



RESEARCH



Home Structure Fires

Marty Ahrens
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Key findings

People feel safe when they are at home, yet more than one-quarter (27 percent) of reported fires occurred in home environments during 2013–2017. Even worse, four of every five (79 percent) fire deaths and three-quarters (73 percent) of all reported fire injuriesⁱ were caused by homeⁱⁱ structure fires.

During this five-year period, US fire departments responded to an estimated average of 354,400 home structure fires per year. These fires caused an annual average of 2,620 civilian deaths; 11,220 civilian fire injuries; and \$6.9 billion in direct property damage.

Sixty-nine percent of reported home fires in 2013–2017 were in one- or two-family homes, including manufactured homes. These fires caused 85 percent of home fire deaths, 65 percent of home fire injuries, and 79 percent of the direct property damage from home fires.

Certain scenarios appear more dangerous than in the past. The death rate per 1,000 reported home fires in 2013–2017 was more than twice as high in fires that began with the ignition of either upholstered furniture or mattresses and bedding as it was in 1980–1984.

Most home fires and fire casualties result from five causes: cooking, heating, electrical distribution and lighting equipment,ⁱⁱⁱ intentional fire setting, and smoking materials. Over the five-year period of 2013–2017 as a whole, cooking was the leading cause of home fires and home fire injuries, while smoking was the leading cause of home fire deaths.

While reported home fires and home fire deaths have been cut roughly in half since 1980, and population-based home fire and fire death rates have fallen by roughly two-thirds, the death rate per 1,000 reported home fires has remained fairly consistent, and was slightly higher in most recent years than it was in 1980. This was driven by an even more pronounced increase in the death rate in one- or two-family home fires. It appears that most of the reduction in fire deaths over the past decades has been due to a reduction in fires rather than the prevention of harm after a fire is reported.

ⁱ Death and injury estimates exclude firefighter casualties.

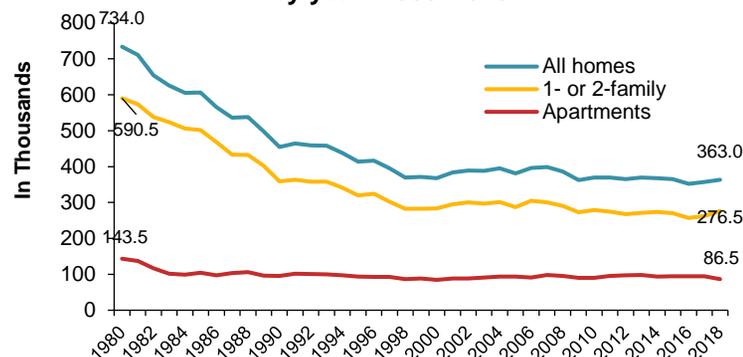
ⁱⁱ The term *home* includes one- or two-family homes, manufactured homes, and apartments or other multifamily housing, regardless of ownership.

Trends in reported fires

Figure 1 shows that estimates of reported home fires and home fire deaths in 2018 were roughly half as high as in 1980. Results from the NFPA Fire Experience Survey (FES) are provided annually in the NFPA [Fire Loss in the United States](#) series of reports. Reported home fires fell 51 percent, from 734,000 in 1980 to 363,000 in 2018.¹ The decline was sharpest during the 1980s and continued more slowly in the 1990s, before essentially plateauing in the past two decades.

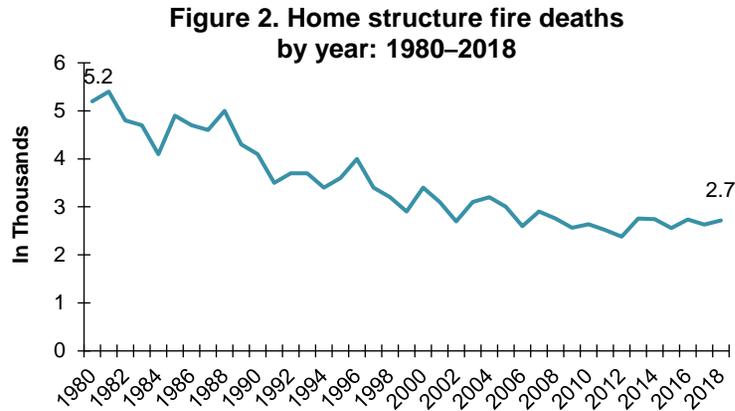
Reported fires in one- or two-family homes fell 53 percent from 1980 to 2018, while fires in apartments or other multifamily homes fell 40 percent. From 2017 to 2018, total reported home fires rose 2 percent.

Figure 1. Reported home structure fires by year: 1980–2018

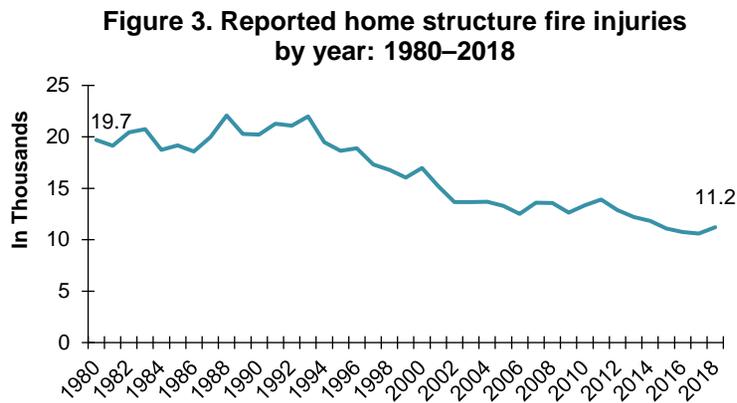


ⁱⁱⁱ Electrical distribution and lighting equipment include installed wiring, outlets, switches, cords, plugs, power supplies, and lighting.

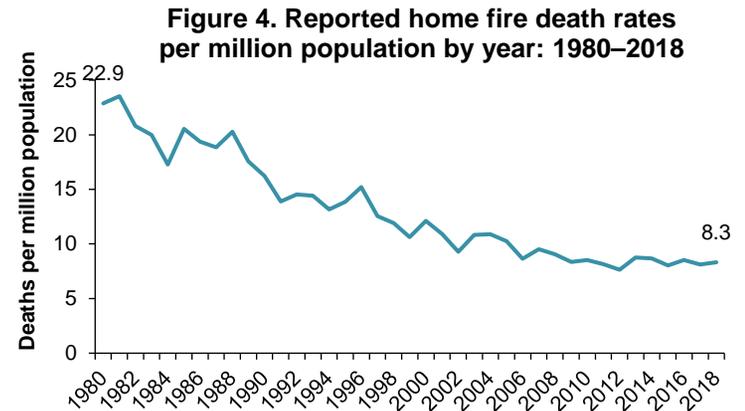
The 2018 home fire death toll of 2,720 was 48 percent lower than the 5,200 such deaths in 1980. See Figure 2.



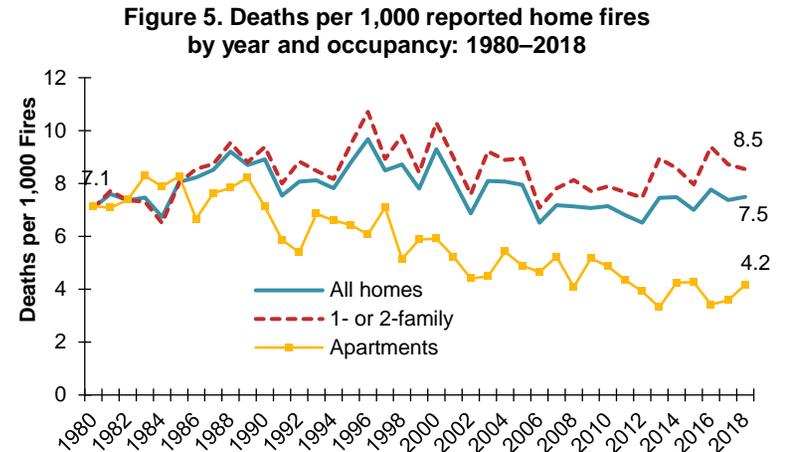
The estimate of reported home fire injuries in 2018 was 43 percent lower than the 1980 estimate. See Figure 3.



Population-based home fire and fire death rates in 2018 were roughly one-third as high as in 1980. The rate of reported home fires per thousand in population fell from 3.2 in 1980 to 1.1 in 2018. The home fire death rate fell from 22.9 per million in population to 8.3 over the same period. See Figure 4.



We have been fairly successful reducing both the number of fires and fire deaths. However, we have not solved the problem of preventing death in reported fires. In 2018, the death rate per 1,000 fires was 7.5, or 6 percent higher than the 7.1 rate in 1980. Rates were generally higher from 1985 through 2005. The peak, in 1996, was 9.7 deaths per 1,000 fires. Overall, this line is much flatter than the other trend lines. See Figure 5.



For one- or two-family homes, the death rate per 1,000 reported fires was 21 percent higher in 2018 than in 1980. For apartments, the rate was 41 percent lower in 2018. More code requirements regulate apartments than one- or two-family homes. Apartment buildings are more likely to have monitored smoke detection systems that notify the fire department when activated. This could result in more minor fires reported in apartment properties. In 2013–2017, 62 percent of reported apartment fires had incident types indicating a cooking fire that was confined to the pan or vessel of origin. This was true of only 26 percent of one- or two-family home fires. Many confined cooking fires are already extinguished by the time the fire department arrives. Apartments are also more likely to have sprinklers than are one- or two-family homes.

About the data

The trends discussed above are based on summary data collected by the NFPA fire department experience survey. Survey results are combined with the more detailed, incident-based National Fire Incident Reporting System (NFIRS) data to provide a deeper understanding of the causes and circumstances of these fires. The most current NFIRS national dataset is for 2017. Estimates are typically presented as national averages. Unknown data were allocated proportionally.

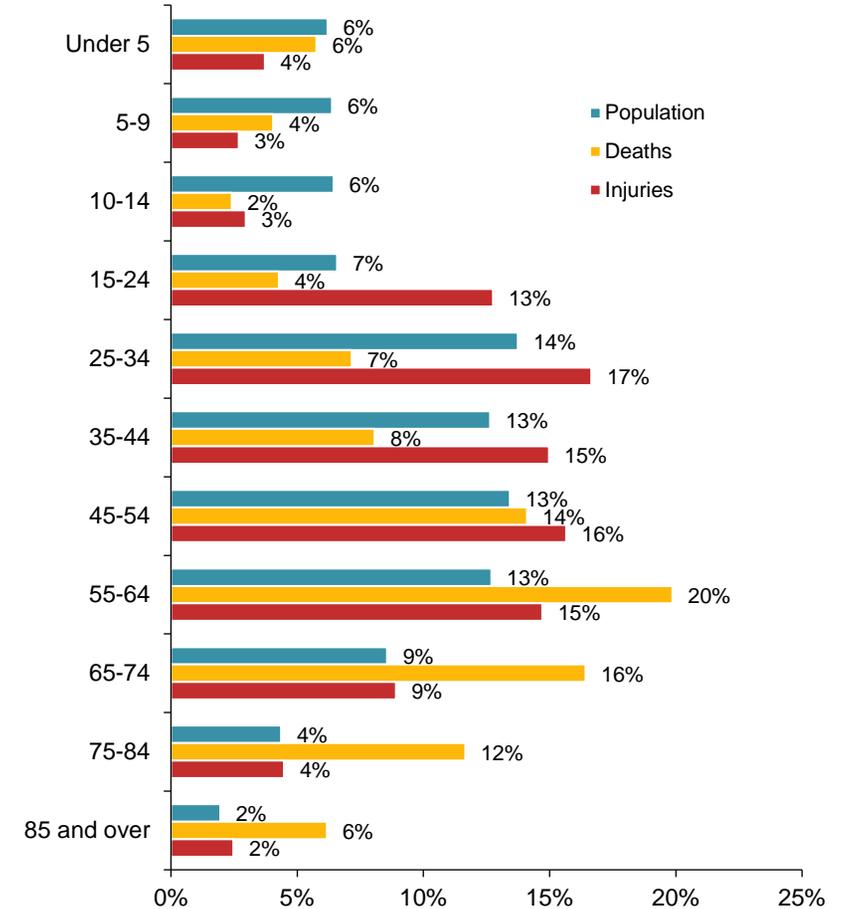
Who are the victims?

Of the people who died in home fires, 56 percent were male, as were 54 percent of those non-fatally injured.

Gilbert and Butry determined that population “frailty,” defined by age- and gender-adjusted natural cause mortality rates, can identify populations vulnerable to fire death but not those vulnerable to non-fatal injuries.² Figure 6 shows that more than half (54 percent) of the fatal home fire victims were 55 and over, and one-third (34 percent) were at least 65 years old. One of every five fatal home fire victims was between 55 and 64 years of age.

More than two-thirds (69 percent) of the people who were non-fatally injured were between 35 and 64 years of age.

Figure 6. Home fire deaths and injuries by age group: 2013–2017



The NFPA 2018 report, [Home Fire Victims by Age and Gender](#), provides more details about the age and gender of casualties by leading cause of fires reported in 2011–2015.

When are home fires most common?

Not surprisingly, home structure fires are more common in cooler months when people spend more time inside and in the hours when people are awake in the home. In 2013–2017, 47 percent of home structure fires and 56 percent of home structure fire deaths occurred in the five month span of November through March. Reported home fires peaked from 5:00 to 8:00 p.m., when many people are coming home from work, are preparing dinner, or are engaged in other household activities. While just one-fifth (19 percent) of reported home fires occurred between 11:00 p.m. and 7:00 a.m., half (52 percent) of the home fire deaths resulted from fires reported during these hours when people are normally asleep and not as quick to discover or respond to a fire. One-third (32 percent) of the people who were fatally injured in home fires during 2011–2015 were asleep at the time.³ People may be sleeping at any hour.

Leading causes of home fires

The ranking of fire causes varies from year to year. The rankings here are based on the annual average percentage of fires and losses in 2013–2017. The likely severity of a reported fire can be measured in deaths or injuries per 1,000 fires and average property loss per fire. Note that the causes were pulled from several data elements in NFIRS, so double counting is possible.

Figure 7 shows that cooking was the leading cause of reported home structure fires and civilian fire injuries and the second leading cause of fire deaths. Cooking activities caused an average of 173,200 home fires per year. These fires caused an annual average of 550 civilian deaths; 5,020 civilian injuries; and \$1.2 billion in property damage. Cooking was the leading cause of fires in both one- or two-family homes and apartments or other multifamily homes, but caused a much larger share of fires in the latter (72 percent) than in one- or two-family homes (38 percent). While cooking was the leading cause of fires and fire injuries, it ranked lower on the casualties (3 deaths and 29 injuries) per 1,000 reported fires and last among the major causes in average loss per reported fire (\$6,700). See the NFPA report, [Home Fires Involving Cooking Equipment](#), for more details about how cooking fires start.

Cooking is also the leading cause of *unreported* fires. In a survey of unreported residential fires in 2004–2005, the Consumer Product Safety Commission (CPSC) found that US households had 50 cooking equipment fires they did not report for every such incident reported to the fire department.⁴

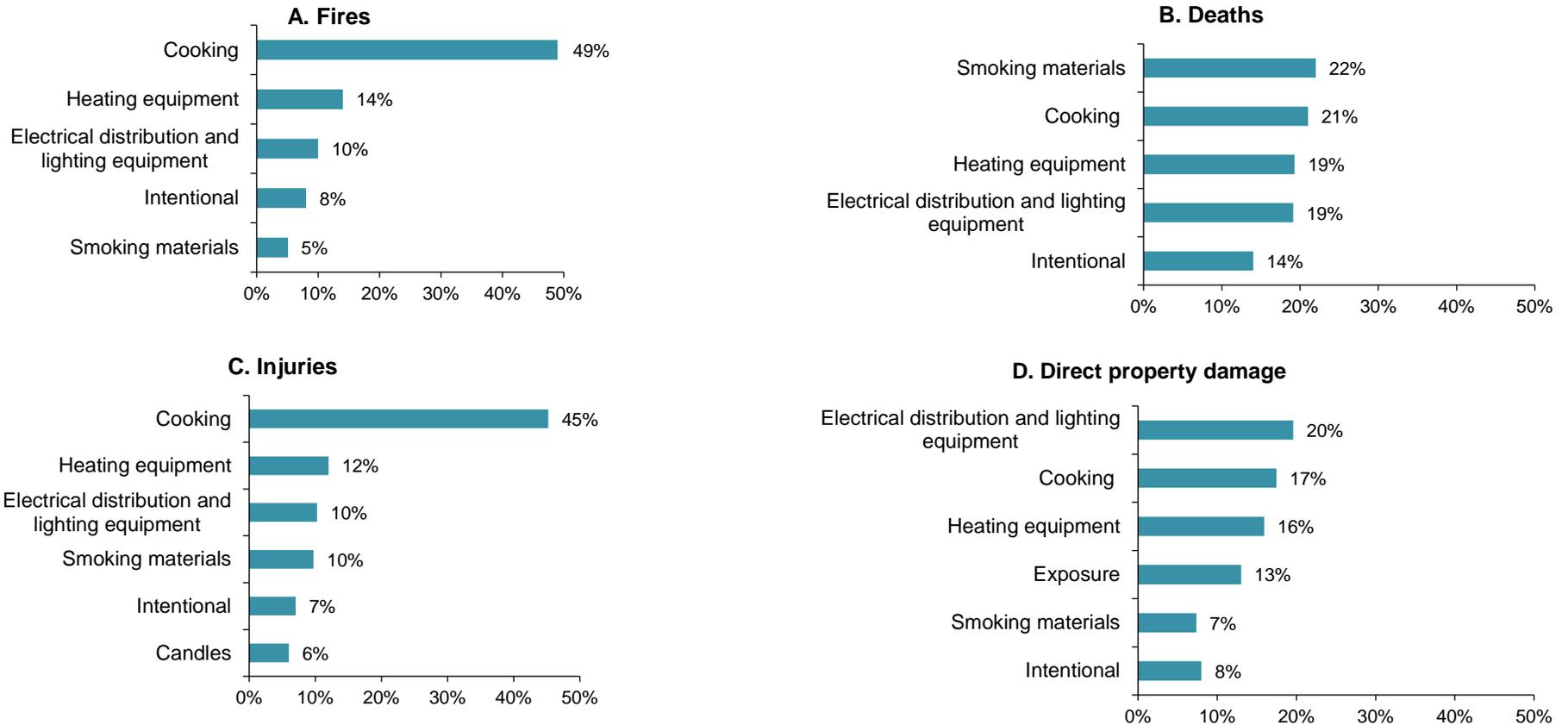
Fires started by smoking materials have been the leading cause or one of the leading causes of home fire fatalities for decades. This was still true for the 2013–2017 period as a whole. During this period, an estimated average of 17,200 such fires caused an average of 570 deaths; 1,090 injuries; and \$479 million in direct property damage annually. The 33 deaths per 1,000 reported fires caused by smoking materials was 4.5 times the rate of 7 deaths per 1,000 reported home fires overall. See the NFPA report, [The Smoking Material Fire Problem](#).

Heating equipment was the second leading cause of home fires and home fire injuries, and it tied with electrical distribution and lighting equipment as the third leading cause of home fire deaths. An average of 50,500 such fires caused 500 deaths; 1,390 injuries; and \$1.1 billion in direct property damage per year. Heating equipment was the leading cause of fire deaths in one- or two-family homes.

Chimney fires, usually minor and in one- or two-family homes, were the most common type of heating fire. Although space heaters, including portable heaters and those that are permanently installed, were involved in only 4 percent of total fires, these incidents accounted for 16 percent of all home fire deaths. The NFPA report, [Home Fires Involving Heating Equipment](#), provides more detail on how these fires start.

Electrical distribution or lighting equipment was the leading cause of home fire property damage. An average of 35,000 such fires caused 500 deaths; 1,130 injuries; and \$1.4 billion in direct property damage per year. Wiring and related equipment accounted for 7 percent of all home fires and 10 percent of all home fire deaths. Cords or plugs were involved in only 1 percent of the fires but 6 percent of the deaths. Extension cords dominated the cord or plug category. More information is available in the NFPA report, [Electrical Fires](#).

Figure 7. Leading causes of home structure fires: 2013–2017



The 28,300 intentional home fires per year caused an annual average of 380 deaths, 790 injuries, and \$533 million in direct property damage. More information is available in the NFPA report, [Intentional Fires](#).

According to death certificate data, 64 percent of all (including non-home) intentional fire or flame deaths in 2013–2017 were suicides.⁵ Conventional fire prevention and fire protection efforts cannot alone prevent these deaths.

Intentional fires heavily overlap with, but are not identical to, legally defined arson fires. For example, children under the age of legal responsibility sometimes intentionally start fires.

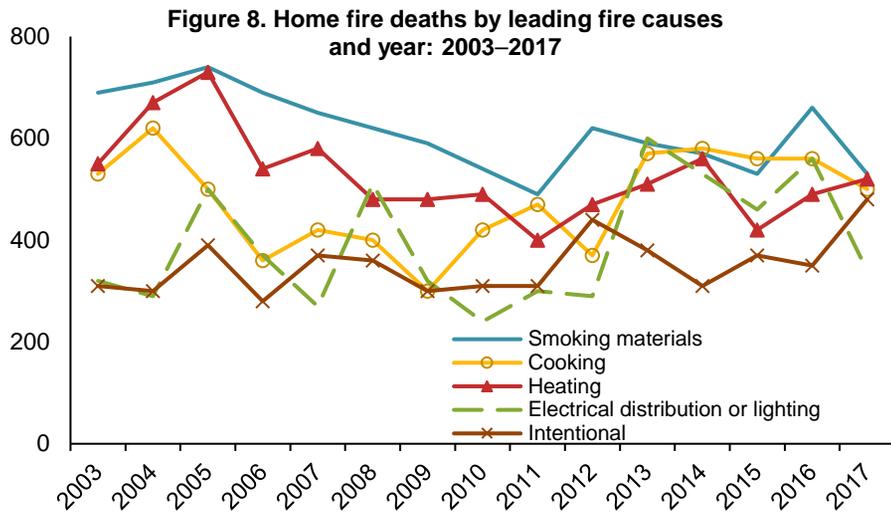
Candles started an average of 7,900 (2 percent) home fires annually, resulting in an average of 80 deaths (3 percent), 720 injuries, and \$268 million

(4 percent) in direct property damage per year. Candle fires had an injury rate of 91 per 1,000 reported fires, roughly three times the overall injury rate of 32 injuries per 1,000 home fires.

Fires caused by exposure to another fire had the highest average property loss of the major causes. The 12,600 (4 percent) home fires per year resulting from exposure caused an average of 20 deaths (1 percent), 60 injuries (1 percent), and \$871 million in direct property damage annually. The average loss of \$69,100 per fire was 3.5 times higher than the average loss of \$19,600 per fire.

In recent years, the leading causes of home fire deaths have converged more than in the past. For most of the past few decades, smoking materials were

clearly the leading cause. While smoking materials were the leading cause of home fire deaths over the five-year period of 2013–2017, cooking was the leading cause in 2014 and 2015. Electrical distribution and lighting equipment caused the largest number of home fire deaths in 2013. Smoking materials caused the largest number of deaths in 2016 and 2017. See Figure 8.



Xiong, Bruck, and Ball conducted interviews with Australians who had survived unintentional residential fires without serious injury. They grouped fire causes into three broad categories: unsafe human behaviors, human long-term inaction, and no human action involved.⁶

Unsafe human behaviors were reported in almost half (46 percent) of the fires and typically occurred within a short time (hours at most) between the behavior and the start of the fire. Unattended cooking, playing with fire, combustibles too close to a heat source, and discarded cigarettes are examples of unsafe behaviors. Forgetting and distraction were mentioned frequently.

Compared to fires with no human involvement, unsafe human behaviors were commonly seen in fires when one or more of the following was true: the individual was in the room of origin when the fire started; the kitchen was the room of origin; the individual suffered from mental illness; the fire

was in an apartment or rental property; or the individual suffered from physical illness, was not working full-time, or was asleep.

Human long-term inaction, such as a failure to clean grease or creosote build-up, failing to replace worn-out equipment, or overloading equipment caused 14 percent of these fires.

Forty percent of the fires were not attributed to any human action. These fires were typically started by faults in electrical or ignition systems.

These categories could be applied to the traditional US fire causes mentioned throughout this report. For example, a review of the factors contributing to ignition in cooking fires in 2012–2016 shows that the vast majority of these fires and casualties were caused by unsafe human behaviors, such as unattended cooking, abandoned material, combustibles too close to cooking equipment, unclassified misuse of material, or equipment unintentionally turned on or not turned off.⁷ Failure to clean the grease from a stove top or oven is an example of human long-term inaction. Roughly 10 percent of cooking fires were caused by mechanical or electrical failures or malfunctions, which are general examples of fires with no human action involved. In some cases, these failures may have occurred because the equipment had worn out.

Similar breakdowns could be done for other causes, such as heating and electrical distribution and lighting equipment. While such an analysis is beyond the scope of this report, breaking out the causes in this way can better target prevention strategies.

Area of origin, victim’s location, and fire spread

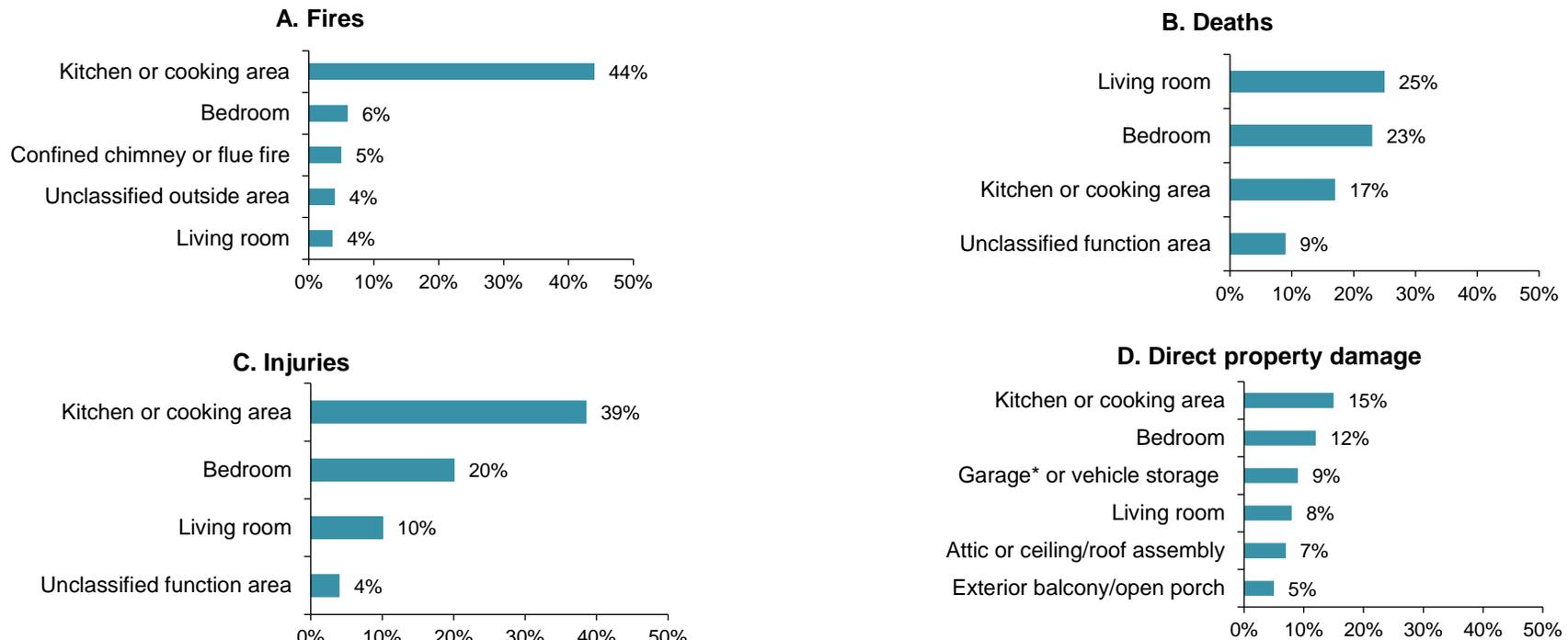
As cooking is the leading cause of home fires and fire injuries, it is not surprising that the kitchen was the leading area of origin for home fires and injuries. See Figure 9. Apartment or multifamily housing fires were more likely to start in the kitchen (68 percent) than were fires in one- or two-family homes (34 percent).

Roughly two-thirds of home fire deaths (65 percent) and injuries (69 percent) were caused by fires in just three rooms: living rooms, bedrooms, and kitchens.

While these three areas were among those associated with the highest property damage, home fires starting in garages (3 percent of fires), in attics or ceiling roof assemblies/concealed spaces (also 3 percent of fires), and on exterior balconies or open porches (2 percent of fires) all caused a disproportionate amount of property damage. Fires in these spaces may be less likely to be discovered when the fire is small than are fires in the interior living spaces.

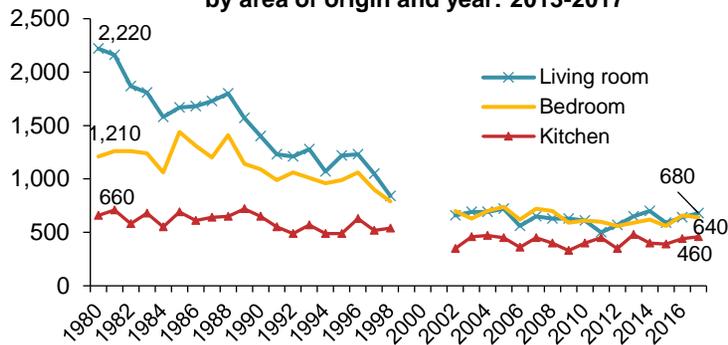
Figure 10 shows that deaths from fires originating in living rooms fell more sharply than deaths from fires starting in bedrooms and kitchens. Historically, the largest number of fire deaths result from fires starting in living rooms. The differences between the three leading areas of origin for home fire deaths have decreased over time, with deaths from fires starting in bedrooms now sometimes slightly exceeding the number of those resulting from fires starting in living rooms. See Figure 10.

Figure 9. Leading areas of origin in home structure fires: 2013–2017



* Does not include fires with property use coded as a residential garage.

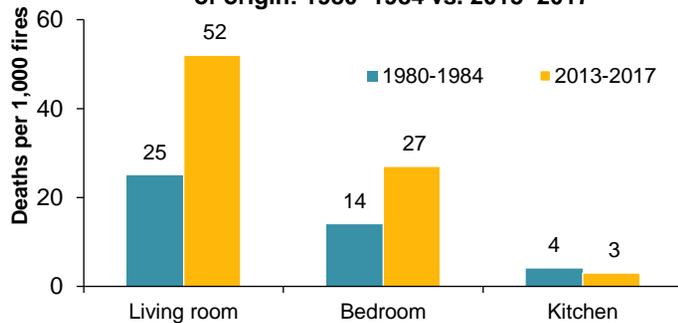
Figure 10. Home fire deaths by area of origin and year: 2013-2017



Compared to home fire deaths in 1980–1984, the average number of deaths in 2013–2017 resulting from fires starting in the living room fell 66 percent, deaths from fires beginning in the bedroom fell 50 percent, and deaths from kitchen fires dropped 31 percent.^{iv}

Fires in the living room were more likely to cause death than fires in other areas. Despite the drop in deaths in all three areas, the average death rate per 1,000 reported fires was roughly twice as high for fires that started in either the living room or bedroom in 2013–2017 compared to 1980–1984. See Figure 11.

Figure 11. Deaths per 1,000 fires in leading areas of origin: 1980–1984 vs. 2013–2017

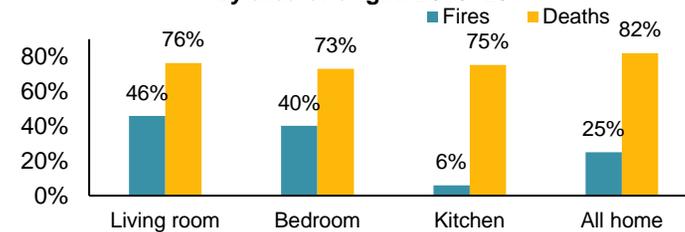


^{iv} Version 5.0 of NFIRS was introduced in 1999 and was adopted gradually over the next several years. Due to the instability of the estimates for 1999–2001—the transition years to NFIRS 5.0—estimates for these years are not shown in the graphs.

In a 2012 article, UL’s Stephen Kerber described experimental burns comparing living room style spaces containing common items in the modern home and rooms with legacy furnishings. He discovered flashover times had decreased from roughly 30 minutes with legacy furnishings to roughly five minutes with the modern items.⁸

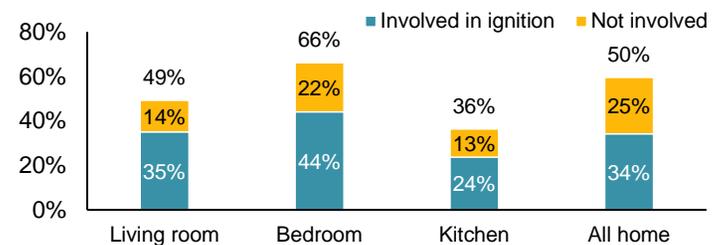
While fire spread beyond the room of origin in only 6 percent of kitchen fires, Figure 12 shows that roughly three quarters of the deaths in all three areas resulted from fires that spread beyond the room.

Figure 12. Fire spread beyond room by area of origin: 2013–2017



Half of the fatalities from fires in the living room and two-thirds of the bedroom fire fatalities were in the room or area of origin when the fire started, compared to roughly one-third of the kitchen fire deaths. Roughly two-thirds of fatal fire victims who were in the area of origin were also involved in the ignition. See Figure 13.

Figure 13. Home fire deaths in area of origin by involvement in ignition and area of origin: 2013–2017



Both fatal and non-fatal fire victims who were not in the area of fire origin when the fire started were more likely to be sleeping than were other fire victims. Fatal fire victims were more likely to have been physically disabled than were those who were non-fatally injured. They were also more likely to have been in the area of origin. See Figure 14.

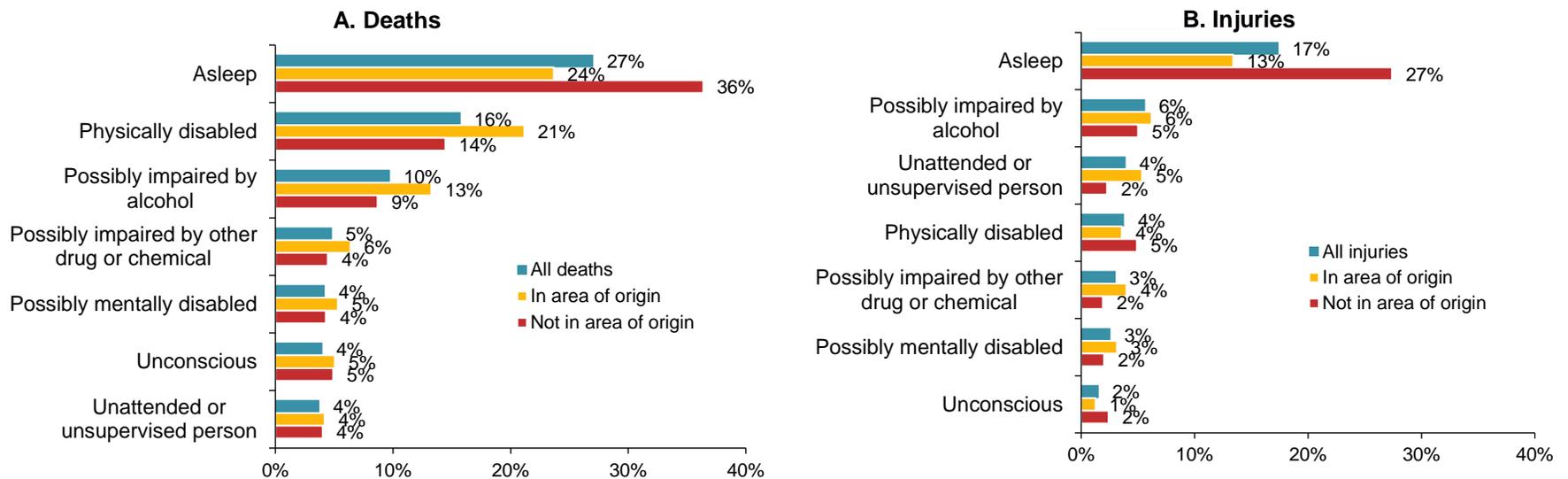
The NFPA analysis of the NFIRS data indicates that 10 percent of the home fire fatalities were possibly impaired by alcohol and 5 percent were possibly impaired by other drugs or chemicals. Multiple entries are allowed in this data element. Some individuals may have had both drugs and alcohol in their bloodstream. NFIRS data comes from the fire service and are likely to underestimate the role of alcohol and drugs.

Autopsy results indicate more frequent alcohol involvement than NFIRS reports would suggest. Autopsies are routinely done on Minnesota fatal fire victims. In 2016, alcohol or drug use was a factor in 35 percent of total Minnesota fire deaths and in 26 percent of the state’s fire deaths in 2017.⁹

Alcohol is widely cited as a contributing factor to fatal fires. Many factors correlate with each other. Citing data from the 2011–2013 US *National Survey on Drug Use and Health*, Higgins and his colleagues reported that 64 percent of people who abused or were dependent on illicit drugs were current smokers, as were 44 percent of those who abused or were dependent on alcohol, 32 percent of those with a mental illness, and 33 percent of those with incomes below the poverty level.¹⁰

A review of European and Australian research indicates that many factors associated with US home fires and casualties are also seen in other industrialized countries. In England, cooking caused roughly half of the reported unintentional dwelling fires and associated injuries from April 2018 to March 2019. Smoking materials caused only 8 percent of the fires but 34 percent of the deaths,¹¹ compared to 5 percent of the fires and 22 percent of the deaths in the US. While the percentages may differ, the patterns are similar.

Figure 14. Home fire deaths and injuries by victim proximity to fire origin and NFIRS “human factor” contributing to injury: 2013-2017



From their review of 517 fatal fires with 571 deaths in Norway during 2005–2014, Sesseng, Storesund, and Steen-Hansen compared several risk factors commonly seen in two age groups: under 67 and at least 67 years of age. For the younger victims, the most common risk factors were alcohol influence (59 percent), known substance abuse (54 percent), mental illness (52 percent), and being a smoker (36 percent). The most commonly seen risk factors in the older adult victims were reduced mobility (47 percent), mental illness (34 percent), cognitive impairment (33 percent), and being a smoker. Many victims had more than one risk factor. Only one person was present at the time of the fire in 71 percent of the incidents. In reports that mentioned post-mortem alcohol tests, alcohol was found in roughly half of the victims.¹²

Australian researchers Xiong, Bruck, and Ball compared factors associated with residential fire death or survival. Many differences were found between survivors and fatal fire victims. Those who died were significantly more likely to have:

- Taken psychotropic or sedative drugs,
- Been in a fire started by a discarded cigarette,
- Been living alone,
- Been more than 70 years of age,
- Been asleep at the time of the fire,
- Been in the room of origin at the time of the fire,
- Consumed alcohol before the fire, or
- Been suffering from a physical illness.

Fires that began in the living room or bedroom were also more likely to have resulted in death, as were fires in homes that were moderately to severely cluttered or in a state of disrepair. Pre-existing disabilities and mental illness were associated with a greater likelihood of death. The risk was also higher in rental housing.¹³

Although the US has little statistical information on the role of cognitive decline, hoarding, or living alone as factors in fire deaths, anecdotal evidence suggests that these also play a role in the fire death problem.

Giebułtowicz and her colleagues analyzed 263 dwelling fire death cases from the Mazowieckie region of Poland in 2003–2011. They found that roughly three out of every five victims were in the room of origin with about half found near upholstered furniture that had burned. Seventy percent of the

victims were men. Seventy percent of the men had consumed alcohol. Living alone was another risk factor.¹⁴

Using data from fatal residential fires in Sweden during 1999–2007, Jonsson and his colleagues identified victim clusters. Three are shown below.

- Ignition of paper or clothing, often by smoking materials. Fires generally stayed small, typically occurred during the day, victims were often elderly women, and alcohol was rarely a factor (17 percent).
- Smoking-related furniture fires in apartment bedrooms or living rooms. Alcohol was often involved. Victims were usually male, often between 45 and 64 years of age. Victims were more likely to die of smoke inhalation than burns (30 percent).
- House fires caused by fireplaces or various electrical issues. These fires were likely to spread beyond the room of origin and victims were likely to be either between 5 and 19 or 80 or older and less likely to be intoxicated.¹⁵

Some clusters can be seen in US home fire fatalities. In an analysis of 2011–2015 home fire deaths and injuries, smoking was the leading cause of home fire deaths overall.¹⁶ However, this was true only in the age group of 45 through 84 years old. Among those 85 and older, cooking caused the most deaths. Eighteen percent of cooking fire deaths in 2011–2015 were caused by the 1 percent of such fires that began with clothing ignition. Four out of five cooking clothing ignition victims were at least 65 years old, suggesting that reduced mobility may have played a role. Of the people who died in intentional home fires, 58 percent were between 35 and 64 years of age. Two-thirds of the victims of all fatal intentional home fires were male.

Fire causes by area of origin

Because cooking fires so dominate the fire problem, looking at all home fires together can make it possible to overlook the importance of other fire causes, which are actually more likely to result in death or injury. Figure 15 shows that the leading causes of fires in living rooms and in bedrooms in 2013–2017 differ greatly from those in kitchen fires, and they are much more varied. Electrical distribution and lighting equipment was the leading or second leading cause of fires in both rooms. Smoking materials and heating

equipment were the two leading causes of fire deaths in the two rooms. Again, the rank differed.

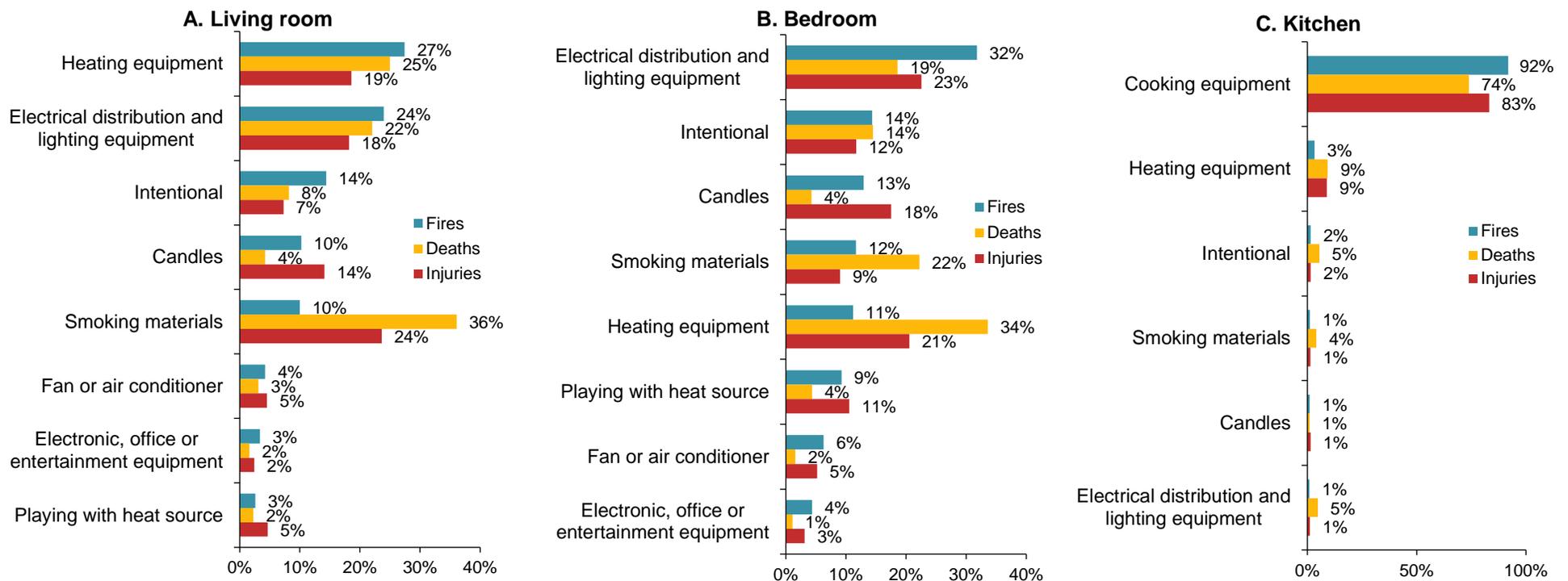
Nine percent of bedroom fires were started by someone playing with a heat source, such as a lighter, a candle, or matches. According to the NFPA 2014 report, *Playing With Fire*, 39 percent of 2007–2011 home structure fires caused by fire play started in the bedroom. Bedroom fires caused 54 percent of the deaths and 57 percent of the injuries that resulted from home fire play.¹⁷ If a fire started in a bedroom with no smoke alarm and the door was closed, serious injury could occur before the smoke reached a hallway smoke alarm. Interconnected alarms with bedroom coverage would sound and alert others elsewhere in the home early in the fire’s development.

While space heater fires are an issue in both living rooms and bedrooms, fireplace and chimney fires are a particular issue in living rooms. Most fireplaces and wood stoves are located in these rooms.

As noted earlier, cooking is by far the leading cause of home fires, and, predictably, the cause of the vast majority of kitchen fires and fire casualties. According to the NFPA 2018 report, *Home Cooking Fires*, one-third (34 percent) of the fatal home cooking fire victims in 2012–2016 were asleep at the time of injury. Fifty-five percent of the non-fatal cooking injuries occurred when someone tried to fight the fire themselves.¹⁸

Although heating equipment was the second leading cause of kitchen fire deaths, the heating equipment most often involved was a heating stove. It is likely that some of these were kitchen ranges that had been miscoded.

Figure 15. Leading causes of fires and casualties in leading areas of home structure fires: 2013–2017



Leading items first ignited in home structure fires

With cooking being the leading cause of home fires, it is not surprising that cooking materials, including food, are the leading items first ignited in home fires and in fires that caused injuries. A wider variety of items first ignited is seen with home fire deaths than with fires or injuries. See Figure 16. The two leading items in home fire deaths are upholstered furniture and mattresses or bedding,^v consistent with the leading areas of origin associated with fire deaths.

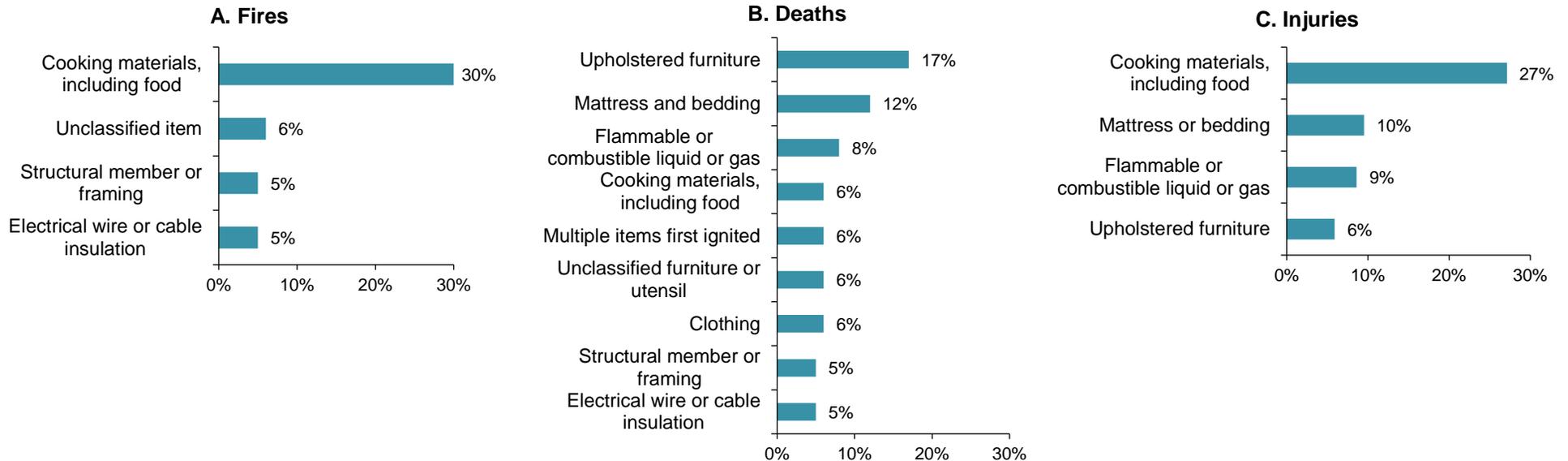
While upholstered furniture was first ignited in an average of only 5,100, or 1 percent, of reported home fires per year, these incidents caused 450 deaths, 660 injuries, and \$243 million (4 percent) in direct property damage. The

8,500 (2 percent) per year that began with mattresses or bedding caused an annual average of 320 deaths; 1,070 injuries; and \$269 million (4 percent) in direct property damage.

The average number of deaths from home fires beginning with the ignition of upholstered furniture in 2013–2017 was 63 percent lower than the 1980–1984 average. Deaths from fires starting with mattresses or bedding were down 58 percent from the earlier period. See Figure 17.

Although the death toll from upholstered furniture and mattresses or bedding has fallen, the death rates per 1,000 reported fires beginning with these items in 2013–2017 is more than twice as high as in 1980–1984. See Figure 18.

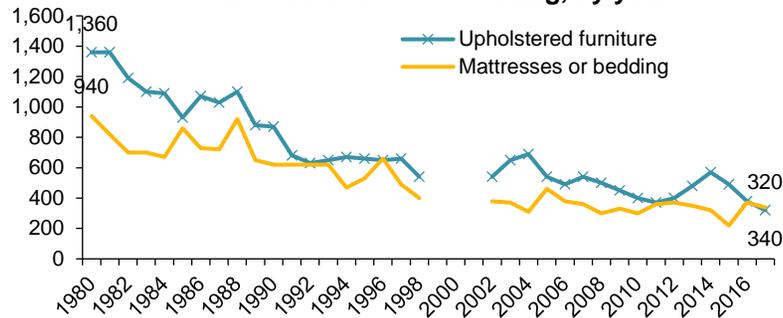
Figure 16. Leading items first ignited in home structure fires: 2013–2017



^v NFIRS groups upholstered sofas, chairs, and vehicle seats into one code choice for item first ignited. NFPA combines two NFIRS item first ignited codes—a) mattress or pillow and b) bedding, blanket, sheet, or comforter—into the category of mattress or bedding. Some furniture, such as folded mattresses covered with upholstery fabric

(futons), traditional sleep sofas with pull-out mattresses, and upholstered furniture with cloth protectors or throw-style furniture covers, could potentially be coded as either upholstered furniture or mattresses and bedding.

Figure 17. Home fire deaths from fires starting with upholstered furniture and mattresses or bedding, by year



With fires starting with upholstered furniture and mattresses or bedding accounting for 1 and 2 percent of the reported fires in 2013–2017, but 17 percent and 12 percent of the home fire deaths, respectively, these events are relatively low-frequency, high-consequence fires. On average, one of every 11 upholstered furniture fires and one of every 27 mattress or bedding fires in this time period resulted in death.

Figure 18. Deaths per 1,000 fires that began with upholstered furniture or mattresses and bedding 1980–1984 vs. 2013–2017



Sean McKenna and his colleagues in the United Kingdom (UK) researched the impact of flame retardants on the burning behavior of and smoke toxicity from simple sofa beds. These were described as double mattresses that folded to rest on a frame and make a sofa. Among the issues prompting this research were UK government statistics showing that the death rate of 25.2 per 1,000 fires for the combination of bedrooms, living rooms, and dining rooms was much higher than the 1.9 deaths per 1,000 kitchen fires and 1.1 deaths

per 1,000 fires for other locations. The proportion of fire deaths caused by inhalation of toxic smoke has also increased over time. Test results showed that sofa beds with flame retardants had a somewhat slower burning rate but produced more lethal effluents when burning.¹⁹ Additional research is needed to determine if similar results would be found in the US.

In their article on Swedish residential fire deaths in 2011–2014, Runefors, Johansson, and Van Hees identified smokers who receive home care as a group likely to be intimate with ignition and unable to move quickly away from harm. Older adults, people with disabilities, and alcoholics are common victims of fires that begin in a bed or upholstered furniture they are occupying. Fatal injury can occur before sprinklers operate.²⁰

Leading heat sources associated with home fire deaths and injuries

Three categories of heat sources—operating equipment; smoking materials; and lighters, candles, or matches (small open flames)—combined initiated fires causing roughly three-quarters of total home fire deaths and injuries.

Considerable attention has been paid to cigarettes and to small open flames as ignition sources. While fires started by operating equipment such as ranges, heating equipment, dryers, and extension cords often have a human element, the role of equipment should not be overlooked. Automatic shutoffs and other safety features can provide protection against predictable human error.

The category of operating equipment includes four NFIRS heat source codes:

- Radiated or conducted heat from operating equipment,
- Sparks, embers, or flames from operating equipment,
- Arcing, and
- Unclassified heat from powered equipment.

During 2013–2017, some type of operating equipment was the heat source in an average of 182,700 (52 percent) home structure fires per year. These fires caused an annual average of 1,060 deaths (40 percent); 5,860 injuries (52 percent); and \$2.8 billion (40 percent) in direct property damage.

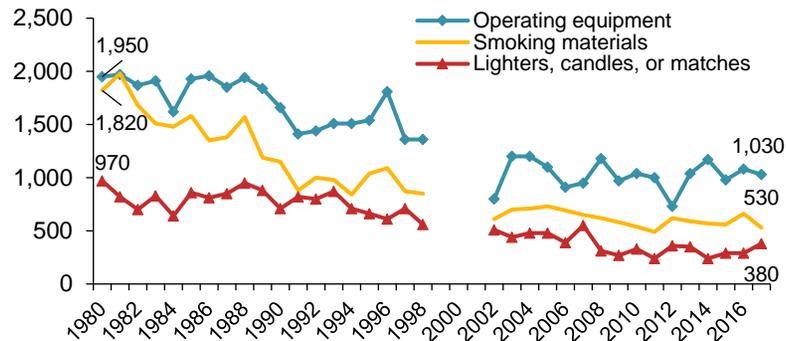
During the same period, lighters, candles, or matches were the heat source in an average of 25,900 (7 percent) home structure fires per year. These fires caused an annual average of 310 deaths (12 percent); 1,540 injuries (14 percent); and \$577 million (8 percent) in direct property damage.

As discussed previously, smoking materials, including cigarettes, pipes, cigars, and undetermined smoking materials, were the heat source in an annual average of 17,200 (5 percent) home fires that caused an annual average of 570 deaths (22 percent); 1,090 injuries (10 percent); and \$479 million in direct property damage (7 percent).

While it is likely that some portion of the fires said to have been started by hot embers or ashes (24,500 fires; 90 deaths; 390 injuries; and \$448 million in direct property damage) were actually started by smoking materials, no adjustments have been made. Completed investigations by the CPSC into eight fatal residential fires in 2016 in which the NFIRS heat source was a hot ember or ash found that five were started by cigarettes and one by a pipe or cigar. They did not investigate non-fatal fires with a heat source code of ember or ash. NFPA has not made these adjustments. Consequently, it appears the estimates of fires started by smoking materials and associated losses in this report likely underestimate the true size of the smoking material fire problem.²¹ It is also likely that some portion of the smoking material fires were started by marijuana cigarettes. Unfortunately, such incidents cannot be identified by the coded data in NFIRS.

Figure 19 shows that smoking material fire deaths have fallen more than deaths from fires started by small open flames or operating equipment.

Figure 19. Home fire deaths by selected heat sources and year

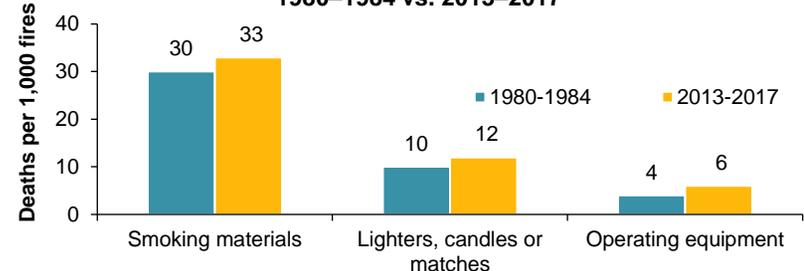


According to the Centers for Disease Control and Prevention (CDC), 33.2 percent of adults smoked cigarettes in 1980.²² In 2017, 16.7 percent smoked combustible tobacco products and 14 percent smoked cigarettes, specifically.²³ The annual average death toll from fires started by smoking materials was 66 percent lower in 2013–2017 than it was in 1980–1984, while deaths from fires started by small open flames (lighters, candles, or matches) were down 61 percent compared to the earlier period.

The death toll from fires started by operating equipment was 43 percent lower in the more recent period than in 1980–1984.

The increase in death rates per 1,000 fires was not as great for the three heat source categories as compared to those for fires starting in furniture or mattresses and bedding. This suggests that the heat source is not driving the increased death rates for upholstered furniture or mattresses and bedding. See Figure 20.

Figure 20. Deaths per 1,000 fires for selected heat sources 1980–1984 vs. 2013–2017



Preventing fires and fire losses

Safer products can prevent many fires from starting. Considerable progress has been made toward safer products, but more is left to be done. Equipment and other product redesigns or automatic shutoffs on heating equipment, cooking equipment, and irons can mitigate human error and improve safety. Such changes may be the most effective and inexpensive approach to fire prevention.

The CPSC issues product safety standards and recalls of unsafe consumer products and collects reports about such products from the public. Reports of

unsafe consumer products can be made to the CPSC at saferproducts.gov. Site users can also search for recalls and other incidents of unsafe products.

The earlier a fire is discovered, the more time there is to escape. Figure 21 shows that a smoke alarm was present in three-quarters of reported home fires, substantially less than the 96 percent of homes with smoke alarms that were reported in telephone surveys done for NFPA.²⁴ However, almost three of every five home fire deaths resulted from fires in which either no smoke alarm was present (40 percent) or at least one alarm was present but did not operate (17 percent).

To better understand smoke alarm reliability, it is helpful to exclude fires with no smoke alarms at all and fires in which the smoke did not reach the device. Smoke alarms operated in 88 percent of the fires in which they were present and the fire was considered large enough to activate them. Seventy-two percent of the deaths in such fires took place in homes with operating smoke alarms.

Some people who are in the room of fire origin may be intimately involved with the ignition. Their clothing or the furniture they are sitting or lying on may catch fire. Even if they are not intimately involved, being in the room where the fire starts dramatically reduces escape time.

Home fire sprinklers can control a fire until help arrives, even when the occupants are unable to act. Fire sprinklers were present in only 7 percent

of reported home fires in 2012–2016. The death rate of 1.1 per 1,000 reported home fires was 85 percent lower when sprinkler systems were present than the 7.7 deaths per 1,000 reported home fires without any automatic extinguishing systems (AES).^{vi} The \$6,900 average dollar loss per fire when sprinklers were present was 63 percent lower than the average \$18,800 loss per fire without AES. See firesprinklerinitiative.org for more information.

In home fires considered large enough to activate sprinklers, they operated 94 percent of the time, and, when operating, they were effective in controlling the fire in 97 percent of the incidents. Overall, sprinklers operated and were effective in 92 percent of the fires large enough to activate them. In 89 percent of home fires with operating sprinklers, only one operated. In 99 percent, five or fewer operated.

Although smoke alarms and sprinklers are often considered separately, the greatest safety is found when both are present.

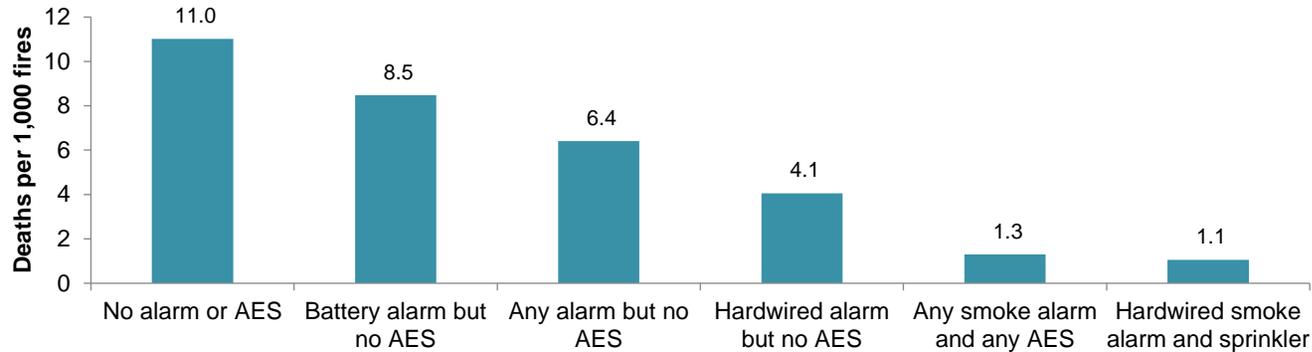
Figure 22 was previously published in the NFPA report [Smoke Alarms in US Home Fires](#). The death rate per 1,000 reported home fires is lowest when both hardwired smoke alarms and sprinklers are present. Whether or not the systems operated is not considered here. A few cautions must be taken into account when interpreting the data.

Figure 21. Smoke alarm status in home structure fires: 2013–2017



^{vi} Excludes properties under construction, partial systems, and fires with sprinklers that failed to operate because they were not in the fire area.

Figure 22. Average fire death rate per 1,000 reported home structure fires by presence of smoke alarms and automatic extinguishing systems 2012–2016



Because these rates are based on reported fires only, they are dependent on which fires were reported. It is likely that the lifesaving impact of battery-powered smoke alarms is underestimated. CPSC’s survey of unreported residential fires found that 97 percent of home fires were handled without the fire department.²⁵ Discovering a fire when it is in its earliest stages increases the likelihood of the occupants being able to handle it themselves. Monitored alarm systems that automatically generate a fire department response when smoke detectors are activated generally include hardwired smoke detectors. This results in a larger share of minor reported fires with hardwired alarms. In many cases, the occupants were alerted and dealt with the fire before the fire department arrived. Sprinklers are more likely to be present in properties with monitored smoke detection systems than in properties without this protection.

Some problems cannot be addressed by the fire service or fire protection alone. Norwegian researchers Gjørund, Almkov, and Halvorsen cited research indicating that a majority of fatal fire victims in Norway had some kind of vulnerability, such as drug or alcohol use, physical or cognitive challenges, low socio-economic status, or other situation that would make an individual less likely to discover a fire in its early stages or to mitigate or

safely evacuate from a fire. Vulnerability is reduced if the individual lives in a home that addresses these issues. They wrote “... A person’s actual vulnerability is determined by a municipality’s organizational and economic capability to provide appropriate organizational and technological measures.”

Fire prevention is only one of the many challenges these individuals face. Although municipalities sometimes map user needs for home care services, the fire service is often not consulted. A lack of resources can make inter-agency coordination less likely. Little guidance exists on how different agencies should work together. Regulations are also generally sector-specific.²⁶

Firefighters often provide emergency medical services, assist after falls, and become aware of dangers before a fire occurs. In many cases, they identify problems that are beyond the scope of fire department capabilities. Assistance from social services, public health departments, or other organizations is often needed. As in Norway, different areas of the US provide services in different ways. Navigating the systems to find the appropriate resources is often difficult.

Additional safety information can be found at the NFPA website, nfpa.org.

Methodology

Supporting tables for all homes, fires in one- or two-family homes, and in apartments or multifamily home are also available online [here](#).

Unless otherwise specified, the statistics in this analysis are national estimates of fires reported to US local fire departments and so exclude fires reported only to federal or state agencies or industrial fire brigades. Estimates are projections based on the detailed information collected in the US Fire Administration's [National Fire Incident Reporting System \(NFIRS\)](#) and the National Fire Protection Association's annual Fire Experience Survey. Except for property use and incident type, fires with unknown or unreported data were allocated proportionally in calculations of national estimates.

In general, any fire that occurs in or on a structure was considered a structure fire, even if the fire was limited to contents and the building itself was not damaged. Only civilian (non-firefighter) casualties are discussed in this analysis. For more information, see "[How the NFPA National Estimates Are Calculated for Home Structure Fires](#)."

The causes shown are those that are well-defined and have clear prevention strategies or have historically been of interest. The data comes from several NFIRS data elements. Double counting is possible. For more information see

"NFPA's Methodology and Definitions Used in "Leading Causes of Structure Fires" Tables."

Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, deaths and injuries to the nearest ten, and property damage to the nearest million dollars. Estimates of zero may be true zeroes or may have been rounded to zero. Percentages were calculated on unrounded estimates. Annual averages do not include inflation adjustments.

Acknowledgments

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the NFIRS and the annual NFPA Fire Experience Survey. These firefighters are the original sources of the detailed data that makes this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are also grateful to the US Fire Administration for its work in developing, coordinating, and maintaining the NFIRS.

To learn more about research at NFPA, visit www.nfpa.org/research.
Email: research@nfpa.org.
NFPA No. USS12G

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