BRANDWEER

Brandweeracademie

Fatal residential fires in The Netherlands

Annual review 2016

De Brandweeracademie is onderdeel van het Instituut Fysieke Veiligheid.

Institute for Safety
Fire Service Academy
PO Box 7010
6801 HA Arnhem
www.ifv.nl
info@ifv.nl
+31 26 355 24 00

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Text and research:	Margrethe Kobes and Pascal Polman
Project leader:	Rijk van den Dikkenberg
Final responsibility:	René Hagen
Translation:	Esther Overeem

Contact:	infopuntveiligheid@ifv.nl
More information:	www.ifv.nl/fatalewoningbranden

Contents

Introduction

The Fire Service Academy of the Institute for Safety (IFV) structurally gathers data on fatal residential fires in the Netherlands. In this process the Fire Service Academy cooperates with the fire brigades and fire research teams involved in these fires. They provide data on fatal residential fires through a questionnaire. The respondents are approached based on information from press reports about a fatal residential fire in their region. In this way fatal residential fires where the fire service did not assist are included. An example of this is a fire that has already been extinguished at the time of discovery.

Prior to the data collection on fatal residential fires in 2016 the questionnaire has been changed. There were in the previous version some questions have led to unclear answers the formulation has been changed. Furthermore, the questionnaire has been abbreviated where possible. The question logic has been adjusted in a way that only with relevant answers a follow-up questions comes up. Based on results from other research of the Institute for Safety some questions have been added. In this way, following the research on the effectiveness of smoke detectors[1], more specific questions are now being asked about the functioning, location, linking and reporting of smoke detectors are being asked. In response to the results of fire experiments in homes[2] more questions are being asked about the state of interior doors and the location of casualties in relation to the seat of the fire. The best location for smoke detectors and the advice to close internal doors is communicated in the information campaigns too. With the additional questions it is expected to obtain more insight in the future on the effect of these campaigns. Besides, additional questions are asked about the degree of smoke development near the casualty and the exact time the casualty is found, to allow a future comparison with the data from the research into rescues in residential fires[3]. Finally, conformation was looked for with the database that fire researchers of the Netherlands Fire Service fill in, in the context of learning of fires[4]. This has for example led to a change in the categorization of fire causes and residential types.

[1] Details are described in 'Gebrand op inzicht' (IFV, 2015) and in 'Kobes, M., Groenewegen, K. and Dangermond, K. (2016). Towards a sound understanding of the effectiveness of smoke detectors in dwellings, Interflam 2016,4-6th July 2016, Royal Holloway College, London, UK.'

[2] Details are described in 'Gebrand op inzicht' (IFV, 2015).

[3] See report 'Reddingen bij brand 2014/2015' (IFV, 2016)

[4] See https://www.brandweer.nl/ons-werk/brandonderzoek

A fatal residential fire is a fire involving civil fatalities due to fire, which took place in a building with a residential function or another 'housing related' object[5] and is not caused intentionally [5].

Residential fire type	Number of fires	Number of fatalities
Fatal residential fire	32 (+1)*	37 (+1)*
Residential fire after proven death by natural causes	2 (+1)**	2 (+1)**
Residential fire as a result of murder or suicide	6	7
Residential fire murder or suicide is unclear, research is ongoing	1	1
Total	**41 (+2)**	**47 (+2)**

* After the start of the analysis a residential fire casualty deceased from CO-poisoning eight months after the fire. This fire and the casualty are not included in the analysis of fatal residential fires in 2016 because of missing data.
** In one fire two people deceased. One person has deceased of natural causes and the second person as a result of the fire. The data on the fire and the second casualty are included in the analysis of fatal residential fires in 2016.

In 2016, 41 residential fires occurred with a fatal outcome. In total 32 fires have been classified as a fatal residential fire with a number of 37 fatalities. These fatal residential fires have taken place in 17 different safety regions.
In 6 fires with a number of 7 fatalities have been a residential fire as a result of murder or suicide and these fires are not part of the analysis of fatal residential fires in 2016. In three fires there is doubt if the cause was murder or suicide. One of these fires is not included in the analysis since no information could be collected about this fire. The two other fires have been included in the analysis.

In three residential fires the casualty has deceased of a (proven) natural cause. One of these fires counts two casualties. One casualty has deceased due to a cardiac arrest and the other casualty due to the fire. In the case of this residential fire only the casualty who has deceased due to the fire is included in this research. At one of the other two fires with a proven natural death the casualty deceased while cooking where then a huge smoke development (no fire) arose. In an another case a kitchen fire started when the casualty already passed away a few hours before.

Below details[6] of the fire characteristics, building characteristics and human characteristics of fatal residential fires in 2016 are displayed.

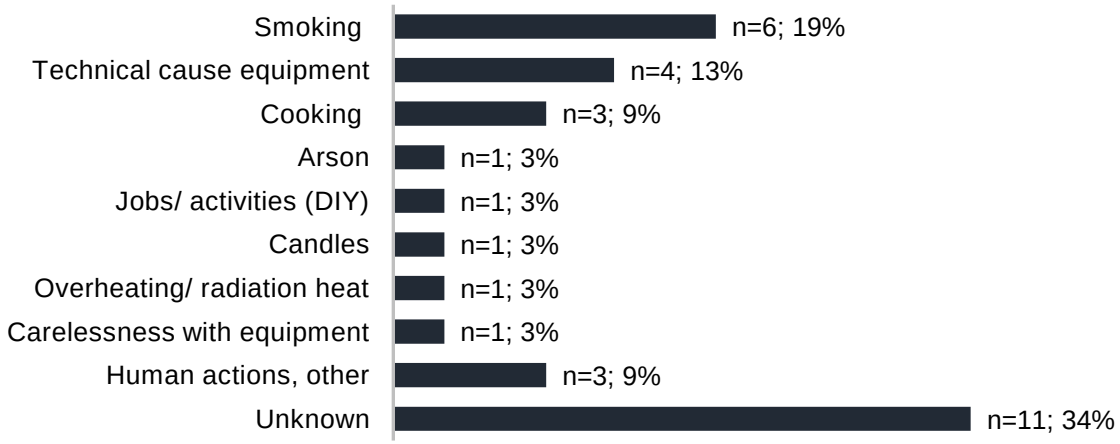
[5] These are the residential fires with fatal outcome where it is certain that there was no arson, murder or suicide. Residential fires with a fatal outcome intentionally caused by accountable adults are excluded from the research. Other types of arson are included in the analysis, for example, fires caused by children playing or confused adults.
[6] The percentages are displayed in round numbers, which makes the sum of the percentages in the figures not 100% everywhere.

1 Fire characteristics

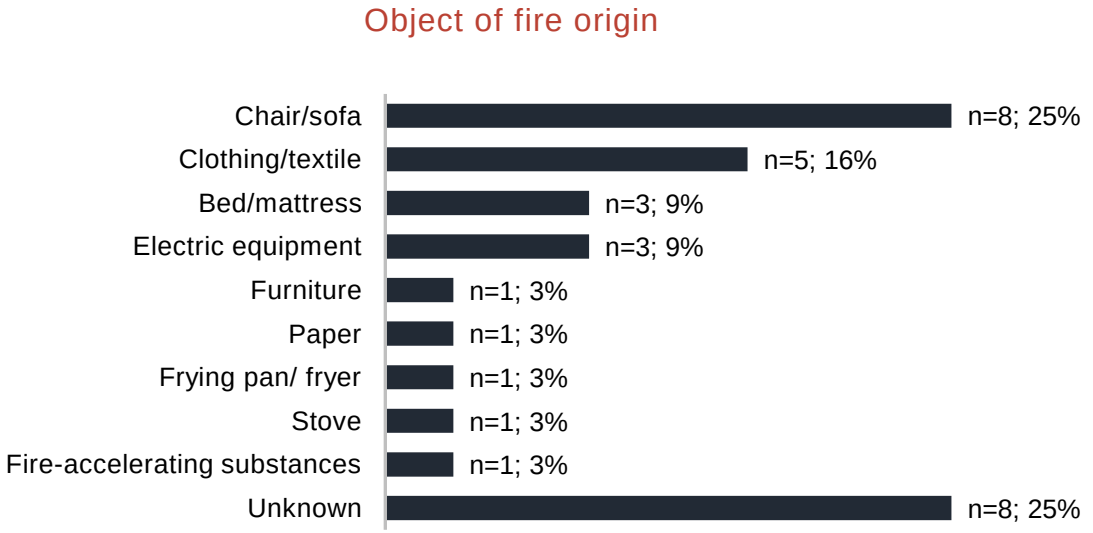
1.1 Fire causes and object of fire origin

In 2016, about half of the fatal residential fires is caused by human activity. Careless smoking (19%) is the most common cause of fire. The category 'other' includes two fires caused by carelessness, once with a flare gun and once when filling a gas lighter. In the third fire the category 'other' there is doubt whether the fire was caused by careless smoking or radiation of a heater. About one out of eight fatal residential fires is caused by a technical cause in electrical equipment. In approximately one third of the fatal residential fires the cause of the fire is not known.

Fire causes

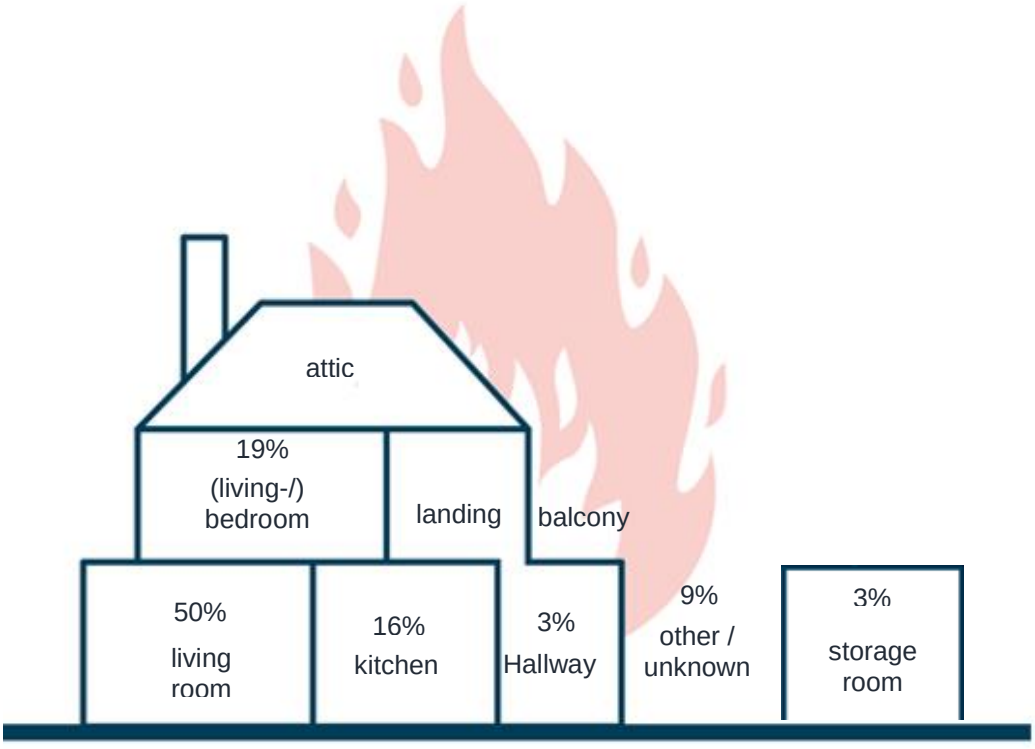


From a quarter of the fatal residential fires in 2016 it is not known in which object the fire started. In other cases fatal residential fires started mainly in a chair or a sofa (25%) and in clothing or textile (16%). The electrical equipment in which fire is caused are a table socket, a television and a set of audiovisual equipment. The fourth fire is probably caused by an electric appliance. The sofa caught fire through a damp rechargeable hair clipper.



1.2 Room of fire origin

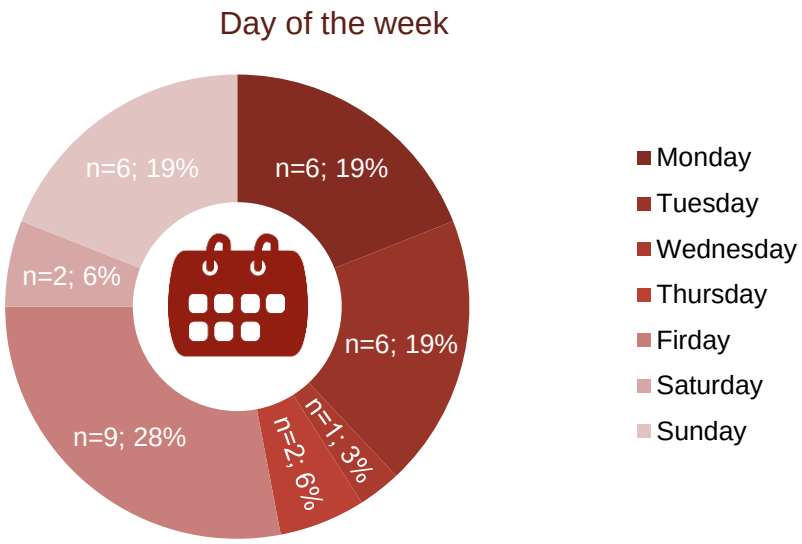
Half of the fatal residential fires occur in the living room. Furthermore, the fatal residential fires occur mainly in the bedroom (19%)[7] and the kitchen (16%). The category 'other' concerns a fire that started in a conservatory.



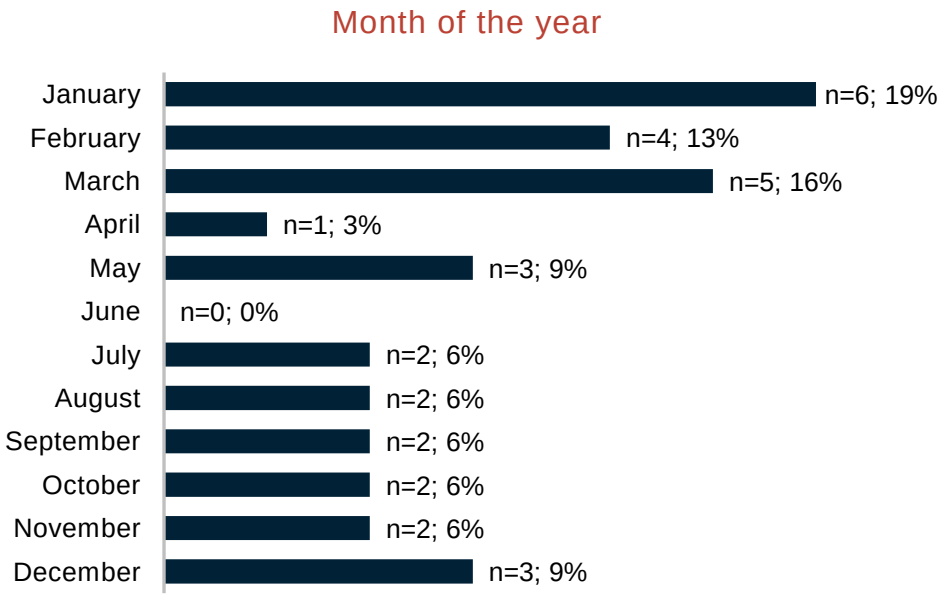
[7] Including once in a living room/bedroom in a nursing home. Three victims deceased, including the resident of the room where the fire started and two residents of nearby rooms.

1.3 Moments of occurrence, of reporting and response time

Most fatal residential fires took place on Friday (28%).

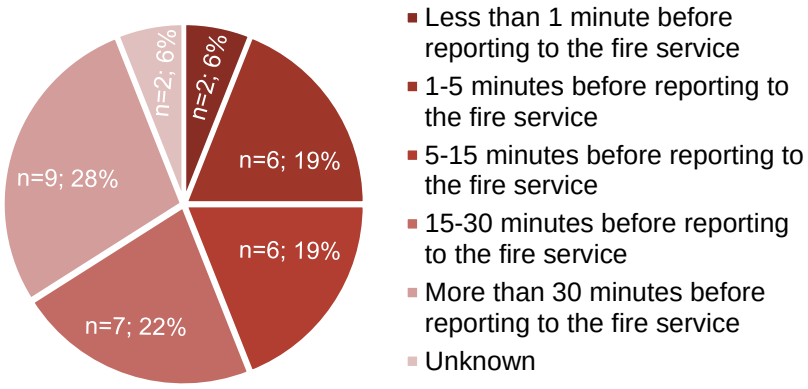


In 2016 approximately one in five fatal residential fires took place in January. Relatively many fatal residential fires took place in February (13%) and March (16%) too.



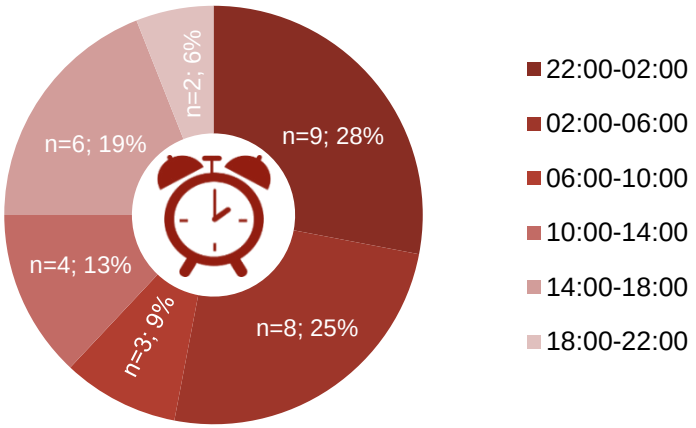
Nearly three in ten fatal residential fires (28%) probably started more than 30 minutes of the fire being reported to the fire service. A quarter of the fatal residential fires probably started less than 5 minutes before reporting to the fire service, of which a small part even less than 1 minute before reporting (6%).

Estimated moment of inception



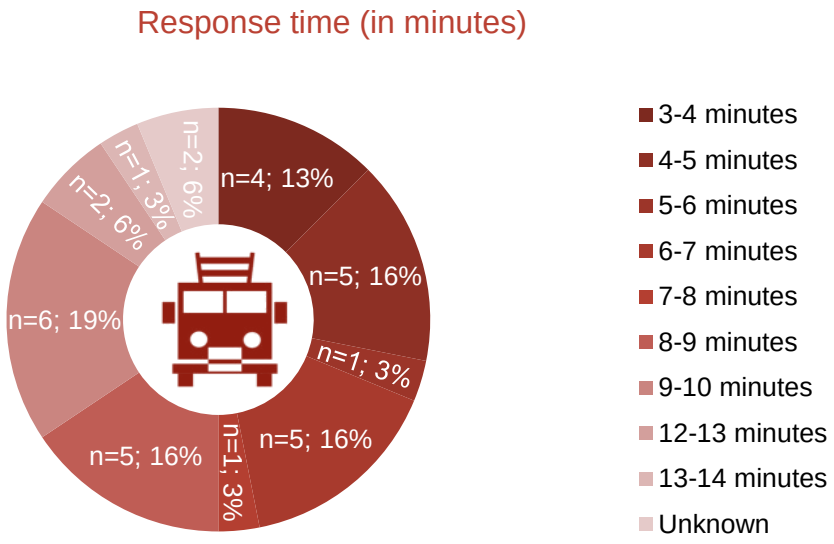
The most fatal residential fires are reported to the fire service between 10 p.m. and 2 a.m. (28%), between 2 a.m. and 6 a.m. (25%) and between 2 p.m. and 6 p.m. (19%).

Time of reporting (in clock hours)



In two fatal residential fires in 2016 the response time is not known. In the remaining fatal residential fires the response time[8] varies between 3,2 and 13 minutes. The average response time is 6,1 minutes (sd=2,8). In about half (53%) of the fatal residential fires of which the response time is known, the fire service arrives within 8 minutes after reporting.

[8] The response time is the time between the time of reporting and the time of arrival of the fire service at the location of the fire.



1.4 Fire dynamics and accelerating factors

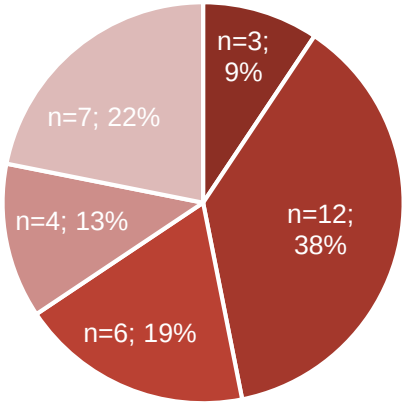
From a quarter of the fatal residential fires in 2016 is reported that the fire already has been extinguished at the time of arrival of the fire service (in all cases referred to as "smothered"). In one of these cases the fire flared up because of the fire service entering the premises. In the other fatal residential fires (75%) de fire was still active at the time of arrival of the fire service.

In the smothered fires, the fire in one case was confined to the object of fire origin, in five cases it spread beyond the object of origin but were confined to the room of fire origin and in one case the fire spread beyond the room of origin but it was confined to one storey of the home. Including the final situation of the smothered fires, almost half (47%) of fatal residential fires were confined to the room of fire origin[9]. In nearly one fifth (19%) of the fatal residential fires the fire even was confined to the object of origin. In most cases (81%) the fire did not spread after arrival of the fire service.

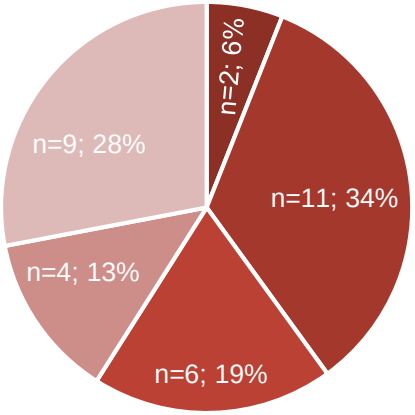
[9] Including the fatal residential fires that were confined to the object of origin.

Fire growth

Situation at arrival



Final situation

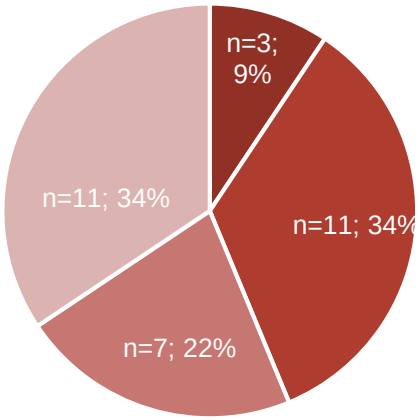


- Confined to the object of origin
- Beyond the object, but confined to the room of origin
- Beyond the room, but confined to floor area of origin
- Beyond the floor, but confined to the compartment of origin (the home)
- Extended beyond the compartment of origin (the home)

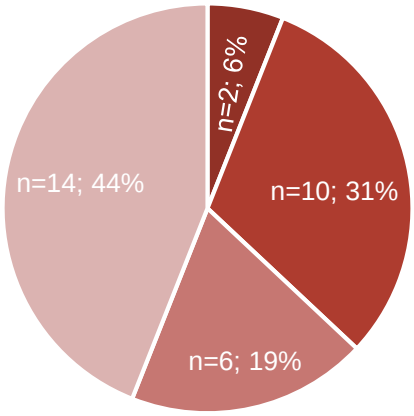
The spread of smoke was when the fire service arrived in almost half (47%) of the fatal residential fires confined to the room of origin, inclusive the final situation of the smothered fires. In most cases (88%) the smoke did not spread further during the firefighting operations.

Spread of smoke

Situation at arrival



Final situation



- Confined to the room of origin
- Beyond the room, but confined to floor area of origin
- Beyond the floor, but confined to the compartment of origin (the home)
- Extended beyond the compartment of origin (the home)

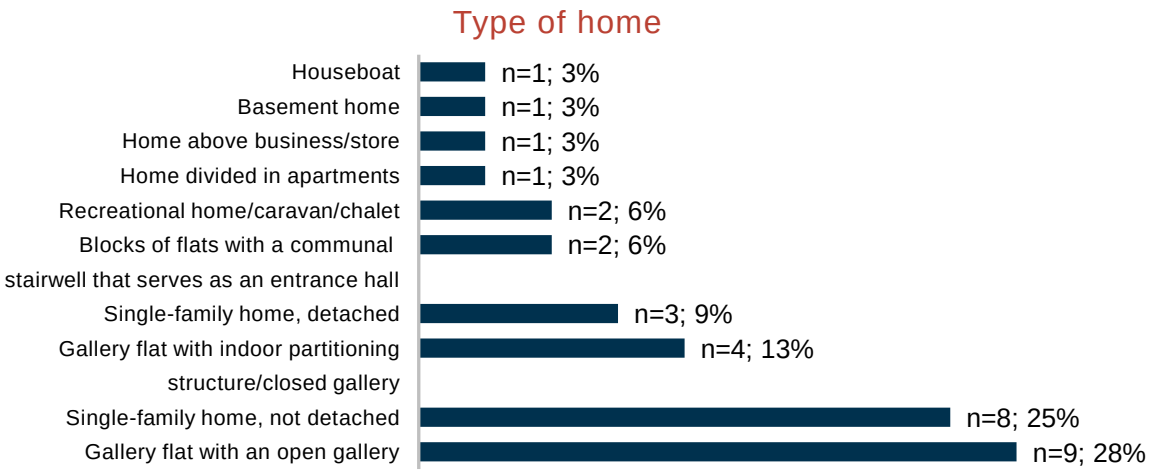
In nearly half (53%) of the fatal residential fires there was a factor that accelerated the fire. In about three out of ten fatal residential fires (31%) this was not the case and in the other cases (16%) this was not known. The most often mentioned accelerating factors are foam rubbers in sofas, chairs and mattresses (41%), a high flammability (24%) – mostly of collected goods – and flammable liquids and vapours (18%). Other fire-accelerating factors are oxygen (6%), flammable wallpaper (6%) and a parachute flare (6%).

In more than two out of five fatal residential fires (44%) there was a factor involved that led to heavy smoke generation. In another 44%, this was not the case and in the remaining 13% this was not known. In almost all cases (93%), foam rubber in sofas, chairs and mattresses is referred to as the main factor of smoke generation, in one case a high fire load generated heavy smoke.

2 Building characteristics

2.1 Type of home

More than half (56%) of the fatal residential fires in 2016 occurred in an apartment or flat.
Often this is a gallery flat with an open (28%) or closed (13%) gallery. About one third (34%) occurred in a single-family home, mainly not detached (25%). The remaining fatal residential fires occurred in a recreational home/caravan/chalet with a light building structure (6%) and a houseboat (3%).

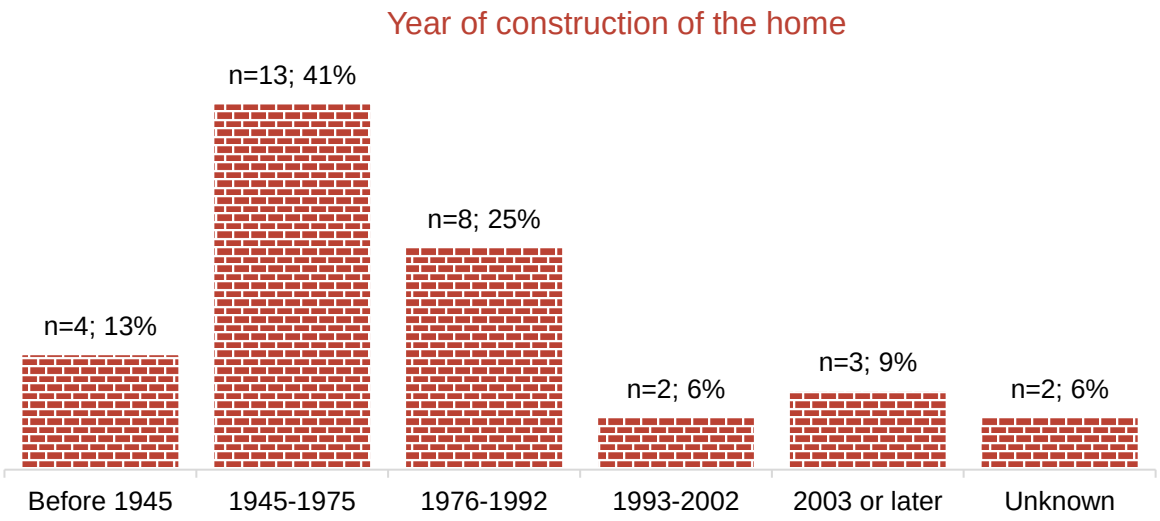


In almost one third (34%) of the fatal residential fires housing with care is regarded (28%) and sometimes with 24-hour care (6%).

2.2 Year of construction and housing tenure

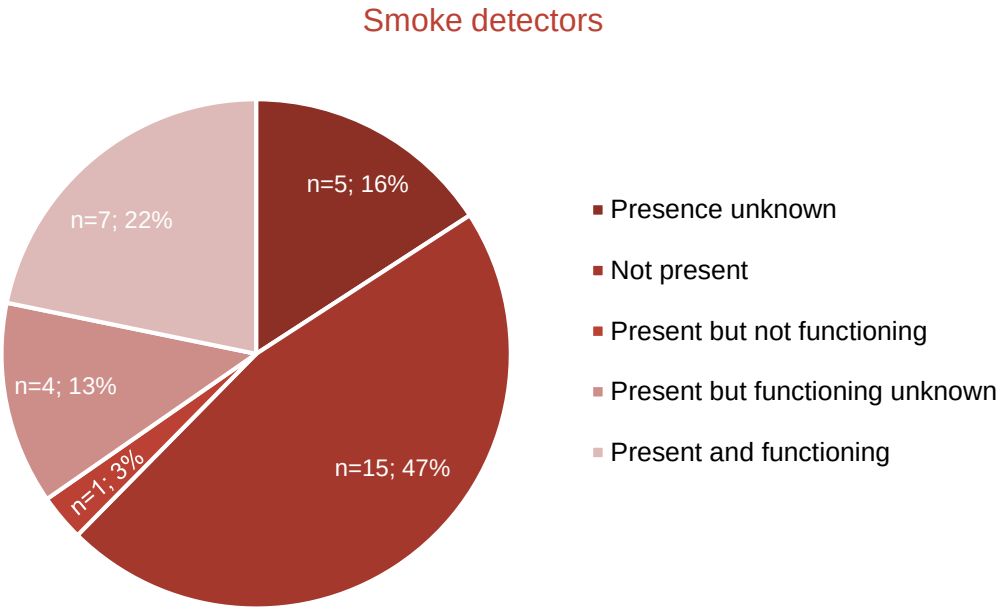
Nearly six in ten fatal residential fires (59%) occurred in a rented house, this generally (41%) involves social rented housing and sometimes (13%) private rented housing. In the remaining cases (6%) the type of rented housing is not known.
About three out of ten fatal residential fires (31%) occurred in a owner-occupied house and in almost one tenth (9%), the housing tenure is not known.

From almost every home (94%) the year of construction is known. Most (41%) homes were built in the period between 1945 and 1975. Almost one fifth (22%) of the homes are constructed based on the general detailed scheme of the Dutch Building Decree (after 1992).



2.3 Smoke detectors

In almost two fifth (38%) of the fatal residential fires there was a smoke detector installed. In one fifth of the fatal residential fires (n=7) there was a proper functioning smoke detector. In one case the smoke detector did not function because it was taped over because of works in the home. In three cases there was an automatic reporting to the control room, where in two cases the victim discovered the fire. And in two cases without automatic reporting to the control room the victim discovered the fire because the smoke detector set off. In two cases the neighbors discovered the fire and in one case it is not known who discovered the fire first.



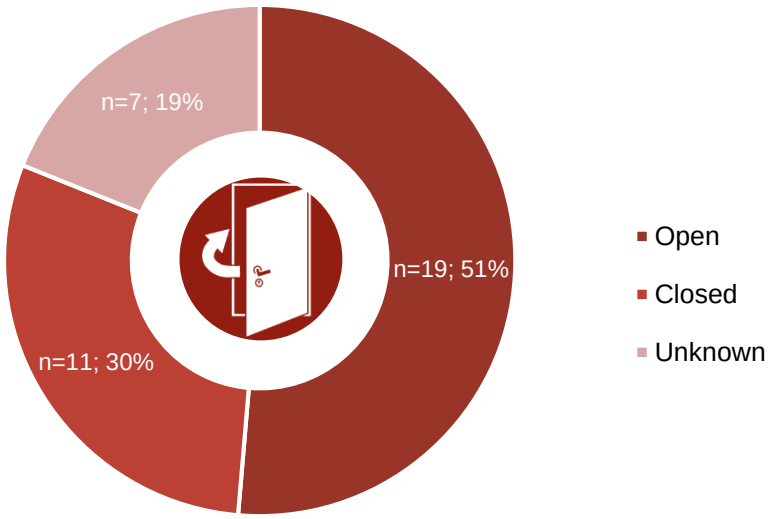
In one of the residential fires with a functioning smoke detector three victims deceased.
Eight out of nine victims of a fatal residential fire with a functioning smoke detector were people who were not able to leave without assistance or people who had limited ability to leave without assistance.
Four in nine victims of a fatal residential fire with a functioning smoke detector(s) are found in the room where the fire started. Three victims were present in the room during the start of the fire. The fourth victim went into the room for a rescue attempt.
In three cases the first smoke detector that set off was located in the room where the fire started. These victims where people who were not able to leave without assistance or people who had limited ability to leave without assistance. In four cases the first smoke detector that set off was located in a room that directly connected to the room where the fire was, namely the hallway on the ground floor (n=2), the living room and the kitchen. For two fires it is not known where the smoke detector was located that first set off.

Questions about the main cause (according to the respondent) that the victim, despite the proper functioning smoke detector, did not survive the fire are asked. The causes mentioned are the type of injuries of the victim (n=2), such as burns or smoke inhalation, a limited mobility of the victim (n=3), sometimes in combination with fact the victim was sleeping (n=2), a rapid smoke development by leaving doors open (n=1) and a fatal attempt to save a pet after the smoke detector set off (n=1).

2.4 Position of internal doors

Half (51%) of the victims were found in a room where the door was open at the time the fire service arrived. In three out of ten victims the door was closed and in two out of five victims it is not known if the door was open or closed.

Position of the door in room victim (n=37)



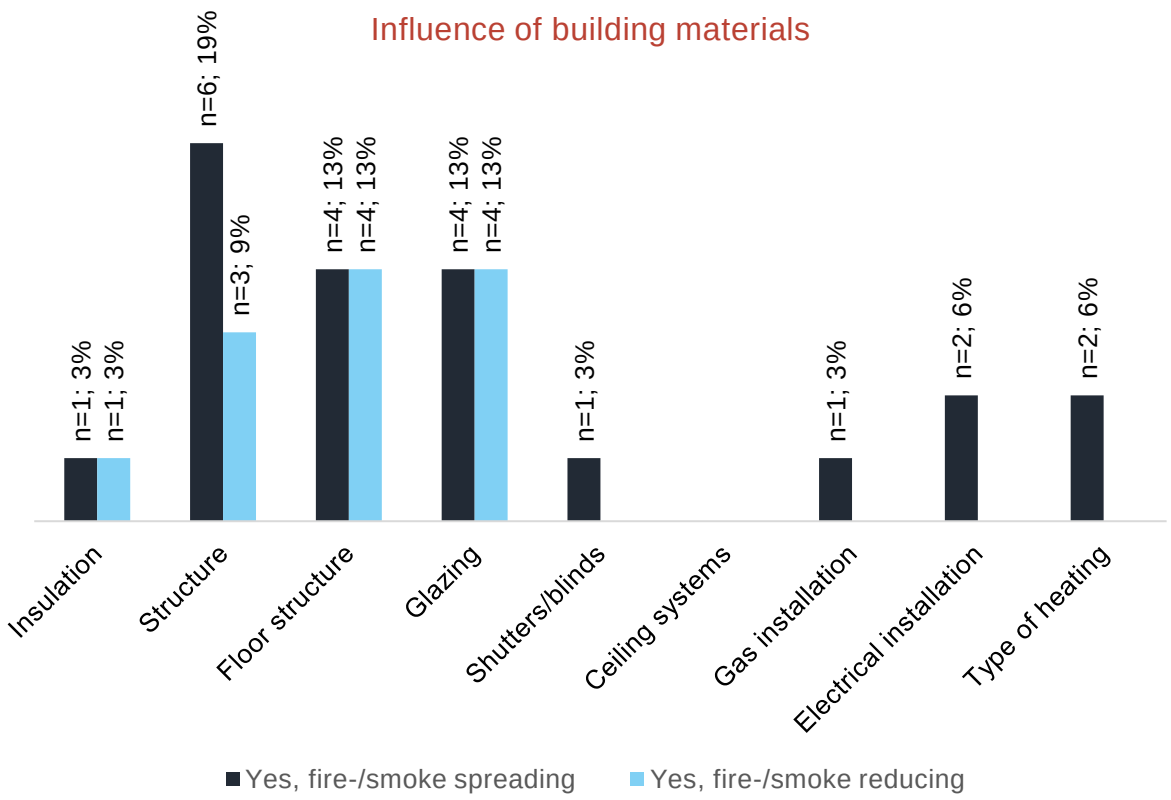
Eleven victims (30%) were found in the room where the fire started. In four cases the door was open, in six cases the door was closed and in one case it is not known if the door was open or closed. In two cases a smoke detector on the landing set off there where the door of the room where the fire was located was open. In two cases a smoke detector on the landing set off. In one case where the door of

the room where the fire was located was closed a smoke detector in that room set off. In two other cases the smoke detector set off in the hallway. In the other cases there was no smoke detector that set off.
Two third (68%) of the victims were not located in the room where the fire started. In most cases the door of the room where the victim was found was open (41% of all victims), where in many cases the door of the room where the fire was located was open (35% of all victims). In some cases the door of the room where the victim was found was closed (16% of all victims) and the door of the room where the fire was too (8% of all victims). For four victims (11%) is it not known if the door of the room where the victim was found was open or closed. For one victim (3%) it is not known if the room where the victim was found was also the room where the fire started.

2.5 Contribution of structural characteristics

Different from previous years, not in every case is asked about the type of materials used in the home, but only when a structural characteristic contributed to the fire- and smoke development. Now the first question per structural characteristic is whether and how it contributed: reducing or spreading. The following question asked is on the type of material that has been of influence on the fire- and smoke development.

The type of insulation material has been of influence on spreading in one fatal residential fire. The type of material has not been specified. In another case it has been of influence on reducing. In the explanation of the questionnaire it was indicated that there was little ventilation causing the fire to smother.
In six cases the structure has been of influence on spreading: in three cases wood structure, in one case concrete structure, in one case a plastic frame structure has caused flashover and in another case soft board ceiling structure was of influence on spreading influence. In three fatal residential fires the used concrete structure has had a reducing influence.
In four fatal residential fires the floor construction caused for an expansion of fire- and smoke development and in four other cases for reduction. In case of a concrete floor there was a reducing influence and in case of a wooden floor there was one case with a reducing effect and in three cases a promoting effect.
Type of glazing has had spreading influence in four cases: in three cases there was multiple (insulation)glass and in one case there was single glass. In four other cases the use of multiple (insulation)glass had a limiting influence on the fire- and smoke development.
In one fatal residential fire several closed shutters have contributed to the fire- and smoke spread. In some other cases, the gas installation, the electrical installation or the type of heating contributed to this.



In eight (25%) of the total fatal residential fires structural characteristics contributed to the fire and/or smoke development. In seven (22%) cases it had a decreasing influence on the fire and/or smoke development. In one case materials both increased and decreased the fire and/or smoke development. The type of insulation, the materials of the structure, the type of glazing and the electrical installation have contributed to the fire and/or smoke development. The floor structure decreased the fire and/or smoke development.

3 Human characteristics

3.1 Injured and in first instance rescued victims

In four fifth (81%) of the fatal residential fires there are besides the fatal victims[10] no injured victims[11]. In more than two fifth (44%) of the fatal residential fires the fatal victims initially got rescued[12], but later deceased of the injuries of the fire. In a small number (6%) of the fatal residential fires one or more victims were able to leave the building without assistance, but yet deceased of the injuries of the fire.

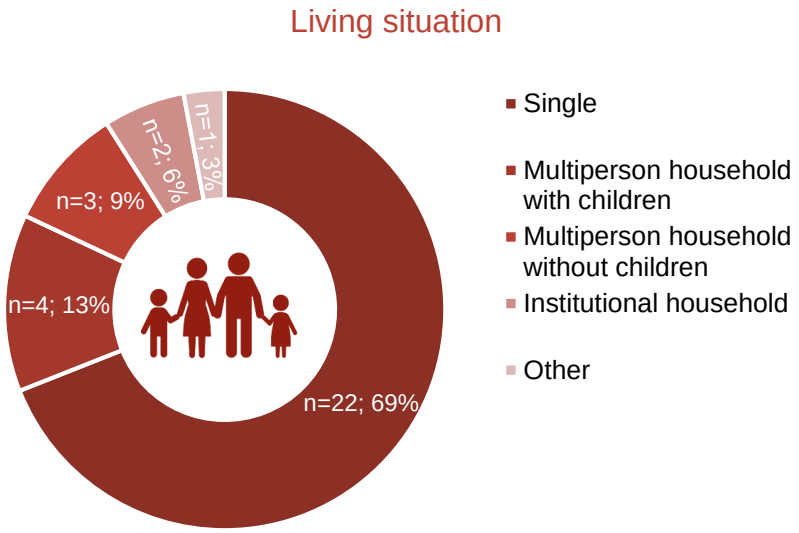
3.2 Living situation, gender and age of fatal victims

The victims are single in most fatal residential fires (69%). In nearly three quarter of the fatal residential fires (72%) the victim is home alone at the time of the fire. In 2016 the following living situations are relevant: ’single’, 'multifamily household with children', 'multifamily household without children', 'institutional household' and 'other'. In the last category there is a large house that is divided into apartments where residents do not have a mutual relationship.

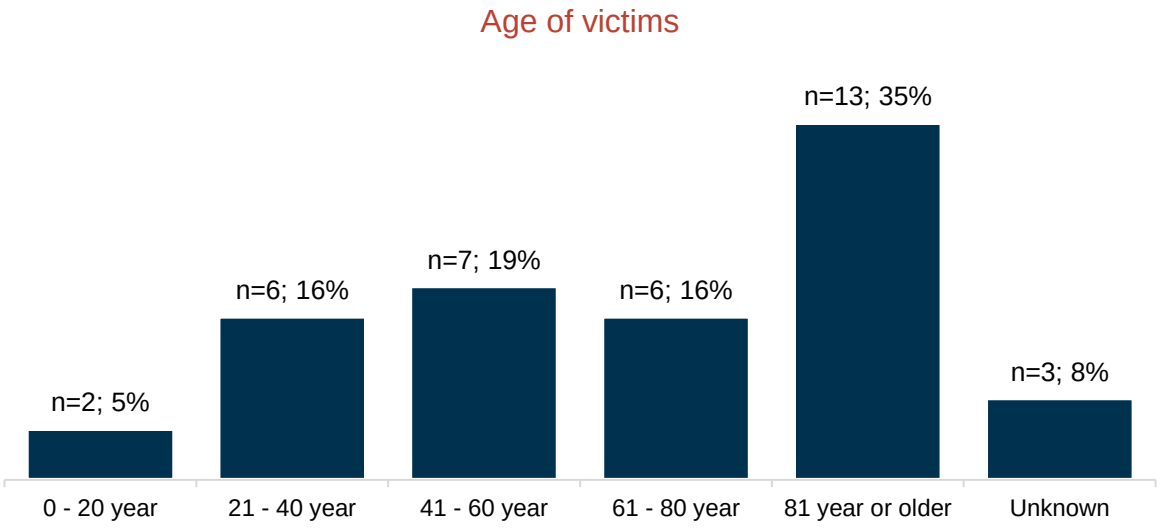
[10] A fatal victim is someone who deceased as a result of the fire or as a consequence of the injuries he or she has suffered. This can be immediate, but also after weeks or months. Although it is difficult to find out in such a case, the person still deceased of the fire in the home. The time of death is not relevant.

[12] An injured victim is someone who has been treated in hospital for the injury. It is not relevant if he or she has been hospitalized or has left the hospital immediately after treatment. People who have suffered minor "injuries" such as grazes, bruises, and mild breathing problems are NOT categorize as "injured".

[13] A rescued victim is someone who would be in a worse condition without this rescue. The worse condition may be caused by fire (heat, fire), smoke or for example jumping. If people stand on a balcony or roof and are being taken off out of precaution, it is not categorized as a rescue. Even if people are taken out of a compartment not threatened by fire, it is not categorized as a rescue.

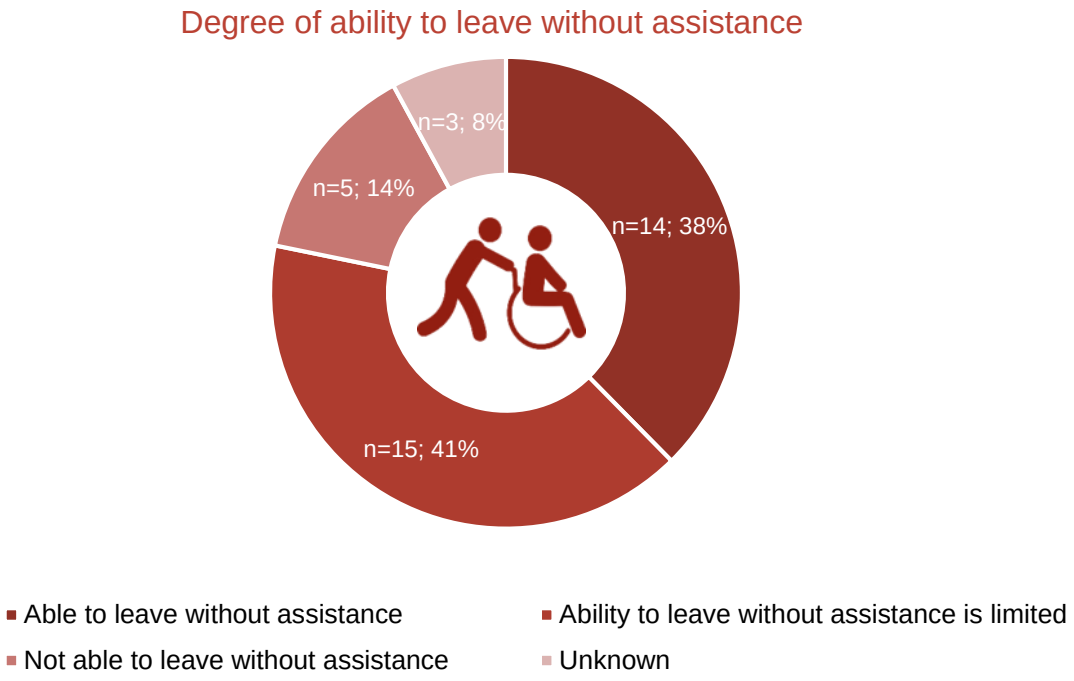


Three quarter (73%) of the victims in fatal residential fires is male. Slightly more than half (51%) of the victims is 61 years or older.



3.3 Degree of ability to leave without assistance

The degree of ability to leave without assistance is determined by the degree of mobility, vision, hearing and mental ability. A person's ability to leave without assistance is reduced (or limited) when there is a restriction in mobility, vision or hearing. When there is a limited mental ability or a combination of limitations, a person is referred to as not able to leave without assistance. Of three victims (8%), the degree of ability to leave without assistance is not known. Over half (53%) of the victims whose degree of ability to leave without assistance is known, is limited or not able to leave without assistance.

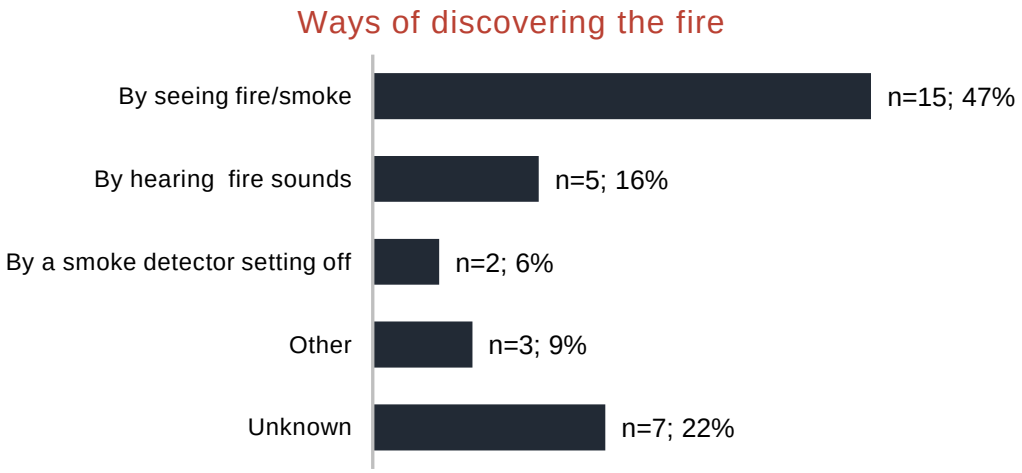


Of the victims found in the room where the fire originated (30%), the majority (24% of all victims) was not able or had a limited ability to leave without assistance. Two (5% of all) victims had no reduced mobility. One victim without a reduced mobility was asleep and the other was surprised by a flashover during a rescue attempt.
Of the victims who have not been found in the room of fire origin (68%), was about half (30% of all victims) not able to leave without assistance or had a limited ability to leave and the other half (30% of all victims) had no reduced mobility. Of 8% of all victims the ability to leave without assistance is not known. Most victims without a reduced mobility were awake (16% of all victims) and some were asleep (8%).
Of the victims of whom it is not known whether they were found in the room of fire origin (3%), their condition (waking or sleeping) at the time of the fire is also unknown.
In total, slightly less than two fifth (38%) of the deceased victims were asleep at the time of the fire, just over two fifth (43%) was awake and for about one fifth (19%) this is not known.

At the time of the fire, five victims (14%) were presumably under the influence of alcohol, drugs or medication. In one third (32%) there was presumption of the use of narcotics and in more than half (54%) this is not known.

3.4 Ways of discovering the fire and first reaction

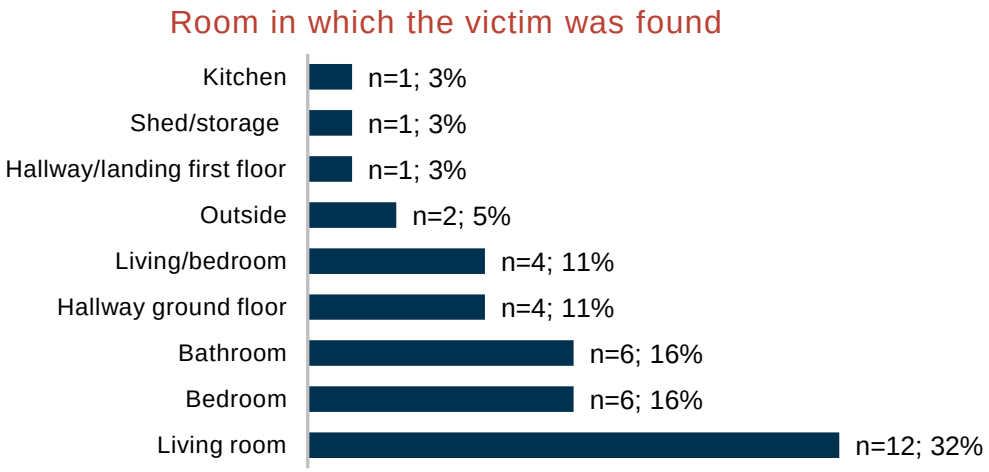
Nearly half (47%) of the fatal residential fires have been discovered by seeing fire- and/or smoke. In two fifth (22%) is not known how the fire was discovered. The category ‘other’ includes discovery by smell of fire and seeing fire, noise of the victim and feeling a heavy blow and vibration in floors.



In four out of ten fatal residential fires (41%) the fire is discovered by the neighbors. In one out of six (16%) by the victim and with the same share (16%) by co-occupants. When neighbors discover the fire, their first response usually is (34%) calling 112.
When the victim or co-occupant discovers the fire, the first response ranges from calling 112 (9%), escape out of the home (6%), carry out a rescue attempt (6%) and searching for the seat of the fire (3%). In two cases (6%), it is not known what the first reaction was.
Overall, the first response in most cases (56%) is calling 112, escape from home (9%) and carry out a rescue attempt (9%). In two fifth (22%) of the fatal residential fires the first reaction is not known.

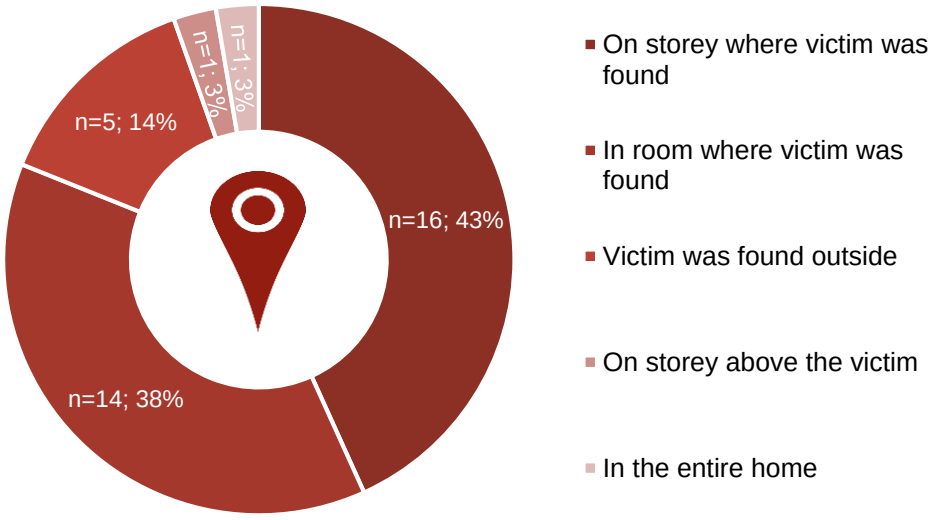
3.5 Location of victims

One third (32%) of the victims was found in the living room and one sixth (16%) in the bedroom.



Of the eleven victims found in the room of fire origin, most of them (n = 9) were found in the living room. One victim was found in the kitchen and another victim was taken from the bedroom.

Location of the fire in relation the victim (n=37)

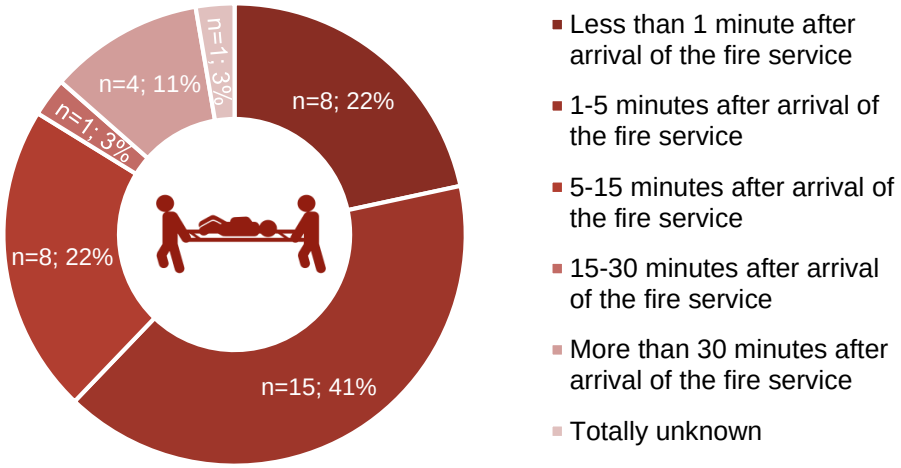


The majority of victims was on the storey where the fire was active[13] (81%), or even in a room where the fire was active[14] (38%). No victim was found on the storey above the seat of the fire.

3.6 Moment of finding and situation of victim

Nearly two thirds (63%) of the victims were found within 5 minutes of arrival of the fire service and more than eight out of ten victims (85%) were found by the fire service within 15 minutes of arrival.

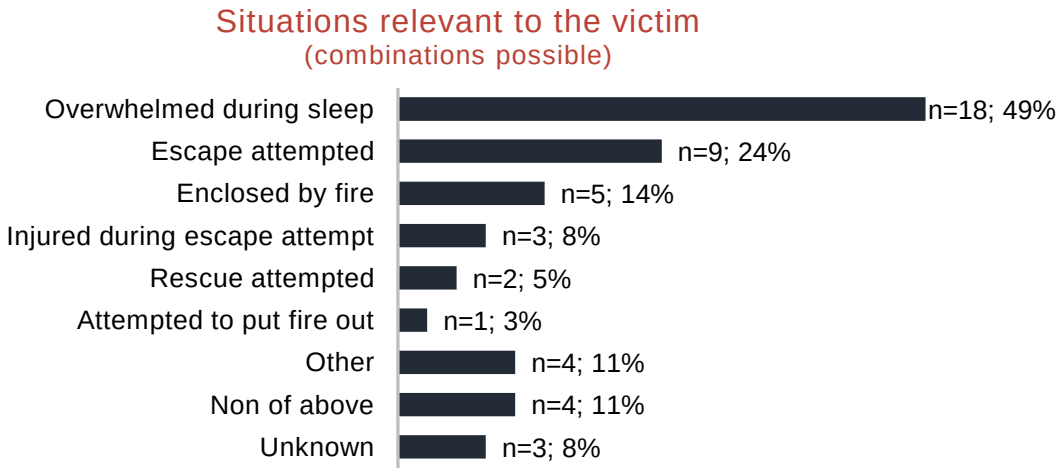
Moment that victim is found (n=37)



[13] Including the cases where the fire was still active in the room where the victim is found.
[14] This does not necessarily have to be the room of fire origin.

In three quarters (76%) of the cases, there was heavy smoke development (vision less than 5 meters) at the time of arrival of the fire service at the location of the victim. In some cases there was a slight smoke development (8%) or there was little or no smoke near the victim (16%). Three out of six victims found in an almost smoke-free surrounding deceased before arrival of the fire service. The other three victims were rescued within 5 minutes of arrival of the fire service, of which one even within 1 minute. They later deceased because injuries in hospital.

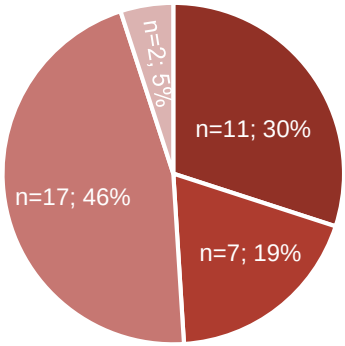
Questions about situations that (likely) apply to the victim are asked. A combination of situations is possible. Approximately half (49%) of the victims are overwhelmed by the fire in their sleep. A quarter (24%) of the victims did an escape attempt, with several (8%) injured or deceased during the escape attempt.



3.7 Moment and circumstances of death

More than half of the victims deceased in the site (54%), about two fifths (44%) in the hospital and one victim (3%) deceased in a burn treatment center three months after the fire.
Nearly half (49%) of the victims were presumably deceased before the fire service arriving. Nearly a third (30%) is probably even deceased before reporting of the fire. About half (46%) of the victims deceased after the fire service arriving. The victim was initially rescued, but deceased later of the injuries of the fire.

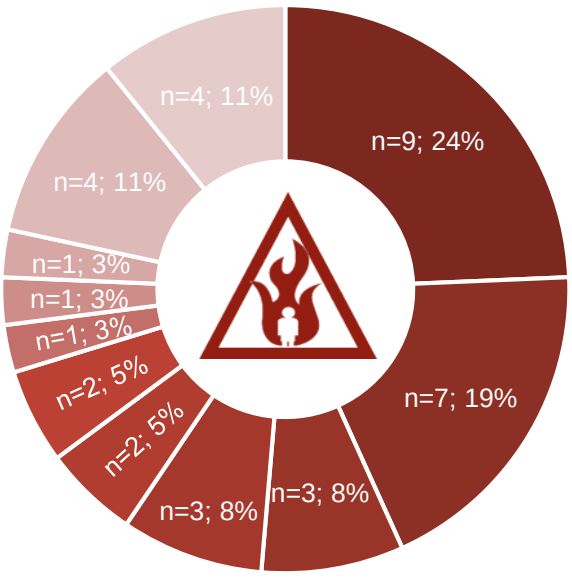
Moment of death



- Before reporting of the fire
- After the reporting, but before the arrival of the fire service
- After arrival of the service
- Unknown

The most important circumstances that have affected the victim's death are heavy smoke and/or heat (24%) and that the victim got overwhelmed by fire while sleeping (19%). For three victims it is indicated that they were deceased by a combination of circumstances, shown in the chart in the category ‘other’. The fourth victim in this category deceased during a rescue attempt. For four victims (11%), it is not known what the most important circumstances of death was.

Most important circumstance that was of influence on death



- Heavy smoke development and/or heat
- Overwhelmed during sleep
- Fire caught clothing or victim
- Smothered fire (suffocation)
- Fast fire development
- Severity of injury of victim
- Not mobile/ limited mobility
- Obstructed escape route (example full of smoke)
- Reduced alert because of alcohol/drugs/medication

Although for half of the victims (49%, n=18) has been reported that they (probably) were overwhelmed in their sleep by the fire, this is only reported as the main circumstance for two fifth (19%, n=7) of the victims. In the case of the other victims who are (probably) overwhelmed in their sleep, the fact that they were sleeping at the time of the fire was not the most crucial circumstance, but a combination of factors (n=3), a huge smoke development and/or heat (n=2), a smothered fire (n=2), the severity of the injury (n=1), a reduced alertness by alcohol, drugs or medication (n=1) or is not known (n=2) what the most crucial circumstance has been.

Institute for Safety

The Institute for Safety (IFV) contributes to a safe society by complementing the safety regions and their partners in professionalizing their tasks. We develop and share relevant knowledge, we have the expertise to acquire and manage communal equipment and we advise the managements involved. In this our motto is: detecting and connecting.

Fire Service Academy

The task of the Fire Service Academy, part of the Institute for Safety (IFV) is to professionalize and retrain fire service employees and people active in combating disasters and crisis management. The Fire-Fighting and Fire Prevention research departments envisage bringing about an optimal interaction between research, education and professional practice, to provide a contribution to a further professionalization of relief workers.