandveiligheid tijdens het koken kunt verhogen:

- Hoofd brandbare dingen zoals thee- en handdoeken uit de buurt van het kooktoestel. Deze kunnen makkelijk in brand raken.
- Bent u aan het koken en gaat de deur- of etesflood? Zet dan het fornuis laag of uit wanneer u wegloopt. Er kan bijvoorbeeld stoom in de pan ontstaan wanneer u er niet bij bent.
- Maak het filter van de afzuigkap regelmatig schoon, het kan in de afzuigkap komen en vlam vatten.
- Staat toch de vlam in de pan? Doe dan een deksel op de pan. Zorg dus dat u altijd een deksel bij de hand heeft tijdens het koken. Gebruik nooit water om het vuur te blussen. Schakel bij vlam in de pan ook het fornuis of de kookplaat uit. Het afzuigkap uit en laat de pan minstens een half uur staan om af te koelen. Ga nooit lopen met de hete pan. Controleer na een half uur of het vuur echt uit is.

TIP: Mocht u tijdens het koken toch de keukens uit moeten, neem dan een potlood of kookveiler mee als geheugensteunje.

## BRANDVEILIGHEID BIJ HET WASSEN EN DROGEN

Bij het wassen en drogen kunt de volgende maatregelen treffen om de brandveiligheid te verhogen:

- Sluit de wasdroger en wasmachine niet aan op één stekkerdoos.
- Maak het filter van de wasdroger na ieder gebruik schoon. Het drogen van was veroorzaakt veel pluis. Dit kan brand veroorzaken.



## Appendix E. Design of the Fire Safety at Home programme

### Opzet interventie Brandveiligheid in de woning

#### Ontvangst/introductie

Welkom heten deelnemers, korte uitleg over de thema's die zullen worden behandeld en het opsplitsen van de groep in drie sub-groepen.

#### Ruimte 1: Het herkennen van brandrisico's

Tijdens deze opdracht wordt met de deelnemers in gesprek gegaan over brandrisico's in de woning. Dit zal aan de hand van afbeeldingen van risicovolle situaties in een woonkamer en keuken gebeuren. Vervolgens wordt in een gesprek besproken of mensen deze situaties in hun eigen woning herkennen en wat zij kunnen doen om dit veiliger te maken.

- De opdracht begint met de begeleider die vraagt: "wie kan een situatie beschrijven waarbij het mis kan gaan in huis en brand kan ontstaan?" In het antwoord moet zowel oorzaak als gevolg genoemd worden (eventueel hierop doorvragen). Bij groepen die opdracht 2 en/of 3 al hebben gedaan dient de begeleider te voorkomen dat zij enkel voorbeelden noemen die zij in die opdrachten zijn tegengekomen. Probeer door te vragen naar nieuwe situaties. Vervolgens met groep bespreken hoe deze situatie voorkomen zou kunnen worden.
- De begeleider laat de groep een afbeelding zien van een woonkamer met daarop verschillende risicovolle situaties. Aan de deelnemers wordt gevraagd om de risico's die te zien zijn op deze afbeelding te benoemen. Vervolgens gaat begeleider met deelnemers in gesprek over de eigen thuissituatie: "Komen dit soort situaties voor in uw eigen woning?" "Kunt u veilige/onveilige situaties uit uw woning benoemen?" Wanneer deelnemers hier antwoord op geven en zij bepaalde risico's herkennen, dient begeleider een handelingsperspectief te bieden. Hoe kunt u dit voorkomen? (check bij deelnemer of hij/zij zich in staat voelt om dit gedrag uit te voeren). Uiteindelijk draait begeleider de foto om en is een afbeelding van de veilige situatie te zien.
- In beide opdrachten wordt met behulp van argumenten het brandveilige gedrag en het belang van het uitvoeren hiervan benadrukt.

## Materiaal voor opdracht 1:



Figuur 1 Risico's in de keuken (links) en veilige oplossingen (rechts)



Figuur 2 Risico's in de woonkamer (links) en veilige oplossingen (rechts).

## Ruimte 2: Opladen van apparaten en gebruik van stekkerdozen

Deze opdrachten vinden plaats in een ruimte die is ingericht als woonkamer. Door middel van opdrachten wordt de deelnemers gevraagd hoe zij in bepaalde situaties zouden handelen. De focus in deze opdracht ligt op de onderwerpen opladen van apparaten en stekkerdozen.

Deelnemers krijgen de volgende opdrachten:

### *Opdracht 1: Koppelen stekkerdozen*

Omschrijving: Op een tafel ligt een mobiel en aan een van de deelnemers wordt gevraagd om deze op te laden. De telefoon mag daarbij niet worden verplaatst. In de ruimte liggen ook enkele verlengsnoeren van 1m lang. Het stopcontact zit op zodanige afstand dat dit niet met 1 verlengsnoer gehaald kan worden. De deelnemers zullen dus waarschijnlijk stekkerdozen aan elkaar koppelen om bij het stopcontact te komen. Uiteindelijk haalt de begeleider

een langer verlengsnoer tevoorschijn waarmee deelnemers het stopcontact wel kunnen halen zonder stekkerdozen te koppelen. De begeleider legt uit dat de opdracht "een beetje flauw" was en dat deelnemers de optie niet hadden om het stopcontact op een veilige manier te bereiken. Vervolgens wordt in gesprek gegaan over de thuissituatie en of men de situatie uit de opdracht herkent. Ook wordt gevraagd of mensen in de thuissituatie tegen barrières aanlopen waardoor zij stekkerdozen gaan koppelen (bijvoorbeeld te weinig stopcontacten of stopcontacten op onhandige plaatsen). Samen met de groep wordt besproken hoe deze barrières overkomen kunnen worden. De begeleider dient dit gesprek te leiden en te zorgen dat er een veilig handelingsperspectief besproken wordt. Vervolgens wordt gevraagd om, per deelnemer, een implementatie-intentie te vormen gebaseerd op deze situatie. Bijvoorbeeld: "Als ik een stopcontact niet kan bereiken door een te kort snoer, dan koop ik in de bouwmarkt een langer verlengsnoer."

### *Opdracht 2: Opladen iPad*

Omschrijving: Aan een van de deelnemers (bij voorkeur degene die op de bank zit) wordt een iPad gegeven met de vraag om deze op te laden. Het stopcontact is zodanig geplaatst dat de bank naast het stopcontact staat maar er geen bijzettafel in de buurt is (deze staat verderop). De begeleider observeert: wat doet deelnemer? Waar legt hij/zij de iPad neer? Veilige optie is iPad op de grond leggen of een bijzettafel pakken en de iPad daarop leggen. Onveilig is de iPad op de bank leggen.

Vervolgens wordt in gesprek gegaan over de thuissituatie en of men de situatie uit het scenario herkent (waar laden deelnemers thuis hun elektrische apparaten op?). Ook wordt gevraagd of mensen in de thuissituatie tegen barrières aanlopen waardoor zij hun elektrische apparaten op onveilige plaatsen gaan opladen. Samen met de groep wordt besproken hoe deze barrières overkomen kunnen worden. De begeleider dient dit gesprek te leiden en te zorgen dat er een veilig handelingsperspectief besproken wordt. Daarna wordt gevraagd om, per deelnemer, een implementatie-intentie te vormen gebaseerd op deze situatie

### *Opdracht 3: Fietsaccu*

Aan een van de deelnemers wordt een fietsaccu gegeven die moet worden opgeladen. De begeleider observeert: wat doet deelnemer? Waar legt hij/zij de fietsaccu neer? Is dit een veilige of onveilige optie? Vervolgens wordt in gesprek gegaan over de thuissituatie en of men de situatie uit het scenario herkent (waar laden deelnemers thuis hun fietsaccu op?). Ook wordt gevraagd of mensen in de thuissituatie tegen barrières aanlopen waardoor zij hun fietsaccu op onveilige plaatsen gaan opladen. Samen met de groep

wordt besproken hoe deze barrières overkomen kunnen worden. Vervolgens wordt aan de deelnemer gevraagd hoe je de situatie veiliger kunt maken tijdens het opladen van de fietsaccu. De begeleider dient te zorgen dat er een veilig handelingsperspectief besproken wordt: hij legt uit wat een veilige plaats is en dat bij voorkeur een fietsaccu wordt opgeladen in een ruimte waar een rookmelder hangt. Daarna wordt gevraagd om, per deelnemer, een implementatie-intentie te vormen gebaseerd op deze situatie

### Ruimte 3: Veilig koken en het gebruik van de wasdroger

De opdrachten behorend bij dit thema vinden plaats in een ruimte die wordt ingericht als keuken/washok. De focus in deze opdracht ligt op de onderwerpen veilig koken en wasdroger.

Per oefening wordt één iemand gevraagd om een handeling uit te voeren. Vervolgens volgt een gesprek met de groep over of dit veilig dan wel onveilig gedrag was. Ook hier worden implementatie-intenties besproken.

#### *Opdracht 1: Afleiding tijdens koken*

In deze opdracht wordt gebruik gemaakt van een fornuis waarbij het aanzetten van het gas en vlam in de pan gesimuleerd kan worden. Beiden kunnen door de begeleider geactiveerd worden m.b.v. een afstandsbediening.

Aan een deelnemer wordt gevraagd om te doen alsof hij iets aan het koken is.

Vraag de deelnemer te tonen hoe hij het fornuis aanzet, waar hij de pannen neerzet enz. om te doen alsof de focus op de wijze van koken ligt. Vervolgens laat de begeleider een telefoon afgaan die in de naastgelegen ruimte ligt.

Aan de deelnemer die bij het fornuis staat wordt gevraagd om de telefoon op te nemen. De begeleider observeert: wat doet de deelnemer? Zet hij het fornuis uit of loopt hij weg bij het fornuis dat nog aan staat? Veilige optie is fornuis laag of uit zetten. Onveilig is weglopen zonder het vuur lager te zetten.

Als de deelnemer wegloopt zonder het gas lager of uit te zetten, activeert de begeleider de vlam in de pan. Met de andere deelnemers wordt besproken of het getoonde gedrag veilig of onveilig is. Laat mensen met elkaar in discussie gaan over wat in het scenario gedaan werd, wat zij thuis doen en wat de veilige optie is. Ook wordt aan de deelnemers gevraagd of zij in de thuissituatie tegen barrières aanlopen waardoor zij weglopen bij het fornuis als er een afleiding is. Samen met de groep wordt besproken hoe deze barrières overkomen kunnen worden. De begeleider dient dit gesprek te leiden en te zorgen dat er een veilig handelingsperspectief besproken wordt. Ook bespreekt de begeleider het handelingsperspectief voor wanneer er vlam in de pan is ontstaan. De begeleider laat dit gedrag vervolgens ook zien. Daarna wordt gevraagd om, per deelnemer, een implementatie-intentie te vormen gebaseerd op deze situatie. Indien mogelijk dienen de deelnemers hierin een cue op te nemen die hen herinnert aan het feit dat het vuur nog aan staat (indien zij dit lager zetten

bij het weglopen van het fornuis). Bijvoorbeeld: “als ik wegliep bij het fornuis omdat de bel gaat, dan neem ik een pollepel mee die mij eraan herinnert dat het vuur nog aan staat.”

### *Opdracht 2: Wasdroger*

In de wasdroger zitten een aantal theedoeken. De begeleider benoemt dat de was net klaar is en vraagt een van de deelnemers om de was uit de droger te halen. Er wordt gevraagd om dit precies zo te doen als thuis. De begeleider observeert of de deelnemer ook nog aangeeft of laat zien dat hij ook het filter van de wasdroger schoonmaakt na gebruik. Vervolgens wordt aan de andere deelnemers gevraagd of het getoonde gedrag veilig of onveilig is. Laat mensen met elkaar in discussie gaan over wat in het scenario gedaan werd, wat zij thuis doen en wat de veilige optie is. Indien het schoonmaken van het filter niet door de deelnemers zelf wordt aangegeven, vraagt de begeleider daar actief naar: “weet u dat u het filter moet schoonmaken?”, “hoe vaak denkt u dat u dit moet doen?” en “weet u waar het filter/de filters in uw wasdroger zitten?” Ook wordt aan de deelnemers gevraagd of zij in de thuissituatie tegen barrières aanlopen bij het schoonmaken van het filter van de wasdroger. Samen met de groep wordt besproken hoe deze barrières overkomen kunnen worden. De begeleider dient dit gesprek te leiden en te zorgen dat er een veilig handelingsperspectief besproken wordt. De begeleider laat vervolgens ook zien waar de filters in de wasdroger zitten en hoe je deze kunt schoonmaken.

### **Afsluiting**

Na het doorlopen van de verschillende scenario's komen de deelnemers bijeen voor de gezamenlijke afsluiting. Hierin wordt gevraagd hoe de deelnemers de voorlichting ervaren hebben, wat zij geleerd hebben en thuis anders kunnen doen (geformuleerd in de vorm van een implementatie-intentie). Om de deelnemers te voorzien van informatie die zij thuis na kunnen lezen, krijgen zij allemaal een folder mee naar huis. Hierin staat een samenvatting van de behandelde onderwerpen, tips om dit in de eigen woning toe te passen, contactgegevens voor vragen na afloop. Ook wordt in de folder gevraagd om op te schrijven hoe de deelnemers hun eigen woning een stukje veiliger gaan maken. Op de folder is hier ruimte voor vrijgehouden en staan per thema drie regels waarop deelnemers implementatie-intenties kunnen opschrijven.



## Appendix F. Questionnaire Fire safety behaviour, determinants and evaluation of the programme

*“Brandveiligheid bij senioren”*

*“Code ERCPN: 188\_11\_02\_2018\_S33”*

*Deze vragenlijst ontvangt u omdat u enige tijd geleden een voorlichting over brandveiligheid in de woning heeft gevolgd bij de Risk Factory.*

*In deze vragenlijst wordt gevraagd naar hoe u de voorlichting ervaren heeft en vragen we naar uw gedrag en mening over brandveiligheid. Het invullen van de vragenlijst kost maximaal 15 minuten.*

*Het is belangrijk dat u op alle vragen een antwoord geeft. Het kan zijn dat u sommige vragen al in een eerdere vragenlijst heeft ingevuld maar wij verzoeken u om deze nogmaals te beantwoorden.*

*Alle gegevens die u invult worden vertrouwelijk behandeld.*

*Evaluatie voorlichting [Deze zes vragen werden alleen gesteld in de tweede vragenlijst]*

*Hieronder volgen enkele vragen over de voorlichting die u heeft ontvangen. Wij horen graag hoe u deze ervaren heeft.*

- Ik heb genoten van de voorlichting  
 Helemaal mee oneens  Oneens  Neutraal  Eens  Helemaal mee eens
- De informatie uit de voorlichting was begrijpelijk  
 Helemaal mee oneens  Oneens  Neutraal  Eens  Helemaal mee eens
- De informatie en oefeningen over brandveiligheid waren nuttig  
 Helemaal mee oneens  Oneens  Neutraal  Eens  Helemaal mee eens
- Ik heb het gevoel dat ik de informatie die gedeeld is kan toepassen in mijn eigen woning  
 Helemaal mee oneens  Oneens  Neutraal  Eens  Helemaal mee eens
- Ik zou andere zelfstandig wonende senioren aanraden om deze voorlichting te volgen  
 Helemaal mee oneens  Oneens  Neutraal  Eens  Helemaal mee eens

- Als ik de voorlichting een cijfer zou mogen geven, dan geef ik deze een:

Heeft u nog aanvullende opmerkingen over de voorlichting? Dan kunt u deze hieronder delen:

### Algemeen

13. Wat is uw geslacht?

- Man
- Vrouw

14. Wat is uw geboortejaar?

15. Wat is uw woonsituatie?

- Alleenstaand
- Samenwonend

16. Welk type kooktoestel heeft u in huis?

- Gastoestel
- Elektrische kookplaat (elektrisch, keramisch of inductie)
- N.v.t. ik kook niet zelf in mijn woning
- Anders, namelijk...

17. Heeft u een wasdroger?

- Ja
- Nee

18. Gebruikt u de wasdroger?

- Ja
- Nee
- N.v.t.



## Uw eigen gedrag

19. In hoeverre is het volgende gedrag op u van toepassing:

- a) Als ik aan het koken ben en de telefoon gaat, dan zet ik het vuur laag of uit voordat ik de keuken verlaat.  
 Nooit  Zelden  Regelmatig  Vaak  Altijd  N.v.t.
- b) Als ik aan het koken ben en er wordt aangebeld, dan verlaat ik de keuken.  
 Nooit  Zelden  Regelmatig  Vaak  Altijd  N.v.t
- c) Ik koppel meerdere stekkerdozen aan elkaar.  
 Nooit  Zelden  Regelmatig  Vaak  Altijd
- d) Ik laad 's nachts mijn telefoon, tablet, elektrische fiets(accu) of scootmobiel(accu) op.  
 Nooit  Zelden  Regelmatig  Vaak  Altijd
- e) Als mijn telefoon of tablet aan de oplader ligt, dan leg ik deze op de bank of op een stoel.  
 Nooit  Zelden  Regelmatig  Vaak  Altijd
- f) Ik maak het filter van de wasdroger na ieder gebruik schoon.  
 Nooit  Zelden  Regelmatig  Vaak  Altijd  N.v.t

## De kans op brand

20. De volgende vragen gaan over de kans op brand in bepaalde situaties. Kunt u aangeven hoe groot u de kans op brand in deze situaties inschat?

0% staat voor helemaal geen kans op brand en 100% betekent dat er altijd een brand zal ontstaan als je dit doet.

- a) De kans dat er brand ontstaat wanneer je op gas kookt is: .....%  N.v.t
- b) De kans dat er brand ontstaat wanneer je elektrisch kookt is: .....%  
 N.v.t
- c) De kans dat er brand ontstaat wanneer je wegloopt bij het fornuis is: .....%  
 N.v.t
- d) De kans dat er brand ontstaat wanneer je stekkerdozen koppelt is: .....%  
 N.v.t

- e) De kans dat er brand ontstaat wanneer je 's nachts je telefoon, tablet, elektrische fiets(accu) of scootmobiel(accu) oplaadt is:.....%  N.v.t
- f) De kans dat er brand ontstaat wanneer je je telefoon op tablet op de bank legt tijdens het opladen is: .....%  N.v.t
- g) De kans dat er brand ontstaat wanneer je niet na iedere droogbeurt het filter van de wasdroger schoonmaakt is:.....%  N.v.t

### Eens/oneens

21. In hoeverre bent u het eens of oneens met de volgende stellingen. U kunt uw antwoord geven door op de lijn een kruisje te zetten ergens tussen helemaal mee oneens (links) en helemaal mee eens (rechts)

- a) Als u wordt afgeleid tijdens het koken (bijvoorbeeld: de telefoon of deurbel gaat), dan vind ik het belangrijk om het vuur laag of uit te zetten om brand te voorkomen.

\_\_\_\_\_ | \_\_\_\_\_  
 Helemaal oneens Helemaal eens  N.v.t

- b) Als u niet in de keuken bent tijdens het koken, zult u een brand niet op tijd kunnen ontdekken.

\_\_\_\_\_ | \_\_\_\_\_  
 Helemaal oneens Helemaal eens  N.v.t

- c) In uw keuken blijven tijdens het koken verlaagt het risico op brand.

\_\_\_\_\_ | \_\_\_\_\_  
 Helemaal oneens Helemaal eens  N.v.t

- d) Slechts 1 stekkerblok gebruiken (dus niet koppelen) is belangrijk om de kans op brand in uw woning te verlagen.

\_\_\_\_\_ | \_\_\_\_\_  
 Helemaal oneens Helemaal eens  N.v.t

- e) Als ik mijn apparaten oplaad is het belangrijk dat ik in de buurt blijf.

\_\_\_\_\_ | \_\_\_\_\_  
 Helemaal oneens Helemaal eens  N.v.t

- f) Het opladen van uw telefoon, tablet, elektrische fiets(accu) of scootmobiel(accu) op de bank is gevaarlijk.

\_\_\_\_\_ | \_\_\_\_\_  
 Helemaal oneens Helemaal eens  N.v.t

- g) Alleen overdag uw telefoon, tablet, elektrische fiets(accum) of scootmobiel(accum) opladen zal het risico op een brand in uw woning verlagen.

Helemaal oneens  Helemaal eens  N.v.t

- h) Het filter van de wasdroger na iedere droogbeurt schoonmaken zal de kans op brand in uw woning verlagen.

Helemaal oneens  Helemaal eens  N.v.t

### Eens/oneens

22. In hoeverre bent u het eens of oneens met de volgende stellingen.

- a) Wanneer ik wegloop bij het fornuis, lukt het mij om niet te vergeten dat ik aan het koken ben.

Helemaal oneens  Helemaal eens  N.v.t

- b) Ik heb voldoende mogelijkheden om mijn telefoon, tablet, elektrische fiets(accum) of scootmobiel(accum) alleen overdag op te laden.

Helemaal oneens  Helemaal eens  N.v.t

- c) Als ik dat zou willen, dan kan ik mijn mijn telefoon, tablet, elektrische fiets(accum) of scootmobiel(accum) op een veilige plek opladen.

Helemaal oneens  Helemaal eens  N.v.t

- d) In mijn huis lukt het mij om gebruik te maken van de vaste stopcontacten en daarom hoef ik geen stekkerdozen te koppelen.

Helemaal oneens  Helemaal eens  N.v.t

- e) Ik ben in staat om de filters van de wasdroger na ieder gebruik schoon te maken.

Helemaal oneens  Helemaal eens  N.v.t

## Vul de zin aan

23. In hoeverre bent u het eens of oneens met de volgende stellingen:

- a) Ik kan zelf de kans op brand in mijn woning verkleinen.

Helemaal oneens | Helemaal eens

- b) Voor mij is brandveiligheid een belangrijk thema in mijn dagelijkse bezigheden.

Helemaal oneens | Helemaal eens

- c) Ik voel me goed in staat om een brand in mijn woning te voorkomen.

Helemaal oneens | Helemaal eens

## Eens/oneens

24. In hoeverre bent u het eens of oneens met de volgende stellingen:

- a) Ik ben van plan om ten allen tijde in mijn keuken te blijven tijdens het koken en dus niet weg te lopen.

Helemaal oneens | Helemaal eens  N.v.t

- b) Ik ben van plan om slechts één stekkerdoos per keer te gebruiken.

Helemaal oneens | Helemaal eens  N.v.t

- c) Ik ben van plan om alleen nog maar overdag mijn telefoon, tablet, elektrische fiets of scootmobiel op te laden.

Helemaal oneens | Helemaal eens  N.v.t

- d) Ik ben van plan om mijn telefoon, tablet, elektrische fiets of scootmobiel op een veilige plek op te laden.

Helemaal oneens | Helemaal eens  N.v.t

- e) Ik ben van plan om het filter van de wasdroger na iedere wasbeurt schoon te maken.

Helemaal oneens | Helemaal eens  N.v.t

Voorafgaand aan de bijeenkomst bij de Risk Factory heeft u ook een vragenlijst ingevuld. Om de twee vragenlijsten die u heeft ingevuld aan elkaar te kunnen koppelen, willen we u vragen om hieronder een unieke code te creëren. Deze code kunt u creëren door de **eerste 2 letters van uw adres**, de **2 cijfers van uw geboortedag** en de **eerste twee letters van uw moeders roepnaam** te combineren.

Een voorbeeld: Piet Smit woont aan de Hoofdstraat, is geboren op 1 januari en zijn moeders naam is Anita. Zijn unieke code wordt: HO-01-AN

De eerste twee letters van uw straatnaam:

De twee cijfers van uw geboortedag:

De eerste twee letter van uw moeders roepnaam:

Uw eigen unieke code:

## Appendix G. Questionnaire process evaluation

1. Is the programme executed according to plan. If not, why?
2. How did you experience the programme?
3. What are the strong points of this programme?
4. What are improvement areas of this programme?
5. Did you notice certain things during the programme? For example, does the programme reach the interest of the entire target group? Did people drop out, and why?
6. Do you think this programme will lead to a change in behaviour among the target group? If so, which ones? If not, why?
7. What recommendations do you have to improve this programme?

## Appendix H. T-tests demographics at baseline

T-tests Pre-data

	T-test pre-data t(df)
<b>Attitude</b>	t(421)=-.18, p=.86
<b>Self-efficacy</b>	Mann-Witney U=22799.5 (ns), p=.13
<b>Intention</b>	t(418)=-1.75, p=.08
<b>Behaviour</b>	
When I am cooking and the telephone rings, I put the heat low before leaving the kitchen	t(376)=.52, p=.60
When I am cooking and someone rings the doorbell, I leave the kitchen	t(387)=1.20, p=.23
I connect power strips to each other	t(422)=.18, p=.86
At night time I charge my phone, iPad, electric bike or mobility scooter	t(421)=-1.40, p=.16
When I am charging my phone or iPad, I put it on the sofa or on a chair	Mann-Witney U=21249 (ns), p=.37
I clean the dryer lint filter after every cycle	Mann-Witney U= 10547.5 (ns), p=.17
<b>Risk perception</b>	
Cooking on a gas stove	t(266)=-1.34, p=.18
Cooking on an electric stove	t(307)=-2.54, p=0.12*
Leaving the stove while cooking	t(306)=-1.54, p=.12
Connecting power strips	t(318)=-.91, p=.37
Charging devices at night time	t(316)=-.96, p=.34
Laying a phone or iPad on a sofa or chair while charging	t(300)=-.51, p=.61
Not cleaning the dryer lint filter after every cycle	t(251)=-.09, p=.93
<b>General fire safety</b>	
I can decrease the chance on a fire in my own home	t(405)=-1.45, p=.15
Fire safety is an important subject for me	t(408)=-.55, p=.58
I feel able to prevent a fire from occurring in my home	t(406)=-1.79, p=.08
General fire safety_total	t(414)=-1.68, p=.50

# Impact of this dissertation





Older adults are overrepresented in statistics on fatal residential fires and injuries which makes them an important target group for fire safety programmes. Therefore, the aim of this dissertation was to develop a behavioural intervention to improve home fire safety behaviour among older adults by using Intervention Mapping.

The findings from the different studies showed that older adults have limited knowledge about fire safety (Chapter 2). Furthermore, we found that perceived behavioural control, attitude and response efficacy are important target variables for fire safety programmes (Chapter 3). These results were used as input for the development of the Fire Safety at Home programme (Chapter 4). An effect study (Chapter 5) showed positive intervention effects of this programme for different fire safety behaviours related to common fire causes among older adults (connecting power strips, placing a phone or iPad on a sofa or chair while charging, and cleaning the dryer lint filter), the social cognitive determinant attitude towards home fire safety, and risk perception towards cleaning the dryer lint filter after every cycle. These results underscore the importance of targeting specific behaviours and determinants in interventions for meaningful change in fire safety practices.

This dissertation broadens the field of fire safety research since this is one of the first studies that focuses on preventive fire safety behaviour. In general, current home fire safety programmes focus on either taking technical preventive measures, such as installing smoke alarms or carbon-monoxide detectors, or planning escape routes. However, since statistics show that behaviours such as cooking are common fire causes among older adults, it is needed to address these behaviours in research.

How the results of this dissertation will impact fire safety education, fire safety regulations, and managing residential buildings will be addressed in the following paragraphs.

### *Impact on fire safety education*

The research as described in this dissertation started from a need for a scientific basis on which fire safety education in the Netherlands can be built. The fire service started organizing fire safety programmes following the example of (programmes in) the United Kingdom. At the start, trial and error was used to find out how a fire safety programme should be organized. Over the years, the importance of input from behavioural sciences has been increasingly recognized. In recent years, the fire service started hiring several behavioural experts and expressed their need for scientific support for their fire safety programmes. This need was supported by the Dutch Burns

Foundation. This dissertation has met those needs by scientifically examining how to develop, implement and evaluate fire safety programmes for older adults.

Furthermore, this dissertation focuses on fire safety behaviours as well as underlying social cognitive determinants. This contributes to a better understanding of fire safety behaviour among older adults. These insights are useful for stakeholders that organize fire safety programmes for this target group such as the fire service, Dutch Burns Foundation, Dutch Burn Care professionals, housing companies, Associations of Owners or (home) care workers. First, by understanding the fire safety behaviour of older adults, choices can be made about which topics to address in fire safety programmes. Second, insights into underlying determinants provide information about how to motivate older adults to improve their fire safety behaviours, and can help in making decisions about which behaviour change methods to use in fire safety programmes.

In addition, the studies described in this dissertation examined how to systematically develop a fire safety programme for older adults. Therefore, the findings of this dissertation are of interest to stakeholders that develop fire safety programmes. This dissertation showed that systematically developing an intervention that targets specific fire safety behaviours, leads to a greater effect in positively influencing these behaviours, overall attitude towards fire safety, and risk perceptions. For meaningful change in fire safety practices, developers must develop fire safety programmes in a systematic way.

In this dissertation, the protocol that was used to systematically develop a fire safety programme for older adults is Intervention Mapping. Intervention Mapping can be used to develop a theory- and evidence-based intervention [9] and informs the implementation and evaluation of interventions. The studies in this dissertation showed that using Intervention Mapping can increase the effectiveness of a fire safety programme. Therefore, it is recommended to use Intervention Mapping in the development of new fire safety programmes. Intervention Mapping can also be used to assess and, if needed, modify current fire safety programmes. To our knowledge, the Intervention Mapping approach has rarely been used in the development of fire safety programmes. Only one study is known in which Intervention Mapping is used in prevention research into burns in young children. Therefore, this dissertation can be seen as a stimulus for the fire service and other stakeholders involved in the development of fire safety programmes to use Intervention Mapping in the future.

The results of the different studies from this dissertation have been shared with fire safety professionals at different international conferences such as the International Safety Education Seminar (2019, 2022 and 2023) and during the European Fire Safety Week (2020, 2021 and 2023). These presentations have led to interest from other fire prevention task areas (such as fire safety engineers) in addition to their mainly technical approach to fire safety.

### *Input for fire safety regulations*

In practice, it is often assumed that technical measures ensure the fire safety in a building. Furthermore, fire safety regulations are based on desired behaviour (e.g. closing doors after leaving the fire room). Solely trusting on fire safety engineering is only possible if you make sure these technical measures are behavioural-independent or if you can influence behaviour of residents in such a way that they will always display the desired behaviour. However, not everything can be engineered, therefore influencing behaviour is important. This dissertation provides ingredients for 1) aligning regulations with behaviour of residents and 2) influencing their behaviour. To address the importance of influencing behaviour next to technical fire safety measures, the author of this dissertation was the first behavioural scientist to ever be invited at the annual Fire Safety and Science conference.

Escaping from a building is becoming increasingly difficult due to the flammability of materials and smoke propagation. Therefore, it is expected that in the future, the stay-in-place principle will become an important solution in residential buildings. However, this requires behaviour change: instead of leaving the building when there is a fire, residents will have to stay in their homes. This dissertation provides input for influencing behaviour by highlighting which possible factors (e.g. determinants) play a role in fire safety issues. The expertise of behaviour change, with associated advices arising from the studies in this dissertation, has been included in several other prevention studies from the Institute for Public Safety commissioned by the national government.

### *Managing residential buildings in the period of occupancy*

Residents should not place materials in escape routes and have to know what to do in the event of a fire. Therefore, it is important that, in the period of occupancy, residential buildings have good fire safety management. Following several (fatal) fires, the National Research Council requested the Dutch government to support building owners with a guideline for the period of occupancy. For this reason, in 2023, the Netherlands Institute of Public Safety has drawn up a guideline for building managers. An important part of this guideline is providing fire safety education for residents. The lessons learned

from this dissertation (e.g. which determinants influence fire safety behaviour) are integrated in this guideline as input for building managers. Furthermore, the results of the different studies from this dissertation have been shared with building managers and housing associations at a symposium about building management during occupancy periods of residential buildings in 2023.

### *Activities*

The results of the different studies of this dissertation have been presented at (inter)national conferences and trade journals for fire safety professionals and healthcare workers, and will be published in scientific journals. Furthermore, to translate the results of this study into practical advice about developing or improving fire safety programmes, presentations about the different studies have been given to the Community Fire Safety teams in different safety regions and to policy makers working for the fire service, housing corporations, care workers and Associations of House Owners. These presentations will continue to be given in the future on request. Furthermore, it will be explored what is needed to make the results and implications of the different studies available for both professionals as well as laypersons. For example, this dissertation will be translated into a public-friendly report. In addition, it will be explored if a web page can or online information video's can be created. The public-friendly report together with the online tools will serve as a guideline for professionals about how to implement lessons learned into their daily practices.

### *Impact on the target group*

As statistics show, older adults are overrepresented in statistics on fire injuries and fatalities. The mortality rate among older adults increases even more with age, with a risk up to three times at 65 years or older compared with people younger than 65 years. This dissertation can help in improving fire safety among older adults and therefore decreasing the chance of them becoming a victim of residential fire. Ideally, we hope to make such an impact that the chances of older adults of becoming a victim of residential fires, will decrease from a factor 3 to a factor 1.5 or 1 in comparison with people younger than 65 years old.

### Conference presentations

1. International Safety Education Seminar, Linz, Austria (2023)
2. European Fire Safety Week, webinar (2023)
3. Conference 'Behaviour change and fire safety', Amersfoort, the Netherlands (2023)
4. Fire Safety and Science congress, Arnhem, the Netherlands (2023)
5. Symposium on fire-safety management in occupancy periods of residential buildings, Arnhem, the Netherlands (2023)
6. Dutch Fire Safety Week, Arnhem, the Netherlands (2023)
7. Conference 'Behaviour change and fire safety', Culemborg, the Netherlands (2022)
8. International Safety Education Seminar, Dublin, Ireland (2022)
9. Dutch Association for Burn Care, Groningen, the Netherlands (2022)
10. European Fire Safety Week, webinar (2021)
11. Fire Safety and Science congress, webinar (2021)
12. European Fire Safety Week, webinar (2020)
13. International Safety Education Seminar, Antwerp, Belgium (2019)
14. Fire Safety and Science congress, Arnhem, the Netherlands (2019)

### Contribution of this dissertation to research reports

1. Netherlands Institute for Public Safety (2023). *Guidelines for fire-safe management of residential buildings*. Arnhem: Netherlands Institute for Public Safety.
2. Netherlands Institute for Public Safety (2022). *Smoke propagation and personal safety*. Arnhem: Netherlands Institute for Public Safety.
3. Dutch Fire Service Academy (2022). *Preliminary study into single escape routes in residential buildings*. Arnhem: Netherlands Institute for Safety.



# Summary



Older adults face an increased risk of injury or fatality in domestic home fires. The ageing population combined with the expectation that more people will continue to live independently instead of moving to a residential care home or nursing home emphasize the need to focus on promoting fire safety behaviours in this age group.

To improve fire safety behaviour among older adults, numerous fire safety interventions have been developed and implemented. In general, those fire safety programmes mostly focus on either taking preventive technological measures (e.g., installing smoke alarms) or planning escape routes. It is needed to develop home fire safety programmes that also focus on preventive safety behaviours, e.g. safe cooking, since these behaviours are common fire causes in older adults. Furthermore, current programmes aim to increase knowledge, awareness and risk perceptions to promote fire safe behaviours assuming that these determinants of behaviour score low. However, literature on measuring the effect of these programmes on fire safety behaviour is scarce.

The dissertation aimed to develop a behavioural intervention to improve home fire-safety behaviour among older adults. Using Intervention Mapping a systematic programme development process was followed based on theory and empirical evidence. In chapters 2 to 5, the steps of needs assessment (**Chapter 2 and 3**), programme development (**Chapter 4**) and programme evaluation (**Chapter 5**) are described.

In the first study, described in **Chapter 2**, we conducted a needs assessment regarding fire safety behaviour to 1) establish the perspectives of adults aged 65 years and older concerning fire-related topics, and 2) inform the design of fire safety programmes. This was an important first step in the development of a new fire safety programme. To provide a first insight into the underlying factors that contribute to risky behavioural patterns, qualitative interviews were conducted. Older adults were questioned about fire safety knowledge and fire safe behaviour in their home situation. The findings showed that participants lack detailed knowledge about risk behaviours that might cause a fire. Their knowledge is limited to sources of fire or moments at which a fire can occur. However, older adults did take preventive measures such as installing smoke alarms and planning an escape route. Determinants that seem to influence fire safety behaviours among older adults are low risk awareness, habitual patterns, and seeing or experiencing barriers such as physical disabilities to implement more fire safe behaviour.

**Chapter 3** describes a quantitative study that was performed to check whether the findings from the qualitative study in Chapter 2 could be confirmed. This study aimed to identify the most important predictors of fire safety behaviours among older adults and determined the relative importance of these predictors in explaining fire safe behaviour. A questionnaire consisting of 42 questions measured fire safety behaviours and underlying determinants of these behaviours. A total of 4414 respondents completed the study. The results showed that most older adults reported performing fire safety behaviours in their homes, in particular not connecting power strips to each other and cleaning the dryer lint filter. However, older adults do not feel very susceptible to the risk of residential fires as indicated by low scores on risk perception and susceptibility. Determinants that showed strong associations with fire safety behaviours were perceived behavioural control, attitude and response efficacy. In addition, this study showed that older adults perceive the emergency services, people who have experienced a house fire themselves, the municipality, and housing companies as trustworthy in communicating about home fire prevention. The findings suggest that the three determinants perceived behavioural control, attitude and response efficacy are important target variables for future interventions promoting fire safe behaviour among older adults.

Based on the input of the needs assessment as described in Chapter 2 and 3, a home fire safety intervention was developed. In **Chapter 4** a detailed description of the systematic development of the programme targeting home fire safety behaviour is described. By following the Intervention Mapping protocol, insights about relevant determinants that influence the behaviour of older adults were combined with the systematic application of behavioural change methods into practical applications leading to the Fire Safety at Home programme. Summarized, this interactive educational programme consists of three parts. First, participants receive a general introduction explaining the structure of the programme and the relevance of the theme 'home fire safety'. Second, together with the participants, different assignments to understand and practice fire safety behaviours are performed. And, third, a plenary meeting discusses how participants experienced the programme and what they can do in their own homes to improve fire safety.

In **Chapter 5** the impact of the Fire Safety at Home programme was evaluated. A total of 433 participants (> 65 years) joined either the Fire Safety at Home programme (intervention group) or a fire safety programme given by the Dutch Fire Service (control group). Outcome measures assessed four fire safety behaviours (staying in the kitchen while cooking, not connecting power strips, charging electronic devices, and cleaning the dryer lint filter after every



cycle) and the key determinants of these behaviours: attitude, self-efficacy, risk perception, and intention. The results showed intervention effects on three of the four fire safety behaviours (connecting power strips, placing a phone or iPad on a sofa or chair while charging, and cleaning the dryer lint filter). Additionally, positive intervention effects were found on the measures of attitude towards home fire safety, and risk perception towards cleaning the dryer lint filter after every cycle. The findings underscore the importance of adopting a systematic approach in programme development and using theory and empirical evidence.

In **Chapter 6**, we discussed the outcomes and implications of this research project. Taken together, the combined results in this dissertation demonstrate that Intervention Mapping is a useful protocol for developing fire safety interventions. Furthermore, the Fire Safety at Home programme has shown to be effective in changing fire safety behaviour and determinants. In addition, the Fire Safety at Home programme has underscored the importance of targeting specific behaviours and determinants in interventions for meaningful change in fire safety practices.

In conclusion, this dissertation has effectively highlighted the need for tailored fire safety interventions targeting older adults, acknowledging their susceptibility to domestic home fires. By using Intervention Mapping, this research not only identified key determinants influencing fire safety behaviors among older adults but also successfully developed and evaluated the Fire Safety at Home programme. The findings underscore the importance of addressing specific behaviors and determinants for meaningful changes in fire safety practices. This dissertation shows how Intervention Mapping is a useful protocol for developing fire safety interventions among older adult populations, contributing significantly to improving their safety and well-being in residential settings.

# Samenvatting (in Dutch)



## Aanleiding

Senioren lopen een verhoogd risico op letsel of overlijden bij woningbranden. De vergrijzing van de bevolking, gecombineerd met de verwachting dat meer mensen zelfstandig blijven wonen in plaats van te verhuizen naar een verzorgingshuis of verpleeghuis, benadrukken de noodzaak om het brandveilig gedrag in deze leeftijdsgroep te bevorderen.

Om brandveilig gedrag onder senioren te verbeteren zijn er al tal van brandveiligheidsinterventies ontwikkeld en geïmplementeerd. Over het algemeen gaat het hierbij om het nemen van preventieve, technische maatregelen (bijvoorbeeld het installeren van rookmelders) of het plannen van vluchtroutes. Het is nodig om interventies te ontwikkelen die zich ook richten op preventief veiligheidsgedrag, bijvoorbeeld veilig koken, aangezien woningbranden bij senioren vaak worden veroorzaakt door onveilig gedrag. Daarnaast zijn de huidige programma's erop gericht om kennis, bewustzijn en risicoperceptie te vergroten, ervan uitgaande dat deze gedragsdeterminanten laag scoren. Literatuur over (het meten van) het effect van deze huidige programma's op brandveilig gedrag is echter schaars.

## Gedragsinterventie voor verbetering brandveilig gedrag

Dit proefschrift heeft tot doel een gedragsinterventie te ontwikkelen om brandveilig gedrag bij senioren thuis te verbeteren. Met behulp van Intervention Mapping is een systematisch ontwikkelingsproces gevolgd, op basis van theorie en empirisch bewijs. Achtereenvolgens worden de stappen van de behoefteanalyse (**hoofdstuk 2 en 3**), de programma-ontwikkeling (**hoofdstuk 4**) en de programma-evaluatie (**hoofdstuk 5**) besproken.

In het eerste onderzoek, beschreven in **hoofdstuk 2**, hebben we een behoefteanalyse uitgevoerd over brandveilig gedrag om 1) de perspectieven van senioren van 65 jaar of ouder rondom brand-gerelateerde onderwerpen vast te stellen en 2) het ontwerp van brandveiligheidsinterventies te ondersteunen. Dit was een belangrijke eerste stap in de ontwikkeling van een nieuw brandveiligheidsprogramma. Om een eerste inzicht te krijgen in onderliggende factoren die bijdragen aan risicovolle gedragspatronen, zijn kwalitatieve interviews gehouden. Senioren zijn bevraagd over hun brandveiligheidskennis en brandveilig gedrag in hun eigen woning. Uit de bevindingen blijkt dat deelnemers geen gedetailleerde kennis hebben over risicovol gedrag dat brand zou kunnen veroorzaken. Hun kennis beperkt zich tot oorzaken van brand of momenten waarop brand kan ontstaan. Senioren nemen echter wel preventieve maatregelen zoals het plaatsen van rookmelders of het plannen van vluchtroutes. Determinanten die brandveilig gedrag bij senioren lijken te beïnvloeden zijn: een laag risicobewustzijn,

gewoontepatronen en het zien of ervaren van barrières om meer brandveilig gedrag te vertonen, bijvoorbeeld als gevolg van een lichamelijke beperking.

**Hoofdstuk 3** beschrijft een kwantitatief onderzoek dat is uitgevoerd om te controleren of de bevindingen uit het kwalitatieve onderzoek uit hoofdstuk 2 konden worden bevestigd. Dit onderzoek had tot doel om de belangrijkste voorspellers van brandveilig gedrag bij senioren te identificeren. Het onderzoek heeft het relatieve belang van deze voorspellers bij het verklaren van brandveilig gedrag aangetoond. De vragenlijst bestond uit 42 vragen over brandveilig gedrag en de onderliggende determinanten van dit gedrag. In totaal hebben 4414 respondenten het onderzoek voltooid. Uit de resultaten blijkt dat de meeste senioren aangeven dat ze brandveilig gedrag in hun huis vertonen. Met name dat ze geen stekkerdozen op elkaar aansluiten en het pluisfilter van de wasdroger schoonmaken. Maar senioren blijken niet erg gevoelig te zijn voor het risico op woningbranden, zoals blijkt uit de lage scores op risicoperceptie en vatbaarheid. Determinanten die sterke associaties vertonen met brandveilig gedrag zijn: waargenomen gedragscontrole, attitude en respons-effectiviteit (de mate waarin men denkt dat een bepaalde respons effectief is in het bereiken van een gewenst doel). Daarnaast blijkt uit dit onderzoek dat senioren de hulpdiensten, mensen die zelf een woningbrand hebben meegemaakt, de gemeente en woningcorporaties als betrouwbaar ervaren in de communicatie over woningbrandpreventie. De bevindingen suggereren dat de drie determinanten waargenomen gedragscontrole, attitude en respons-effectiviteit belangrijke doelvariabelen zijn voor toekomstige interventies gericht op het bevorderen van brandveilig gedrag bij senioren.

Op basis van de input uit de behoefteanalyse zoals beschreven in hoofdstuk 2 en 3, is een brandveiligheidsinterventie ontwikkeld. **Hoofdstuk 4** geeft een gedetailleerde beschrijving van de systematische ontwikkeling van een programma gericht op brandveilig gedrag in woningen. Door het Intervention Mapping-protocol te volgen, zijn inzichten over relevante determinanten die het gedrag van senioren beïnvloeden gecombineerd met de systematische toepassing van gedragsveranderingsmethoden. Dit heeft geresulteerd in het programma Brandveiligheid in Huis. Dit interactieve, educatieve programma bestaat uit drie delen. Deelnemers krijgen eerst een algemene introductie waarin de opbouw van het programma en de relevantie van het thema 'brandveiligheid in huis' worden uitgelegd. Vervolgens worden, samen met de deelnemers, verschillende opdrachten uitgevoerd om brandveilig gedrag te begrijpen en te oefenen. Als laatste wordt er plenair besproken hoe de deelnemers het programma hebben ervaren en wat zij thuis kunnen doen om de brandveiligheid te verbeteren.

In **Hoofdstuk 5** wordt de impact van het programma Brandveiligheid in Huis geëvalueerd. In totaal namen 433 deelnemers (> 65 jaar) deel aan het programma Brandveiligheid in Huis (interventiegroep) of aan een brandveiligheidsvoorlichting van de brandweer (controlegroep). De uitkomstmaten beoordeelden vier vormen van brandveilig gedrag (in de keuken blijven tijdens het koken, geen stekkerdozen aansluiten, elektronische apparaten opladen en het pluisfilter van de wasdroger na elke cyclus schoonmaken) en belangrijke determinanten van dit gedrag: attitude, eigen-effectiviteit en risicoperceptie. Intentie werd toegevoegd als voorspeller van toekomstig brandveilig gedrag. De resultaten laten positieve interventie-effecten zien op drie van de vier brandveiligheidsgedragingen (het koppelen van stekkerdozen, het plaatsen van een telefoon of iPad op een bank of stoel tijdens het opladen en het schoonmaken van het pluisfilter van de wasdroger). Bovendien zijn er positieve interventie-effecten gevonden op attitude ten opzichte van brandveiligheid in huis en op risicoperceptie ten aanzien van het schoonmaken van het pluisfilter van de wasdroger na iedere cyclus. De bevindingen ondersteunen het belang van een systematische aanpak bij de ontwikkeling van interventies en het gebruik van theorie en empirisch bewijsmateriaal.

**Hoofdstuk 6** bespreekt de uitkomsten en implicaties van het onderzoek. De resultaten van dit promotieonderzoek laten zien dat Intervention Mapping een bruikbare methode is om brandveiligheidsinterventies te ontwikkelen. Bovendien is gebleken dat het programma Brandveiligheid in Huis effectief is om brandveilig gedrag en determinanten te veranderen. Daarnaast heeft het programma aangetoond dat het belangrijk is om te focussen op specifieke gedragingen en determinanten bij interventies voor het bewerkstelligen van betekenisvolle veranderingen in brandveilig gedrag.

## **Conclusie**

Er kan geconcludeerd worden dat dit promotieonderzoek effectief de noodzaak heeft aangetoond van op maat gemaakte brandveiligheidsinterventies voor senioren. Waarbij wordt erkend dat senioren een verhoogd risico lopen als het gaat om woningbranden. Door gebruik te maken van Intervention Mapping heeft dit onderzoek niet alleen de belangrijkste determinanten geïdentificeerd die brandveilig gedrag onder senioren beïnvloeden, maar is ook met succes het programma Brandveiligheid in Huis ontwikkeld en geëvalueerd. De bevindingen ondersteunen het belang van het richten op specifieke gedragingen en determinanten voor betekenisvolle veranderingen in brandveilig gedrag. Dit promotieonderzoek laat zien dat Intervention Mapping een bruikbare methode is voor het ontwikkelen van brandveiligheidsinterventies voor senioren en aanzienlijk bijdraagt aan het verbeteren van hun veiligheid in de woonomgeving.

Dankwoord (in Dutch)



“Jij hebt toch Psychologie gestudeerd?” Met die vraag riep jij, René, mij eind 2018 bij je. Er kwam namelijk een vacature voor een promovendus die zich bezig zou gaan houden met gedragsverandering bij senioren. Dit deelde jij zoals je zelf zei “puur ter info” want ik wilde toch niet promoveren. Wat jij niet wist, was dat deze ambitie sinds mijn studie ergens in mijn achterhoofd was blijven hangen. Mijn enthousiasme om weer iets met mijn achtergrond te kunnen doen én de uitdaging om mijzelf als onderzoeker te ontwikkelen, was door deze mededeling snel aangewakkerd.

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Gedurende het onderzoek heb ik gemerkt dat zowel senioren als voorlichters openstaan voor nieuwe inzichten en verandering. Ik hoop dan ook dat de inzichten uit mijn promotieonderzoek gebruikt zullen worden in de praktijk. Want zoals in dit onderzoek naar voren kwam: of je nu tot de doelgroep senioren behoort of juist tot de voorlichters, je bent nooit te oud om te leren!

# Curriculum Vitae



Margo Karemaker was born on October 10th, 1989 in Amsterdam, the Netherlands. After obtaining her VWO diploma from Almende College, location Isala in Silvolde, she started her Bachelor of Science in Crime Science at Saxion Hogeschool in Enschede in 2008.

During this study, she already started with the pre-master's programme in Psychology at the University of Twente. In 2013, she obtained her Bachelor of Science degree and continued with the pre-master's programme at the University of Twente. After completing the pre-master's programme, she started with a master's in Psychology with a specialization in Conflict, Risk & Safety. This master focused on a deeper understanding of the (socio) psychological dynamics of safety issues in the broadest sense of the word. She obtained her Master of Science degree in 2014.


After her graduation, she did an internship at the WODC (Research and Data Centre), the knowledge centre in the field of the Dutch Ministry of Justice and Security.

Until 2015, when she saw a vacancy for a traineeship at the Netherlands Institute for Public Safety (NIPV). During this traineeship, her interest in conducting research was further confirmed and she further developed her research skills. She has been working as a researcher at this institute since 2017. In 2018, a vacancy for a PhD candidate was announced in which her background in psychology could be combined with her work on fire safety. She started this PhD in February 2019 which has led to this dissertation. During her PhD, she completed the following two courses: Intervention Mapping: designing theory-based and evidence-based behaviour change programmes, and PhD Research Writing (basics I). She worked under the supervision of Prof. Dr. Rob Ruiter, Dr. Gill ten Hoor, Dr. Carine van Schie, and EM Lector René Hagen.

Her work as a researcher at the NIPV mostly focuses on fire safety, (preventive) human behaviour, and behaviour change.







Older adults face an increased risk of injury or fatality in domestic home fires. The ageing population combined with the expectation that more people will continue to live independently instead of moving to a residential care home or nursing home, emphasizes the need to focus on promoting fire safety behaviours in this age group. Therefore, this dissertation focuses on developing a behavioural intervention to improve home fire safety behaviour among older adults. Using Intervention Mapping, a needs assessment regarding fire safety behaviour was conducted followed by the systematic development and evaluation of a fire safety intervention.

This dissertation has effectively highlighted the need for tailored fire safety interventions targeting older adults, acknowledging their susceptibility to domestic home fires. This research not only identified key determinants influencing fire safety behaviours among older adults but also successfully developed and evaluated the Fire Safety at Home programme. The findings underscore the importance of addressing specific behaviours and determinants for meaningful changes in fire safety practices.

Margo Karemaker is a researcher at the Netherlands Institute for Public Safety (NIPV). Her research mostly focuses on fire safety, human behaviour and behaviour change.