

Characteristics of fatal residential fires in Sweden

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SP Report 2015:53

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Abstract

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About 90 persons die every year in Sweden as a result of residential fires. The decrease has been very limited over the last two decades despite safety measures as smoke detectors and the more recent regulations on self-extinguishing cigarettes. In order to decrease the number of fatalities it is important to find characteristics of residential fires that results in fatalities. A comparison between the characteristics of residential fires and fatal residential fires is therefore made in this work where mainly publicly available statistics is used. Further characteristics are found by the use of some additional data made accessible to the research project from the Swedish Civil Contingency Agency.

The data shows that fatal residential fires are often large when the rescue service arrive involving several rooms, there is usually only one person in the fire compartment when the rescue service arrive, the fire occurs in the night/early morning and it starts often in a sofa or bed and is in many cases caused by smoking.

Key words: Characteristics of Residential fires, characteristics of fatal residential fires, fire statistics

SP Sveriges Tekniska Forskningsinstitut SP Technical Research Institute of Sweden

SP Report 2015:53 ISBN 978-91-88001-77-1 ISSN 0284-5172 Borås 2015

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Preface

This report has been prepared within the project "Analys av brandsäkerhetens fysiska bestämningsfaktorer och tekniska åtgärder som stöd till nollvisionen", a project which will identify technical parameters which have an impact on the number of fatal residential fires and find means to decrease the number of fatalities and injuries in residential fires. The project is funded by MSB which is gratefully acknowledged.

In order to conduct the work MSB has provided data to the project and been very helpful in explaining parameters and layout of data. We would like to thank especially Colin McIntyre at MSB for all his help in this.

Sammanfattning

I Sverige dör det årligen ca 90 personer i en bostadsbrand. Även om risken att omkomma i en bostadsbrand i ett längre perspektiv har minskat så har antalet omkomna varit ungefär det samma de senaste årtiondena trots insatser som rökdetektorer och mer nyligen självslocknande cigaretter.

Myndigheten för samhällskydd och beredskap antog 2010 en nollvision att ingen ska skadas allvarligt eller omkomma till följd av brand i Sverige. Då de flesta som förolyckas i bränder omkommer till följd av en bostadsbrand är det av stor vikt att antalet döda i bostadsbränder minskas. Ett steg i att åstadkomma detta är den utlysning om forskningsmedel som MSB gjorde 2014. Tre projekt beviljades i denna utlysning varav ett var "Analys av brandsäkerhetens fysiska bestämningsfaktorer och tekniska åtgärder som stöd till nollvisionen" där tekniska faktorer som kan ha en påverkan på antalet döda i bostadsbränder identifieras tillsammans med potentiella lösningar.

Denna rapport utgör det första steget i det projektet vari statistik används för att finna karakteristiska drag för bostadsbränder som har en dödlig utgång. Statistiken som används är MSBs allmänt tillgängliga statistik om bostadsbränder och dödsbrandsdatabasen på ida.msb.se tillsammans med allmänt statistik från SCB och, i några fall, ytterligare data som MSB har genom insatsrapporteringen som inte är allmänt tillgänglig.

I rapporten görs jämförelse mellan bostadsbränder och bostadsbränder med dödlig utgång. I de flesta fall görs jämförelsen genom att studera stapeldiagram, i några fall kompletteras detta med en statistik analys genom vilken man kan bestämma huruvida skillnaden mellan bostadsbränder generellt och bostadsbränder med dödlig utgång är statistiskt signifikant.

Data för vissa parametrar klassificeras ofta som okänd, särskilt vad gäller brandorsak och startföremål. Det är ändå möjligt att finna en del karakteristika. Data visar att bostadsbränder som resulterar i dödsfall ofta är stora redan när räddningstjänsten kommer till platsen och att branden då involverar mer än ett rum. Bostadsbränder med dödlig utgång kännetecknas också av att det ofta endast är en person i brandcellen när räddningstjänsten kommer till platsen. De flesta bostadsbränderna inträffar på eftermiddagen/kvällen men de bränder som har dödlig utgång inträffar i regel på natten eller mycket tidig morgon. Bränder som startar i sängen eller en soffa/fåtölj resulterar oftare i dödlig utgång jämfört med t.ex. bränder som startar på spisen. Rökning är en vanlig brandorsak för dödliga bostadsbränder.

1 Introduction

About 90 persons die every year in Sweden as a result of a residential fire. Even if the risk of dying in a residential fire has been decreasing somewhat the past 50 years [1], the risk has now levelled out and the decrease has been very limited over the last two decades despite safety measures as smoke detectors and the more recent regulations on self-extinguishing cigarettes [2]. In recognition of this the Swedish Civil Contingency Agency (MSB) initiated a research effort in 2014 in order to investigate why the numbers are not decreasing more and what could be done to decrease the numbers. Three projects were funded in this effort. One of them was "Analys av brandsäkerhetens fysiska bestämningsfaktorer och tekniska åtgärder som stöd till nollvisionen", a project which will identify technical parameters which have an impact on the number of fatal residential fires.

This work is a first step in that project. In this study technical parameters that have an impact on the number of fatal residential fires are identified. The work is based on the statistics concerning residential fires in general and fatal residential fires in particular that MSB has been made available since 1998 [3] together with data that MSB has specially provided to this project and general statistics on Sweden as published by Statistics Sweden (SCB).

In order to decrease the number of fatalities in residential fires it is important to decrease in particular residential fires that lead to fatalities as determinants for residential fires and fatal residential fires are different [4]. Therefore it is important to find characteristics of residential fires that results in fatalities. A comparison between the characteristics of residential fires and fatal residential fires is therefore made. In most cases the comparison is made simply by studying diagrams comparing residential fires to fatal residential fires. In some cases, where it can be difficult to determine if the differences that might be noted are truly indicating a difference between different categories or not, the statistical method variance analysis (ANOVA) is used.

2 MSB's Fire Statistics

MSB's publicly available fire statistics is accessible through the IDA database website ida.msb.se. The fire statistics is based on information collected by means of the incident reports that are filled in by and supplied to MSB by the rescue services for all incidents where the Swedish rescue services have responded. The database is open to the public, in order to get full access to the public data you only need to register. However, the website is in Swedish only and in order to find similar data in the IDA database the parameters used in the data sampling from the database are given both in Swedish and translated into English in this report.

2.1 Residential fires

The public database contains several types of accidents and not only fires. For "Fires in buildings" (Brand i byggnad) it has the following parameters:

- Year (År)
- Name of Rescue service (Räddningstjänst), in many cases similar to municipality
- County (Län)
- Municipality (Kommun)
- Type of Municipality (kommungrupp) Suburban to big city, Suburban to larger cities, Rural Municipality, Sparsely populated region, Densely populated region
- Commuter municipality, Big city, Larger city, Tourism city, Production city
- Building (Byggnad) type of building (gas station, student house, vacation house, hotel, jail, defence building, school, industry, farm, dwelling, outside, hospital, etc.)
- Building type (Byggnadsgrupp) (public building, other, dwelling, outside, industry or unknown)
- Month (Månad)
- Day of the month (Dag)
- Day of the week (Veckodag)
- Date (datum)
- Cause of fire (Brandorsak)
- Size of fire upon arrival (Omfattning vid ankomst)
- Total size of fire (Brandens totala omfattning)
- Smoke detector present (brandvarnarförekomst)
- Start room (startutrymme)
- Start item (startföremål)

In order to evaluate residential fires one should select dwelling (Bostad) under the building type (Byggnadsgrupp). Dwellings include apartment buildings, single family houses, detached or terraced houses and summer/vacation houses.

The rescues service collects and supplies MSB with more information than what is stored in the publicly available IDA database. Such data has been obtained directly from MSB for this project and relevant parts of it is also analysed in this report.

2.2 Fatal fire database

MSB also provide a special database over fatal fires. This data is based on a separate reporting system as it is not possible for the responding officer to follow up on people that were injured at the time of the fire and then perhaps die on a later stage. In case someone is killed in a fire that the rescue service did not attend, these could be fires due

to suicide or in remote areas without nearby neighbours that are not noticed, then these fires are also covered with this reporting system. The system is described by Jonsson et. al. [5]. The parameters reported are similar as those in the fire database, but not completely similar:

- Year (År)
- County (Län)
- Municipality (Kommun)
- Type of Municipality (kommungrupp) Suburban to big city, Suburban to larger cities, Rural Municipality, Sparsely populated region, Densely populated region, Commuter municipality, Big city, Larger city, Tourism city, Production city.
- Building type (Byggnadsgrupp) (public building, other, dwelling, outside, industry or unknown)
- Building (Byggnad) type of building (gas station, student house, vacation house, hotel, jail, defence building, school, industry, farm, dwelling, outside, hospital, etc.)
- Fire object (Brandobjekt) Forest, container, ship, car, etc
- Cause of fire (Brandorsak)
- Size of fire (Brandens omfattning)
- Smoke detector presence (brandvarnarförekomst)
- Gender (Kön)
- Age (Åldersklass)
- Month (Månad)
- Day of week (Veckodag)
- Time (Tid på dygnet)
- Start room (startutrymme)
- Start item (startföremål)

2.3 Terminology

The incident reporting sheet that the rescue service use for the reporting is provided in appendix 1. The terminology used in the incident report can be ambiguous in some cases and the way of reporting or defining different situations can vary from rescue service to rescue service. Some guidance has been provided by MSB upon the introduction of the current incident report sheet. This guidance is described in Appendix 2. In this report data for fatal residential fires is compared to data for all residential fires and in that way discrepancies between recue services is evened out.

The terminology in this report might not always be similar to the terminology used by e.g. NFPA in the USA as the terminology used here has been translated from the Swedish words and in recognition of the guidance given to the rescue services in order to give an indication what lies behind the words. The terminology used in the report is also discussed in appendix 2.

The public database as of 2015-09-30 contains statistics for the years 1999-2014 for fatal fires and 1998-2014 for residential fires. When this work was initiated only data until 2013 was available and therefore data for 1999-2013 is used for the analyses in this report.

Residential and fatal residential fires

During the years 1999-2013 a total of 1 292 people died in a residential fire. The number of fatal residential fires over the same time is 1 183 indicating that the vast majority of fatal fires results only in one fatality. The distribution of fatal residential fires and number of fatalities over the years is shown in Figure 1. As seen the number goes up and down with high values in 2002 and 2010 and a low number in 2004 but show no particular trend over this short series. A similar pattern can be observed in Figure 2 for residential fires attended by the rescue service with a low number in 2004 and a high number in 2010. However, the differences between the years are not as large as for fatal residential fires.











Figure 3 Portion of residential fire that results in at least one fatality, distribution over years in 1999-2013.

Figure 3 presents the percentage of the residential fires attended by the rescues service that result in at least one fatality. On average it is a bit more than one percent of the residential fires attended by the rescues service that results in fatalities.

In order to decrease the number of fatalities in residential fires it is important to decrease the number of residential fires but in particular to decrease the type of residential fires that leads to fatalities. Therefore it is important to find characteristics of residential fires that results in fatalities. A comparison between the characteristics of residential fires and fatal residential fires is therefore made. In order to base the analysis on as much data as possible the whole time period 1999-2013 is used for the analysis. In cases where differences can be seen over time, this is also presented.

3.1 Type of dwelling

The yearly number of fatal residential fires and residential fires in general per type of dwelling can be seen in Table 1 and Table 2 respectively. As seen most fatal residential fires occur in apartment buildings and single family houses while the number in Semidetached, linked and terraced houses and vacation houses is lower. The trend is similar for residential fires attended by the rescue service.

According to statistics from Statistics Sweden [6] most people in Sweden lives in single family houses, closely followed by apartment buildings as seen in Table 3. By dividing the number of fatalities in a specific type of dwelling, with the number of people living in that type of dwelling, the numbers as presented in Figure 4 is obtained. From Figure 4 one can perhaps see that the number for apartment buildings is a bit higher than the number in single family houses for most years. An ANOVA analysis of the data confirms this difference. The number for semi-detached houses varies a lot but it is in general lower than the number for single family house and apartments. The large variation is due to that it is a rather unusual type of dwelling compared to the others and a small variation in number of fires will have a large impact on the numbers.

Year	Anartment	Single	Semi-detached	Vacation
1 cui	building	family house	house*	house
	(flerbostadshus)	(villa)	(rad/par/kedjehus)	(fritidshus)
1999	38	25	1	3
2000	40	45	2	6
2001	45	52	3	4
2002	60	42	4	4
2003	30	53	5	6
2004	21	21	5	2
2005	36	36	2	3
2006	32	31	2	2
2007	38	32	6	2
2008	39	38	7	3
2009	55	41	6	4
2010	54	50	4	4
2011	37	32	4	7
2012	40	38	3	10
2013	38	32	4	3
total	603	568	58	63

Table 1Number of fatalities per type of dwelling and year [3]

*includes also linked and terraced houses

Table 2	Number of fires that the rescue service attended in dwellings depending on dwelling type
	and year [3]

Year	Apartment	Single family	Semi-detached	Vacation
	buildings	house (villa)	house*	house
	(flerbostadshus)		(rad/par/kedjehus)	(fritidshus)
1999	3 230	2 668	219	313
2000	3 355	2 241	208	348
2001	2 900	2 914	208	357
2002	2 775	2 828	184	328
2003	2 652	2 995	169	364
2004	2 451	2 441	184	283
2005	2 669	2 755	175	310
2006	2 706	2 743	167	274
2007	2 946	2 723	176	317
2008	2 844	2 687	196	276
2009	2 919	3 052	187	275
2010	2 934	3 262	231	277
2011	2 815	2 595	208	301
2012	2 998	2 699	201	253
2013	2 864	2 562	207	258

* includes also linked and terraced houses

Year	Apartment buildings	Single family houses	Semidetached house
1999	39.4 %	49.8 %	10 %
2000	40.6 %	48.7 %	9.5 %
2001	40.6 %	48.7 %	9.5 %
2002	40.1 %	48.6 %	10.1 %
2003	42.4 %	47 %	9.1 %
2004	41%	48.5 %	9 %
2005	40.7%	48.1 %	9.7 %
2006	39.8%	49.5 %	9.4 %
2007	39.8%	49.5 %	9.4 %
2008	42.7%	48.6 %	8.6 %
2009	43.1%	47.6 %	8.8 %
2010	43.9%	47.3v	8.4 %
2013	40.1%	53.8 %*	*

Table 3Residents by type of building, % [6]

* The single family house number probably includes semi-detached, linked and terrace houses



3.2 Type of municipality

The statistics available in IDA has been split into different type of municipalities as listed in Table 4. Assuming that it is mainly the municipalities in the categories marked with a star in Table 4 that are densely populated, it seems that both residential fires and fatal residential fires are more common in more rural areas.

Type of	Number	Number of	Fires per	Number	Fire
Municipality	of fires	inhabitants	100 000	of fire	fatalities per
		according to IDA	inhabitants	fatalities	100 000
		(over the years)			inhabitants
Suburban to big					
city*	9 997	137 608 757	46	148	0.69
Suburban to					
larger cities*	3 113	21 572 359	67	44	0.95
Rural					
Municipality	3 123	4 616 899	122	46	1.80
Sparsely					
populated					
region	4 288	2 557 963	88	67	1.38
Densely					
populated					
region*	9 557	4 868 862	76	129	1.02
Commuter					
municipality*	7 579	12 643 257	74	97	0.95
Big city*	14 243	10 239 030	60	184	0.78
Larger city*	24 750	23 629 847	61	321	0.78
Tourism city	4 262	40 892 661	98	72	1.66
Production city	10 595	4 350 195	87	173	1.43

Table 4Number of residential fires and fatal residential fires for different types of municipality,
summary over the years 1999-2013

* Category assumed to indicate dense population

3.3 Time

The number of residential fires, fire fatalities in residential fires and number of fatal residential fires in January-December respectively over the years 1999-2013 are presented in Table 5. The normalized number of residential fires and fatalities in residential fires per month is shown in Figure 5. As seen the distribution varies in a similar manner even if the curvature is more pronounced for the fatalities with a lower portion occurring in the summer time and a larger portion in December.

 Table 5. Number of residential fires, fire fatalities in residential fires and number of fatal fires per month over the time period 1999-2014

3.6 (1			
Month	Number of	Number of fire fatalities	Number of fatal
	residential fires	in residential fires	residential fires
January	11 343	1 293	1 184
February	8 779	154	142
March	8 484	134	126
April	7 497	124	112
May	6 938	112	100
June	6 044	100	89
July	5 652	64	60
August	5 550	57	49
September	5 656	50	49
October	6 740	82	71
November	7 341	105	97
December	11 649	122	115

Figure 6 shows the distribution of normalized number of residential fires and fatalities in residential fires over the week. As seen the differences are minor even if there is a larger portion of fatalities occurring towards the end of the week compared to the residential fires.



Figure 5 Distribution of normalized fatalities in residential fires and residential fires over the year.



Figure 6 Distribution of fire fatalities and residential fires over the week

A large difference is however seen in fatalities in residential fires and residential fires for the time of the day when the fire alarm came, where the fatal residential fires peaks between 2 and 3 in the night while residential fires in general peaks between 18 and 19 hours in the evening as presented in Figure 7.





3.4 Smoke detector

One of the most studied parameters when it comes to residential fires and fatal residential fires is the use of smoke detectors. Table 6 present the use of smoke detectors in residential fires in general and fatal residential fires in Sweden. It is worth noting that presence of smoke detector should only be classified as "yes" if the smoke detector was placed at such a place that it ought to have been activated. No information is however given whether it activated or not here. As seen the use of smoke detectors is about the same for both categories.

Table 6Use of smoke detectors in residential fires in	n general and fatal residential fires.
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Smoke detector present	Number of fires (%)	Number of fatal fires (%)
Yes	33 497 (36%)	377 (32%)
No	38 819 (42%)	546 (46%)
Unknown	19 357 (21 %)	261 (22%)

3.5 Fire start room

Table 7 presents the number of fires and fatal fires starting in specific rooms. The percentage per starting room out of the total number is presented in Figure 8, while Figure 9 presents the percentage per starting room that results in a fatal fire. As seen fires starting in the living room and bedroom are the most fatal ones together with those starting in an Unknown room. Fires in Hallways, Hobby room and Bathroom are also prone to results in a fatal fire, but these fires are not so common. Kitchen also account for a large portion of fatalities but given the large amount of fires that start in the kitchen, kitchen fires are less prone to result in a fatality.

Start room	Number of	Number of fatal	Number of
	fatalities	fires	residential fires
Living room	346	319 (27%)	7 093 (8%)
Bedroom	286	263 (22%)	4 358 (5%)
Unknown	254	223 (19%)	3 626 (4%)
Kitchen	224	211 (18%)	24 987 (27%)
Hallway	43	37 (3%)	1 728 (2%)
Other	52	48 (4%)	4 048 (4%)
Basement	17	16 (1%)	3 318 (4%)
Heating room	15	15 (1%)	4 102 (4%)
Balcony	14	13 (1%)	3 164 (3%)
Bathroom/sauna	19	17 (1%)	2 112 (2%)
Storage	10	9 (0.7%)	2 295 (2%)
Garage	7	7 (0.6%)	1 878 (2%)
Outside	5	5 (0.4%)	3 113 (3%)
Chimney	1	1 (0.1%)	18 786 (19%)

 Table 7
 Start room for fatal and residential fires in general





Fire start room for fatal residential fires and residential fires presented as percentage of total number of fatal residential and residential fires respectively



Figure 9 Ratio of fatal residential fire to residential fire per start room

The dwelling type for the 254 fires with unknown start room is listed in Table 8, as seen single family houses is the by far most common building with unknown start room for fatal residential fires.

Dwelling type	Byggnad	Number of fires	Number of fatalities
Single family house	Villa	163	185
Apartment building	Flerbostadshus	33	37
Vacation house	Fritidshus	22	26
Attached/terraced	Rad-/par-/kedjehus	5	6
house			

Table 8 Dwelling type for residetial fires with unknown start room.

3.6 Size of fire

Figure 10 shows the size of the fire when the rescues service arrives on site for residential fires and fatal residential fires. It is clearly seen that the fatal fires are rather large in most cases involving one or several rooms while residential fires in general mostly are rather small with smoke only, extinguished or confined to the start item.



Figure 10 Size of fire when rescues service arrives at site for fatal residential fires and residential fires in general.

4 Cause of fire

Most studies conducted on residential fires and fatal residential fires have been focused on the cause of the fire. The Swedish reporting system contains 19 different causes in the residential fire database as described in Appendix 2. These are to some extent a mixture of causes such as forgotten stove and ignition sources such as heat transfer and sparks.

The available data on causes for fatal residential fires together with data for residential fires is provided in Table 9 with the number of fatalities, number of fatal residential fires and residential fires. The number of fatal residential fires and residential fires is also expressed as percentage of total in brackets in Table 9.

For fatal fires the most common cause is Unknown followed by smoking. Deliberately lit, Other, Forgotten Stove, Lit candle, Technical malfunction and Heat transfer are of the same order of magnitude. For residential fires the most common causes are Unknown, Chimney fire and Forgotten stove followed by Deliberately lit, Other, Technical malfunction and Heat transfer.

Fire cause		Number	Number of	Number of
Swedish term	Translated into	of	fatal fires	residential fire
Brandorsak	English	fatalities	(% of total)	(% of total)
Okänd	Unknown	505*	457* (39)	18635 (20)
Rökning	Smoking	332	317 (27)	3 325 (4)
Anlagd med uppsåt	Deliberately lit	90	83 (7)	7 195 (8)
Värmeöverföring	Heat transfer	82	70 (6)	6 085 (7)
Glömd spis	Forgotten Stove	78	69 (6)	14 503 (16)
Annan	Other	77	72 (6)	6 933 (8)
Levande ljus	Lit candle	58	54 (5)	3 317 (4)
Tekniskt fel	Technical malfunction	45	39 (3)	8 313 (9)
Gnistor	Sparks	10	9(1)	1 882 (2)
Barns lek med	Child playing with	9	7(1)	990 (1)
eld	fire			
Explosion	Explosion	4	4 (0.3)	175 (0.2)
Blixtnedslag	Lightning	1	1 (0.1)	982 (1)
Soteld	Chimney fire	1	1 (0.1)	16 103 (18)
Återantändning	Re-ignition	1	1 (0.1)	820 (1)

Table 9	Cause of fire for fatal residential fires and residential fires during years 1999-2013.

* includes 9 fatalities/fatal residential fires with "no information", "cause not given"



of residential and fatal residential fires respectively.

The cause for fatal residential fires and residential fires are presented in Figure 11 as % of total number of residential and fatal residential fires respectively. The figure shows that Unknown and Smoking are common causes for fatal residential fires, while Forgotten stove and Technical malfunction seldom results in a fatal fire as compared to how often they do occur.

Figure 12 shows the ratio between fatal residential fires and all residential fires for each cause. The figure shows that in particular the cause smoking is particularly fatal followed by unknown and explosion. Fires that are not very deadly include: Chimney fire, Forgotten stove, Technical malfunction, Lightning, Sparks and Re-ignition.



Figure 12 Ratio of fatal residential fires to residential fires as a function of cause

4.1 Unknown cause

The large portion of unknown cause is troublesome and has the potential to bias analyses. The actual causes hidden in the category unknown cause may contain any kind of distribution of known causes. A common assumption is that the unknown cause can be distributed over the known causes with the same distribution as the known causes. However, there is no evidence that this is the case. Due to the uncertainties that are introduced by the large number of unknown cause it is important to investigate the unknown cause category further.

Figure 13 shows the percentage of fatal residential fires and residential fires that has an unknown cause (including no cause provided) during 1999 to 2013. A small steady decrease can be noted for the full time period for the residential fires. The pattern for fatal residential fires is however different, with a large decrease in percentage of unknown cause from 1999 to 2005. From 2005 it increases again to flatten out at almost 50 % in the years 2009-2013. It can also be noted that the level in 1999 and in 2013 is of the same magnitude, of 50 %, whereas the dip in 2005 is about 20 %. The reason for the low percentage around 2005 is that a person employed at MSB phoned the different rescue services and asked them for more information about the fatal residential fires which then led to classifications for a most likely cause of the fire. There are reasons to believe that the rescue services in Sweden are in many cases reluctant to provide any cause in the reporting system unless they are 100% sure that that is the cause and that there is enough evidence to hold in a court.



Figure 13. Percentage of fatal residential fires and residential fires with unknown cause per year

4.1.1 Residential fires with unknown cause

The number of residential fires with unknown cause per dwelling type presented in Table 10 show that most of the fires with Unknown cause occur in Vacation houses. Apartment buildings and semi-detached houses has a somewhat higher percentage of unknown cause than Single family houses.

Dwelling type		Number of	Total number	%	
Swedish term	English	residential fires with	of residential	unknown	
Byggnad	translation	unknown cause	fires	cause	
Flerbostadshus	Apartment	10 107	43 043	23	
x 7'11		7.522	41.1(0	10	
Villa	Single family	7 523	41 162	18	
	house				
Fritidshus	Vacation	1 776	4 531	39	
	house				
Rad-/par-	Semi-detached	662	2 937	23	
/kedjehus	house*				

 Table 10
 Type of dwelling for residential fires with unknown cause

* includes also linked and terraced houses

The majority of the fires with unknown cause are small upon rescue service arrival but the percentage of fires with unknown cause increases as the fire size increases as seen in Table 11.

Size of fire	Upon arrival – unknown	Upon arrival – all	% unknown cause	Total fire involvement –
	cause	causes	cuuse	unknown cause
Only smoke	2 110	22 251	9	NA
Start item	4 634	24 532	19	7400
One room	4 359	13 819	32	4938
Several rooms	4 203	7 359	57	1803
Several fire	792	1 286	62	5358
compartments				
Several	-	-	-	441
buildings				
Extinguished	2460	22 332	11	NA
Unknown, no	77	94	82	128
info				

 Table 11
 Number of fires per size of residential fire

For the small fires, i.e. Only smoke, Start item and Extinguished upon arrival, it may be possible to attain more information about the fire by studying start item and start room of these fires. Figure 14- Figure 16 show the most common start rooms for fires that were categorised as Only smoke, Start item or Extinguished upon rescue service arrival.

The most common start rooms for the residential fires categorized as Only smoke upon rescue service arrival, see Figure 14, are garbage room and kitchen followed by unknown. Kitchen is the most common starting room for the residential fires with unknown cause that were extinguished when the rescue service arrived as can be seen in Figure 15. Figure 16 shows fires limited to the Start item upon recue service arrival where Garbage room dominate the picture and the other nine causes are fairly evenly distributed.



Figure 14. The ten most common start rooms for residential fires with unknown cause that were categorised as Only smoke at the time of rescue service arrival.



Figure 15. The eleven most common start rooms for residential fires with unknown cause that were categorised as Extinguished at the time of rescue service arrival.



Figure 16 The ten most common start rooms for residential fires with unknown cause that were categorised as Start item only at the time of rescue service arrival.

In total, Garbage room is the major starting room for small residential fires with unknown cause. Causes for fires in garbage rooms can be several including hot ashes in the garbage, other material not suitable to put in the garbage, arson, self-heating, etc. However given that the garbage room contains a lot of garbage it is not easy to determine the start item if it is piece of paper, a light bulb etc.as there is no category garbage that can be selected (there is only one category "garbage in container") and therefore the large amount of unknowns for these fires is not so surprising.

Figure 17- Figure 19 show start items for the fires with unknown cause where fire size upon rescue service arrival was classified as Only smoke, Extinguished and Start item respectively. In all three diagrams Start item Unknown and Other dominates.



Figure 17. The most common start items for residential fires with unknown cause that were categorized as Only smoke at the time of rescue service arrival.









The most common start items for residential fires with unknown cause that were categorized as Start item only at the time of rescue service arrival.

4.1.2 Fatal residential fires with unknown cause

Most of the fatal residential fires with unknown cause occur in single family houses as shown in Table 12 where a bit more than 50% of the fatalities in a single family house occur in a fire with unknown cause. From Table 13 it is also clear that many fires with an unknown cause are large fires with 30% of the fires in several fire compartmentations with a unknown cause and 25% of the fires in several rooms.

Dwelling type		Number of	Number of	Number of
Swedish term Byggnad	English translation	fatalities with unknown fire cause, (total number)	fatal residential fires with unknown fire cause	residential fires, all causes
Villa	Single family house	291 (568)	263	41 162
Flerbostads- hus	Apartment buildings	158 (603)	147	43 043
Fritidshus	Vacation house	30 (63)	25	4 531
Rad-/par- /kedjehus	Semi-detached house	18 (58)	14	2 937

Table 12Type of dwelling for fatal residential fires with unknown cause.

Table 13Size of fire upon arrival for fatal fires with unknown cause.

Size of fire		Number of	Number of
Swedish term	English	fatalities with	fatal fires
Brandens omfattning	translation	unknown cause	
		(total number)	
Endast rökutveckling	Only smoke	2 (28)	2
Brand i startföremål	Contained to	14 (270)	12
	start item		
Brand i ett rum	Contained to	70 (658)	68
	one room		
Brand i flera rum	In several	308 (1216)	277
	rooms		
Brand i flera	In several	35 (112)	28
brandceller	fire cells		
Branden	Extinguished	18 (102)	15
släckt/slocknad			
Okänd, Uppgift	Unknown,	50 (198)	47
saknas	no info		

Not knowing the cause of a large fire when arriving at site, is not so strange as it is very difficult to find the cause when several rooms are on fire. The same is true for investigations conducted after the fire. However for fires of smaller size, like those which give only smoke, are confined to start item or the start room as listed in Table 13, it is possible to get an indication of what was the cause of the fire by studying the start item and start room for these fires. This is done in Table 14 for start item only, in Table 15 for one room and Table 16 for extinguished. The two fires with only smoke development started in the kitchen and in a closet, no information is available on item ignited for these fires.

Start item and starting room is listed for the 12 fires that was contained to the start item in Table 14. As can be seen most of these fires are in "Furnishing", Clothing, Bed or Sofa/armrest chair if the start item is not unknown.

Start room (Swedish: startutrymme)	Start item (Swedish: startföremål)
Bath room (1 fire 2 dead) (badrum/toalett)	Furnishing (Lös inredning)
Hallway (Hall)	Unknown (okänd)
Kitchen (kök)	Coffee brewer (Kaffebryggare)
Kitchen	Clothing (Kläder)
Kitchen	Unknown (okänd)
Bedroom (Sovrum/sovsal)	Bed (Säng)
Bedroom (2 fires. 2 dead)	1 Other 1 unknown (1 Annan 1 okänd)
Living room (Vardagsrum)	Furnishing (Lös inredning)
Living room (3 fires, 4 dead)	Sofa/Armrest chair (Soffa/fåtölj)

Table 14Start room and start item for fatal residential fires confined to the start item only with
unknown cause.

The start-item and start room for fires in one room only is listed in Table 15 and for fires with smoke only in Table 16. Also in Table 15 and Table 16 the start items Furnishing, Clothing, Sofa/armrest chair and Bed are common if not unknown.

Start room (fires)	Start item
Other (5)	Other, unknown
Hallway (1)	Furnishing
Garage (1)	car
Basement (3)	Furnishing (1), unknown (2)
Kitchen (13)	Electric central (1), stove (1), heating appliance (1),
	furnishing (2), unknown (8)
Unknown (3)	Unknown(3)
Heating room (2)	Unknown(2)
Bedroom (16)	Electric installation(1), Furnishing (3), Unknown (7),
	Sofa/Armrest chair (1), Bed (3), TV (1)
Laundry room (1)	Tumble dryer (1)
Living room (22)	Furnishing(3), Unknown (9), Paper (1), Sofa/armrest
	chair (6), Bed (2), TV (1)
Workshop/hobby room (1)	Unknown (1)

Table 15	Start-item and start room for fatal residential fires with unknown cause confined to one
	room only.

Table 16Start-item and start room for fires with unknown cause that were extinguished upon
arrival.

Start room (fires)	Start item (fires)
Hallway (1)	Bed (1)
Corridor (1)	Furnishing (1)
Kitchen (3)	Furnishing (2), Unknown (1)
Unknown (4 fires, 5 dead)	Furnishing (1), Unknown (3 fires 4 dead)
Bedroom (3)	Clothing (1), Unknown (2)
Living room (3 fires 5 dead)	Sofa/armrest chair (2), Unknown (1 fire 3 dead)

An indication of what causes might be hidden in the large unknown cause is provided in Figure 20 where the distribution of causes during years 2003-2006 is compared to the distribution during years 2010-2013. Smoking and Forgotten stove has a higher portion during the years 2003-2006 while Arson, Other and Technical malfunction shows a slightly higher portion during the years 2003-2006.



Figure 20. Cause of fire distribution for fatal residential fires during years 2003-2006 and 2010-2013.

4.2 Smoking as a cause of fire

Smoking is the second largest cause of fatal fires according to the statistics available in IDA. The distribution of fatalities in residential fires due to smoking over the years can be seen in Figure 21. As seen there seems to be an increase in the late 90-ies and early 2000-es but has since decreased. People aged 44 and younger dies rarely in a fire caused by smoking in 2014. The number of people aged 80+ that are killed in a fire caused by smoking has also decreased to some degree in recent years.

These patterns are similar to the trends in number of smokers in Sweden. Figure 22 shows the portion of smokers in different age groups over time according to statistics from Statistics Sweden (SCB) [7], as seen the number is decreasing in all groups. Figure 23 show the same distribution as a function of age, as seen peak smoking are changing gradually from the age of 30-34 in 1980 to the age 50-55 from 1998 and onwards. It is also interesting to note that the number of smokers among the elderly population is decreasing indicating that also elderly people smoke less. This may lead to a lower number of fire related fatalities among elderly as a large portion of the fatalities is in smoking related fires.





Figure 22 Number of smokers in different age groups over time in Sweden



Figure 23 Age-distribution of smokers

In Figure 24 the number of fire fatalities with cause smoking is plotted with the number of 100.000 persons smoking daily. A steady decline of the number of smokers can be seen where the number of daily smokers in Sweden decreases by about a third from 1999 to 2013. During the same period the number of fire fatalities in residential buildings caused by smoking appear to be decreasing of a similar magnitude. However, this does not account for possible confounders or other changes in smoking habits as only the habits of daily smokers have been measured.



The data on number of smokers is based on statistics on SCB on smoking paired with SCB statistics on the population in Sweden [7]. The data on the numbers of smokers in Sweden were adjusted to fit the age groups of fire fatalities data. Due to a mismatch of categories, smokers of the age 16 and 17 are included in the population data for the group 18-24, but not for fatalities (none were recorded). Also, data for smoking for people older

than 84 were missing for the time period 1999-2006. An assumption was therefore made that the smoking habits of persons 80-84 were the same as smoking habits of people older than 80 in general. These assumptions may have a limited effect on the graphs and data presented.

Smoke habit data is missing for the year 2007 as seen in Figure 24 and Figure 25. There was also a change in methods on how smoke habit data was collected. From 2008 and onwards surveys were done during two year time periods instead of the previous yearly measurements. This can be seen is the graphs as data for 2008 and 2009 are the same in Figure 24 for both years, e.g. they were averaged.

In Figure 25 the ratio of fire fatalities with cause smoking in residential buildings and the number of thousand persons smoking daily are plotted for each age group. Variations for age groups 18-24, 25-44, 45-64 and 65-79 seem to be quite stable. The variations during the period 1999-2004 for age group 80+ is large and there is no evident explanation. It is still clear that there is a correlation between age and the risk of dying in a smoke related fire.



Figure 25 Ratio of smoke related fire fatalities in residential buildings per number of thousand persons smoking daily during 1999-2014, shown per age group.

In order to reduce the number of fires caused by smoking many countries have adopted the use of self-extinguishing cigarettes. In Sweden and EU it came into force in November 2011 that all cigarettes sold in EU should comply with the EN16156 [8] requirements of RIP Reduced Ignition Propensity. No effect of this regulation can however be seen in the statistics yet and the benefit of the requirements have been subject to debate in many countries. The EN 16156 test is conducted on a special filter paper and the requirement is that 75% of them should self-extinguish before they have been consumed if left lying on the paper. In a recent study cigarettes fulfilling this standard were placed in the test apparatus for furniture instead of on the filter paper [9]. The study showed that the cigarette does not self-extinguish in the majority of cases when placed on upholstered furniture and could very well start a fire. The factor that has most influence of whether ignition will occur or not is not the cigarette itself but the material nearby the cigarette [9].

5 Start Item

Another important characteristics of residential and fatal residential fires is the start item of the fire. This is reported in Table 17 and Figure 26. As seen the unknown start item is the most common start item for fatal residential fires followed by bed, furnishing and sofa. For residential fires in general the most common start item is other, stove, chimney and unknown. From Figure 27 it is obvious that fires starting in bed or sofa/armrest chair are the most fatal followed by clothing and flammable liquid.

Start Item	Startföremål	Number of fatalities	Number of fatal residential fires (% of all fatal	Number of residential fires (% of all
TT 1	01 ** 1	452	residential fires)	residential fires)
Unknown	Okand	453	404 (34 %)	10 635 (11%)
Bed	Säng	178	170 (14 %)	1 014 (1%)
Furnishing	Lös inredning	143	134 (11%)	7 969 (8%)
Sofa/armrest	Soffa/fåtölj	117	112 (9%)	854 (0.9%)
chair				
Other	Annat	81	78 (7%)	17 540 (18%)
Stove	Spis	81	72 (6%)	16 654 (17%)
Clothes	Kläder	70	65 (5%)	701 (0.7%)
Flammable	Brandfarlig	39	35 (3%)	650 (0.7%)
liquid	vätska			
Electrical	Elinstallationer	30	27 (2%)	2 825 (3%)
appliances	och elcentral			
Fire place	Eldstad	15	15 (1%)	7 036 (7%)
TV	TV	15	14 (1%)	1 322 (1%)
Chimney	Rökkanal	4	4 (0.3%)	16 470 (17%)

 Table 17
 Start item for fatal residential fires and residential fires in general





Start item for fatal residential fires and residential fires presented as percentage of total number of fatal residential fires and residential fires respectively



Figure 27 Percentage of residential fire per fire cause that results in a fatal residential fire

The percentage of fires with unknown start item shows a similar patterns as the unknown cause during years 1999-2013 with a decrease until 2005 when the percentage of unknown start item starts to increase again as seen in Figure 28.



Figure 28. Percentage of fatal and residential fires with unknown start item.

5.1 Start item unknown – fatal residential fires

The type of dwelling for fatal residential fires with unknown start-item is reported in Table 18, as seen the pattern is similar to the unknown cause, the majority of the unknown start items are in single family houses.

Dwelling type	Number of fatalities in residential fires	Number of fatal residential fires
Single family house	287	253
Apartment building	117	109
Vacation house	35	31
Attached/terraced house	14	11

Table 18Dwelling type for fatal residential fires with unknown start item

Table 19 shows that the most common start room after unknown is the living room. The table also shows that the absolute majority of fatal residential fires with unknown start item involves several rooms when the rescue service arrives at the scene.

Table 19Start room for fatal fires with unknown start item

Start room	Number of fatalities in residential fires	Number of fatal residential fires
Unknown	228	199
Living room	85	72
Bedroom	46	45
Kitchen	45	41
Other	35	33
Hallway	14	14

 Table 20
 Size of fires for fatal fires with unknown start item and unknown start room

Size of fire	Number of fatalities in residential fires	Number of fatal residential fires
Start item only	1	1
One room	3	3
Several rooms	169	149
Several fire cells	23	16
Extinguished	4	3
Unknown, no info	28	27

An indication of what start items might hide in the large portion of unknown can be obtained by studying the distribution of start items for the years 2004-2006, when the portion of unknown start item was low due to that a person employed at MSB phoned the different rescue services to find out possible cause, start item etc, with the years e.g. 2011-2013 as done in Figure 29. The start items Furnishing, flammable liquid, open fire place, Fridge/Freezer, Chimney, Sofa/armrest chair, Bed, TV laundry machine and heating appliance are the start items that are a bit more common during years 2004-2006.





5.2 Start item unknown – residential fires in general

Table 21 shows the dwelling type for fires with unknown start item for residential fires, as seen unknown start item is a bit more common in single family houses than in apartment buildings. The size of the fire when the rescue service arrives to an unknown start item fire is presented in Table 22. One can see that the fires is in many cases rather large involving one or several rooms already when the rescue service arrives. The residential fires with unknown start item usually starts in an unknown room, the living room, the kitchen, bedroom, other or storage as presented in Table 23.

Dwelling type	Number of fires with unknown start item	Total number of fires	Percentage unknown
Single family house	4 951 (50 %)	41 162	12 %
Apartment building	3 139 (31 %)	43 043	7 %
Vacation house	1 601 (16%)	4 531	35 %
Attached/terraced	270 (3%)	2 937	9%
house			

 Table 21
 Portion of fires with unknown start item for residential fires

Table 22Size of fire when rescue service arrives and the end size for residential fires with
unknown start item

Size of fire	Upon arrival	Total size
Only smoke	653	
Start item	1 290	1 607
One room	2 417	2 001
Several rooms	3 992	1 057
Several fire cells	769	4 843
Several buildings		382
Extinguished	771	
Unknown, no info	69	71

Start room	Startutrymme	Number of fires
Unknown	Okänt	3 416
Living room	Vardagsrum	943
Kitchen	Kök	896
Bedroom	Sovrum/sovsal	726
Other	Annat	577
Hallway	Hall, korridor	365
Detached storage space	Fristående förråd/uthus	507
Basement	Källare (ej boyta)	411
Attic	Vind	417
Garbage room	Soprum/sopnedkast	299
Balcony	Balkong/altan and	339
	Balkong/Loftgång	
Heating room	Pannrum	202
Garage	Fristående and Inbyggt	341
	Garage and Radgarage	
Outside	Utanför byggnaden,	189
	utomhus	
Storage space	Förråd	108
Clothes space	Förråd/klädkamamre	116
Stairway	Trapphus/korridor,	151
	trapphus	

 Table 23
 Start room for residential fires with unknown start item

6 Building characteristics

The publicly available data in IDA does not contain much information on different building characteristics. However, data on number of floor and which floor the fire started are recorded by the rescue service in the incident report. Other examples of data that is recorded but not publicly available is the presence of fire compartmentation and number of people left in the fire compartment when the rescue service arrived. In order to do an analysis of these data the project has been granted access to all the data for fires in dwellings stored in MSB databases from the incident reports. In the incident report the rescue services make a note of fatalities and injuries, no update is made of this initial report should a fatality occur at a later stage as in the fatal fire database as described in section 2.2. The analysis conducted here is based on the incident reports and therefore the number of fatalities and fires is somewhat different from the fatal fire database.

In this analysis comparisons are made visually between the two groups "Residential fires with no fatalities / injuries" and "Residential fires with fatalities " for data from 2012 and 2013. The data is also analysed with an analysis of variance (ANOVA) in the SPSS program [10]. The general purpose of an ANOVA analysis is to test for significant differences between mean values between groups [11] in order to see if there are any statistical significant differences (p < 0.05) between the groups.

6.1 Number of floors

Figure 30 shows the number of floors in the building for residential fires with no fatalities / injuries and residential fires with fatalities. The ground floor is "1", the first floor is "2" and so forth.

It is not possible to make out any difference between the two groups in Figure 31 and according to the ANOVA analysis there is no statistically significant difference between the two groups. Thus, it appears that this building parameter is not a contributing reason to that people die in fires.



Figure 30 Comparison of the number of floors in fires with no fatalities or injuries and fires with fatalities in residential buildings.

The number of floors in a residential building depends on the type of dwelling. The two major groups of dwellings, apartment buildings and single-family houses (Table 2) are studied separately in Figure 31 and Figure 32. The differences between the two groups are small for both apartment building fires and single-family house fires, and no trends can be spotted.



Figure 31 Comparison of the number of floors in fires with no fatalities or injuries and fires with fatalities in apartment buildings.



Figure 32 Comparison of the number of floors in fires with no fatalities or injuries and fires with fatalities in single family houses.

6.2 Fire Compartmentation

There are some differences in between the two groups in regard to the presence of fire compartmentation as presented in Figure 33. There are no indications that fire compartmentation plays any large role in fire fatalities, because no significant difference between the "Fires with fatalities" and "Fires with no fatalities / injuries" have been

noticed. (see Figure 33) It is often unknown whether any fire compartmentation existed in the more extensive fires and there is a significant difference between the "fires in several rooms / fire compartments" compared to less extensive fires (see Figure 34). This makes sense because a fire compartment would probably limit the damage if it existed. It is also notable that the building type "Single-family house" is overrepresented among the most extensive fires (see Figure 35) and it is probably due to the fact that fire compartments seldom exists in this type of building.







Figure 34 Presence of fire compartmentation in fires with no fatalities or injuries and fires with fatalities in residential buildings.



Figure 35 Size of fires when the rescue service arrived for different types of dwellings.

6.3 Floor where fire started

Figure 36 shows the fire start floor for residential fires with no fatalities / injuries and residential fires with fatalities. The ground floor is "1", the first floor is "2" and so forth.

It might be visually hard to determine if there is any significant difference between the two groups "Fires with fatalities" and "Fires with no fatalities / injuries" when it comes to the floor where the fires started as presented in Figure 36. However, according to the ANOVA analysis there is a significant difference between the two groups. The main differences seams to lie in that more fires with no fatalities or injuries occurs in basement levels where no apartments normally exists



Figure 36 Comparison of the floor of fire origin in fires with no fatalities or injuries and fires with fatalities in residential buildings.

Since the number of floors depends on type of dwelling (section 6.1) is it also relevant to study the floor or fire origin in regard to dwelling type. The differences between the groups for apartment fires are small, but Figure 37 illustrates that deadly fires have a tendency to start higher up in the building compared to fires with no fatalities or injuries. When it comes to single-family houses it can be noted that the first floor is more common to be the floor of fire origin amongst the fatal fires. These differences are relatively small however.



Figure 37 Comparison of the floor of fire origin in fires with no fatalities or injuries and fires with fatalities in apartment buildings.



Figure 38 Comparison of the floor of fire origin in fires with no fatalities or injuries and fires with fatalities in single family houses.

6.4 Number of people left

Based on Figure 39 it is evident that there is a difference between the two groups "Fires with fatalities" and "Fires with no fatalities / injuries" when it comes to number of people left in the fire compartment when the rescue service arrived. These differences are

statistically significant. It is more common that none and two or more people are left in the building for the category "Fires with no fatalities/ injuries", while one person more commonly remain in the building in the "Fires with fatalities" category.



Figure 39 Comparison of the number of people left when the rescue service arrived in fires with no fatalities or injuries and fires with fatalities in residential buildings.

7 Conclusions and continued studies

This report is based on publicly available data from MSB on residential fires and fatal residential fires together with public statistics from Statistics Sweden on smoking habitats and number of people living in different types of dwellings and some non-public data obtained from MSB concerning number of floors in the building, the floor the fire started on, fire compartmentation and number of people left in the building. Both the publicly available data from MSB and the non-public data is collected by MSB through the incident reporting system together with the special reporting on fatal fires. The number of "Unknowns" is high in the data, both in terms of cause, start item and starting room. However, still it is possible to identify some characteristics when comparing fatal residential fires with residential fires:

- Slightly more than 1% of the residential fires result in at least one fatality
- A fatal residential fire is often large when the rescue service arrives at the scene
- Fatal residential fires occur more commonly in the late night/early morning
- Usually only one person is present in the fire compartment when the rescue service arrives to a fatal residential fire
- There is only marginal differences regarding the presence of smoke detectors in residential fires and fatal residential fires.
- Both fatal residential fires and residential fires are less common in and around larger cities
- Fires starting in beds, sofas, armrest chairs or clothing results more often in fatalities than other start items while fires starting on the stove, in the fire place or the chimney seldom results in fatalities compared to the number of these fires.
- Fires starting in the living room or bedroom result more often in fatalities than fires starting in other rooms.
- Smoking is a common cause in fatal residential fires while lightning, forgotten stove, chimney fire, technical malfunction and re-ignition seldom results in fatalities compared to the number of this type of fires.
- The likelihood of dying in a residential fire might be somewhat higher for a person living in an apartment than for a person living in a single family house. However the differences are small and given the uncertainties in the number of people living in different types of dwellings it might be that there is no difference.
- The number of floors in a building does not seem to differ between fatal and non-fatal fires.
- The fire start floor in an apartment building seems to be slightly higher in fatal fires than in non-fatal fires.

The statistics used in the study have uncertainties in that there are differences in the way different rescue services report their data and define different types of fires and start items/causes. As a comparison between residential and fatal residential fires is done throughout this report it is assumed that these differences have a smaller impact on the results. The statistics from Statistics Sweden also include uncertainties for number of people living in different types of buildings and number of smokers. This might have an impact especially on the comparison of likelihood of fatalities in apartment buildings and single family houses.

About 90 person die every year in or after a residential fire. In order to base the analysis on as much data as possible the whole time period 1999-2013 was used for the analysis. The number of unknown causes and unknown start items is very high, unknown is in fact the most common cause or start item. If the actual distribution of start items and cause in the category unknown would be unevenly distributed compared to known items and cause, then the results would change dramatically. As the portion of unknowns has varied over the time period studied, with a much smaller portion during the years 2003-2006 when a person called up the different recue services that had reported fatal fires with unknown causes or start item, these years were also studied in comparison with the other years. This comparison gave that Smoking and Forgotten stove probably are among the causes that would increase most if the number of unknown cause is smaller and the start items Furnishing, Flammable liquid, Sofa/armrest chair, Stove, Bed and TV are among the start items that would increase. The number of TV fires was however larger also before 2004 and the decrease in TV fires during 2011-2013 can be due to the flat screen TVs used today instead of the old type of TVs which contained more mass and where a candles could be placed on the TV.

The study showed that in the majority of cases where fatalities had occurred the fire was large already when the rescue service arrived at the site, which means that the initial fire had to have been large enough to give a spread of the fire and not self-extinguish. In many of these cases the start item and/or cause or start room are categorized as unknown. Unknown start item or cause is more common in Single family houses.

In case the fire is smaller, like in the start item only, smoke only or extinguished, it is possible to find out more about the fire by studying the start room, start item or cause in some cases. Studying the fatal residential fires with unknown cause one find that they started in Furnishing, Other, Sofa/armrest chair, Bed, Clothing and TV. The most common start room for fatal residential fires with unknown start item is the living room.

The next step in this project is to continue with further analyses of the public and proprietary data to determine if differences in building and dwelling characteristics can be identified that can answer questions like why fatal residential fires are large upon rescue service arrival or if there are any organisational factors such as rescue services response time. Differences between single family houses and apartment buildings will be investigated together with differences between municipalities and municipality types. Also the impact of interiors like furniture will be investigated.

8 References

- Jonsson, A., Nilsson, F., Runefors, M., Särdqvist, S:, "Fire-Related Mortality in Sweeden: Temporal Trends 1952 to 2013. Fire Technology 2015. DOI: 10.1007/s10694-015-0551-5
- 2 Van Hees, P., Johansson, N., Bränder i boendemiljö En förstudie från BRANDFORSK, LTH, Report 3146, Lund 2010.
- 3 IDA accessible at ida.msb.se
- 4 Nilsson, F. Bonander C, Jonsson A, "Differences in Determinants Amongst Individuals Reporting Residential Fires in Sweden: Results from a Cross-Sectional Study", Fire Technology Vol 51:3, 2015
- 5 Jonsson A., Bergqvist A., Andersson R. "Assessing the number of fire fatalities in a defined population", Journal of Safety Research, Vol 55 December 2015, pp 99-103
- 6 Bostads-och byggnadsstatistisk årsbok 2012, Statistiska centralbyrån 2012, Yearbook of housing and building statics 2012, http://www.scb.se/statistik/ publikationer/BO0801_2012A01_BR_BO01BR1201.pdf
- 7 <u>http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/?rxid=6e2e9f3b-c078-4f81-adc7-cc0a10940419</u>
- 8 EN16156:2010 Cigarettes Assessment of the ignition propensity
- 9 Larsson, I., Bergstrand, A., "Studie: självslocknande cigaretter teori och verklighet", SP Arbetsrapport 2015:4P02859 på uppdrag åt MSB, 2015 (to be published)
- 10 IBM SPSS Software accessible at: http://www-01.ibm.com/software/analytics/spss/ [downloaded 2015-09-29]
- 11 StatSoft, Inc. Electronic Statistics Textbook, 2013. accessible at http://www.statsoft.com/textbook/ [downloaded 2016-03-18]

Appendix 1 Incident report

The reporting sheet for fire in a building is shown below. All terms are in Swedish but the sheet is provided here in order to give an indication of how the data is gathered. The rescue service make crossmarks for the different selections. In some cases only one cross should be made, in some it is allowed to make several.

	st			Eget larmnr	
		Brand i I	byggnad sid 1 (2	2)	
1 Startutrymme	B Skorsten	Badrum/toa	lett 🔲 Kållare (ej bo	Minst yta) D Personalutrymme	ett alternativ markeras
Eristående	Pannrum	Bastu	Balkong/altar	Kontor	Cistern
Förskd/	Fläkt-/luftbehan	d 🔲 Vardagsrum	Lofiging	Datacentral	Silo Silo
Fristliende	Soprum/	Sovrum/sov	sal Eldriftrum	Lastbrygga	
garage Inbyggt garage	Trapphus	Hall	Produktionski	kal 🗆 Lager	
Radgarage	Korridor	Verkstad	Försäljningsk	okal 🗆 Upplag	
🗆 кок	Tvättstuga	Vind	Samlingsloka	al Djurstall	Okänt
Annat Precise	Ya				
Bedömningen är	🗖 trolig	mycket trolig	g 🛛 säkerställd	Ett alt	ernativ markeras
Totalt antal våningar ova	an mark	Startvåring	Startrummet	låg i en överbyggd gård/ga	lleria
2 Startföremål				Minut	ell alternativ markeras
Byggnadens	Gardiner	Diskmaskin	Dator	Transformator	Ovriga
Bökkanal	Eldstad	Kaffebrygga	re 🛛 Stereo/video/	DVD Andra elinst.	Expl. ämne/
Sing	Uppvårmnings-	Spis	Strykjärn	Fläkt/annan	Brandtarlig
Soffartátólj	Bastuaggregat	Ky01rys	Giödlampa	Skråp i con-	Brandfarlig gas
Annan lös	Torktumlare	Tvättmaskin	Lysrörsarmati	ar Maskin	Splarfordon
Klåder	☐ Torkskåp	П ти	Elcentral	Personbil	Okänt
Papper/kartong	Annat Pre	cisera			
Bedömningen är	trolig	mycket troi	ig 🛛 säkerställd	<u>EII</u> alte	ernativ markeras
Bedömningen är Fabrikat.	trolig	mycket troi	ig 🛛 säkerställd	Ett alte	ernativ markeras
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Bedömningen är Fabrikat. 3 Direkt brando Anlagd med uppsåt	Drsak Ett alter	mycket troit	ig säkerställd nodell Vid brandorsak so Bränsle Ved Olas	Ett alle Serienummer bfeld eller startföremd Ett alter Eldstadstyp Rk Värmepanna Lokaleidstad	amativ markeras Al <i>eldstad/rökkanal</i> nativ av varje markeras Skkanaltyp Tegel Spance
Bedömningen är Fabrikat. 3 Direkt brando Anlagd med uppsål Barns lek med eld Rökning	Trolig Troli	mycket troi mycket troi Typ/m mativ markeras evande ijus leta arbeten	ig säkerställd nodell Vid brandorsak so Bränsle Ved Olja Pellets	Ett alk Serienummer stelde eller startföremå Ett alke Etdstadstyp Rk Uärmepanna C Lokaleidstad (pppen spin, Lakek m.n.)	ernativ markeras bi eldstad/rökkanal nativ av varje markeras šikkanalityp] Tegel] Stainör] Annan
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Bedömningen är Fabrikat. 3 Direkt brando Anlagd med uppsåt Barns lek med eld Rökning Tekniskt fel		evande ijus ieta arbeten iarmeöverföring	ig säkerställd nodell Vid brandorsak so Bränste Ved Olja Pellets Annat	Ett alte Serierummer Steld eller startföremd Ett alter Etdstadstyp Rk Utamepanna Lokaleidstad (oppen som, Landa m.m.)	arnativ markeras Al <i>eldstad/rökkanal</i> nativ av varjo markaras Sikkanaltyp J Tegel J Stairör J Annan
Bedömningen är Fabrikat. 3 Direkt brando Anlagd med oppsåt Barns lek med eld [Rökning [Tekniskt fel [Gotto]		evando ijus leta arbeten lixtnedslag	ig säkerställd nodell Vid brandorsak so Bränsle Vid brandorsak so Bränsle Vid brandorsak so Bränsle Olja Olja Pellets Annat	Ett alte edgivit att fastighets:	ernativ markeras Al <i>eldstad/rökkanal</i> nativ av varje markeras Skkanaltyp I Tegel I Stairer I Annan Annan Trativ markeras ägaren själv utför/
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Räddningstjänst	Eget larmnr			
Brand i byggnad sid 2 ((2)			
5 Utrustning avsedd för annan än räddningstjänsten Upps	skattat antal personer i brandcellen			
Fanns Användes Fungerade ja nej vet ej ja nej vet ej Brandvarnare DDD vid bra	andens början			
Handbrandsläckare	ddningstjänstens ankomst			
Inomhusbrandpost/	iv hur utrymningen gick till i Huvuddelen block 10			
Annan				
6 Brandteknisk utrustning Automatlarm	Anläggning/enhet			
Funge- Begrän- Fanns Användes rade sade Släckte				
ja nej ver ej ja nej ja nej ja nej ja nej ja nej Sektion centralappa	arat Sektion undercentral Detektor nr			
Automatiskt	som larmade Minst ett alternativ markeras			
släcksystem	Flamdetektor Annat släcksystem			
Autom. brand-	or Combinations- Larmtryckknapp detektor			
	tor Vattensprinkler Gasutsläpps- detektor			
släcksystem	kabel/ Dkänd			
	Precisera			
Brandcells- gränserna Larmlagring tilläm	Ett alternativ av varje markeras npades Larmorganisationen fungerade tillfredsställande			
* Om nej, beskriv varför i Huvuddelen block 10 ja ne	ej 🗖 ja 🗖 nej			
7 Räddningstjänstens åtgärder	Minst ett alternativ markeras			
Dörrforcering Lodning av rökkanal Inträngning fra	ån högfordon, antal man h min			
Invändig släckning Skydd av närliggande objekt Rökdykning (livräddning) Antal mantimmar				
Släckning från marken	egendomsskydd) Antal mantimmar			
Släckning från högfordon Avstängning av gas/el Värmekamera/IR-teknik användes vid rökdykning (livräddn/släckn)				
Annan Inspektion med värmekamera/IR-teknik i övrigt				
	🗖 Inga åtgärder			
Livräddning Minst en markering Antal Brandgasventil OBSI Ei rvr-åtgårdet	ation för att förhindra brandspridning			
Rökdykning, räddningsmask användes	utrymnings- brand- hotade			
Rökdykning, räddningsmask användes ej Befintlig lucka/fönste	er/fläkt			
Undsatta via hogtordon/stege				
Räddningstjänstens	fläktar			
Ingen livräddning förekom	Ingen brandgasventilation utfördes			
8 Släckmedel/släckmetod Minst en markering				
Vatten från Släckbil Brandpost Tankbil Branddamm Övrigt öppet vatten Uppskattad förbrukad				
mängd vatten (m ³)				
Skum (ej nandbrandslackare) Ange använt skumkoncentrat, mångd och expansion	nsgrad n □ Lätt			
□ Övr skumvätskor: I Expansionsgrad □ Tung □ Mellar	n 🗆 Lätt			
Handbrandsläckare Ange antalet använda Vatten CO ₂				
Andra släckmetoder Dimspik Skårsläckare Kvävning Lämpning Annan Precisera				

Appendix 2 Terminology used for the incident report sheet and in this report

Start item

The explanation given for the term "Startföremål" to the rescue service is "Item that can be considered to be crucial for the fire occurrence". The term "startföremål" has thus been translated directly into Start item instead of the term "item first ignited" as used in some countries. Item first ignited can in many cases be different from start item as for tumble dryers where perhaps it is the clothing within the dryer that is the item first ignited.

The 41 possible start items in the residential fire reporting are listed in Table 24. More than one alternative can be chosen. Figure 40 shows how the start item reporting section looks like for the residential fires as seen the different start items do not seem to be in an specific order. The fatal residential fire database contains 32 different start items as listed in Table 25.

Swedish term	Translation used in this	Comment in education
	report	material
Andra elinstallationer	Electrical appliances	
Annan lös inredning	Furnishing	
Annat	Other	
Bastuaggregat	Heating source for sauna	
Brandfarlig gas	Flammable gas	
Brandfarlig vätska	Flammable liquid	
Byggnadens utsida	Outside	
Dator	Computer	
Diskmaskin	Dishwasher	
Elcentral	Electrical box (Electrical	Connection appliance
	appliances)	intended for distribution of
		electrical energy
Eldstad	Open fire place	
Expl. Ämne/Sprängämne	Explosive	
Fläkt/annan vent. anläggning	Fan/ventilation	
Gardiner	Curtains	
Glödlampa	Light bulb	
Kaffebryggare	Coffee machine	
Kläder	Clothing	
Kyl/frys	Fridge/Freezer	
Lysrör	Florescent lamp	
Lysrörsarmatur	Florescent lamp	
Lös inredning	Furnishing	
Maskin	Machine	
Okänt	Unknown	
Papper/kartong	Paper	
Personbil	Car	
Rökkanal	Chimney	
Skräp i container/mots	Garbage in container or	
	similar	
Soffa/fåtölj	Sofa/armrest chair	

Table 24. Start Items in the residential fires database

Swedish term	Translation used in this	Comment in education
	report	material
Spis	Stove	
Spårfordon	Rail vehicle	
Stereo/Video	Stereo/Video player	
Stereo/video/DVD	Stereo/Video	
	player/DVD player	
Strykjärn	Iron	
Säng	Bed	
Torkskåp	Drying cabinet	
Torktumlare	Tumble dryer	
Transformator	Transformer	
TV	TV	
Tvättmaskin	Laundry machine	
Uppvärmningsanordning	Heating equipment	
Övriga vägfordon	Other road vehicle	

2 Startföremål				Minst ett alterna	tiv markeras
Byggnadens	Gardiner	🗆 Diskmaskin	Dator	Transformator	Ovriga vädfördon
Rökkanal	Eldstad	□ Kaffebryggare	Stereo/video/DVD	Andra elinst.	Expl. ämne/
□ Sāng	Uppvärmnings-	🗆 Spis	Strykjärn	Fläkt/annan vent, anläggning	Brandfarlig
Soffa/fåtölj	Bastuaggregat	□ Kyl/Trys	Glödlampa	Skrap i con-	Brandfarlig gas
Annan lös	Torktumlare	Tvättmaskin	Lysrörsarmatur	Maskin	Spärfordon
☐ KJäder	Torkskåp	TV 🗆	Elcentral	Personbil	Okänt
Papper/kartong	Annat Pre	cisera			
Bedömningen är	trolig	mycket trolig	säkerställd	<u>Ett</u> alt	ernativ markeras
Fabrikat.		Typ/modell		Serienummer	

Figure 40. The start item section in the fire reporting system. The different start items do not seem to appear in any specific order

Table 25. Possible start items in fatal residential fire database

Swedish term	Translation used in this
	report
Andra elinstallationer	Electrical appliances
Annan lös inredning	Furnishing
Annat	Other
Bastuaggregat	Heating source for sauna
Brandfarlig gas	Flammable gas
Brandfarlig vätska	Flammable liquid
Byggnadens utsida	Outside
Dator	Computer
Elcentral	Electrical appliances
Eldstad	Open fire place
Explosivt Ämne	Explosive
Fläkt/vent. anläggning	Fan/ventilation
Gardiner	Curtains
Glödlampa	Light bulb
Kaffebryggare	Coffee machine
Kläder	Clothing

Swedish term	Translation used in this	
	report	
Kyl/frys	Fridge/Freezer	
Lös inredning	Furnishing	
Okänd	Unknown	
Papper/kartong	Paper	
Personbil	Car	
Rökkanal	Chimney	
Skräp i container	Garbage in container	
Soffa/fåtölj	Sofa/armrest chair	
Spis	Stove	
Stereo/Video	Stereo/Video player	
Säng	Bed	
Torktumlare	Tumble dryer	
Transformator	Transformer	
TV	TV	
Tvättmaskin	Laundry machine	
Uppvärmningsanordning	Heating equipment	

Start room

No guidance is given on what is meant by the term "startutrymme" (direct translation starting place) in the education material. The possible selections are listed in the table below. More than one alternative can be chosen. Many of the options are not really a room, but as this study focuses on residential fires the term start room has been chosen.

Swedish term	Translation used in this	Comment in education
	report (collection term	material
	used)	
Annat	Other	
Badrum/toalett	Bathroom/Toilet	
	(Bathroom)	
Badrum/toalett/bastu	Bathroom/Toilet/Sauna	
	(Bathroom)	
Balkong/altan	Balcony/terrace (Balcony)	
Balkong/loftgång	Balcony/Access balcony	
	(Balcony)	
Bastu	Sauna	
Cistern	Tank	
Datacentral	Computer room	
Djurstall	Animal shed	
Elcentral	Electrical box	
Eldriftrum	Electric power room	
Fläkt/luftbehandlingsrum	Fan/air treatment room	
	(Ventilation)	
Fristående förråd/uthus	Detached storage house	
	(Storage)	
Fristående garage	Detached garage (Garage)	
Storage	Storage	
Förråd/klädkammare	Storage/clothing storage	
	(Storage)	

Table 26 Start Rooms in the residential fire and fatal residential fire's database

Swedish term	Translation used in this	Comment in education	
	report (collection term	material	
	used)		
Försäljningslokal	Sales local		
Hall	Hallway		
Höupplag/loge/lada	Haystorage/Barn		
Inbyggt garage	Built-in garage (Garage)		
Kontor	Office		
Korridor	Corridor (Hallway)		
Källare (ej boyta)	Basement		
Kök	Kitchen		
Lager	Storage		
Lastbrygga	Dock leveler		
Loftgång	Access balcony		
Luftbehandlingsutrymme	Air treatment room		
	(Ventilation)		
Okänt	Unknown		
Pannrum	Heating room		
Personalutrymme	Staff room		
Produktionslokal	Production facility		
Radgarage	Row of garages (Garage)		
Samlingslokal	Assembly hall		
Silo	Silo		
Skorsten	Chimney		
Soprum/sopnedkast	Garbage room		
Sovrum/Sovsal	Bedroom		
Trapphus	Stairway		
Trapphus/korridor	Stairway		
Tvättstuga	Laundry room		
Upplag	Storage		
Utanför byggnaden	Outside building (Outside)		
Utomhus	Outdoors (Outside)		
Vardagsrum	Living room		
Verkstad	Workshop		
Verkstad/hobbyrum	Workshop		
Vind	Attic		

Brand i byggnad sid 1 (2)						
1 Startutrymme	_	_	_		Minst ett alternativ markeras	
Utanför byggnaden	Skorsten	Badrum/toalett	Källare (ej boyta)		Personalutrymme Höupplag/k	oge/
Fristående förråd/uthus	Pannrum	🗖 Bastu	Balkong/altan		Kontor Cistern	
Förråd/ klädkammare	Fläkt-/luftbehand	I 🔲 Vardagsrum	Loftgång		Datacentral Silo	
Fristående garage	Soprum/ sopnedkast	Sovrum/sovsal	Eldriftrum		Lastbrygga	
Inbyggt garage	Trapphus	Hall	Produktionslokal		Lager	
Radgarage	C Korridor	Verkstad	Försäljningslokal		Upplag	
🗆 Kök	🗆 Tvättstuga	□ Vind	Samlingslokal		Djurstall 🛛 Okänt	
Annat Precisera						
Bedömningen är	□ trolig	mycket trolig	säkerställd		Ett alternativ markeras	
Totalt antal väningar ovan	mark	Startvåning	Startrummet låg i	en ö	werbyggd gård/galleria	

Figure 41. Start room in in the fire reporting system.

Smoke detector

For smoke detector the guidance is given that it is a smoke detector mounted on a place where it ought to have been activated by the fire.

Cause of fire

For cause of fire one can choose between 19 different options as provided in the table below. Only one options should be chosen. The following guidance is given: Why did the fire occur?

Swedish term	English	Comment in educational material
	translation	
Anlagd med uppsåt	Deliberately lit	Fire started with the intention to harm people,
		property or environment
Annan	Other	
Barns lek med eld	Child playing	Fire due to child playing or experimenting with
	with fire	fire. The suspect assumed to be younger than 15
		years
Blixtnedslag	Lightning	
Explosion	Explosion	
Friktion	Friction	Friction producing more heat than is cooled
		away. Heat increases until ignition occurs
Fyrverkeri	Fireworks	
Glömd spis	Forgotten	Heat from forgotten stove that causes a fire like
	stove	dryout
Gnistor	Sparks	
Hantverkare		
Heta arbeten	Hot works	Welding, cutting or other work that produices
		heat, spraks or smoke
Levande ljus	Lit candle	
Okänd	Unknown	
Rökning	Smoking	
Självantändning	Self-heating	Chemical, physical or biological process that
		produces more heat than is cooled away. Heat
		increases until ignition occurs
Soteld	Chimney fire	Combustion process starting in soot in chimney
Tekniskt fel	Technical	
	malfunction	
Värmeöverföring	Heat transfer	
Återantändning	Re-ignition	

Table 27. Cause of fire in the fire reporting system

3 Direkt brand	lorsak	<u>Ett</u> alternativ markeras	
Barns lek med eld	Fyrverkerier	Levande ljus	
🗖 Rökning	🗖 Glömd spis	Heta arbeten	
Tekniskt fel		☐ Värmeöverföring	
☐ SoteId	Gnistor	Blixtnedslag	
□ Självantändning	☐ Friktion	Aterantändning	
🗆 Annan 🛛 Precisera	a	🛛 Okänd	
<u>Ett</u> alternativ markeras Bedömningen är □trolig □mycket trolig □säkerställd			

Figure 42 Cause of fire in frie reporting system

In the fatal fires database only 16 different options are available as listed in the table below.

Swedish term	English translation
Anlagd med uppsåt	Deliberately lit
Annan	Other
Barns lek med eld	Child playing with fire
Blixtnedslag	Lightning
Explosion	Explosion
Glömd spis	Forgotten stove
Gnistor	Sparks
Levande ljus	Lit candle
Okänd	Unknown
Orsak ej angiven	Cause not given
Rökning	Smoking
Soteld	Chimney fire
Tekniskt fel	Technical malfunction
Uppgift saknas	No information given
Värmeöverföring	Heat transfer
Återantändning	Re-ignition

Table 28. Cause of fire in fatal fires reporting system

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