Civilian Fire Fatalities in Residential Buildings

These topical reports are designed to explore facets of the U.S. fire problem as depicted through data collected in the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS). Each topical report briefly addresses the nature of the specific fire or fire-related topic, highlights important findings from the data, and may suggest other resources to consider for further information. Also included are recent examples of fire incidents that demonstrate some of the issues addressed in the report or that put the report topic in context.

Findings

- Ninety-one percent of all civilian fatalities in residential building fires involve thermal burns and smoke inhalation.
- Bedrooms (55 percent) are the leading location where civilian fire fatalities occur in residential buildings.
- Fifty-one percent of civilian fire fatalities in residential buildings occur between the hours of 10 p.m. and 6 a.m. This period also accounts for 49 percent of fatal fires.
- Seventy percent of fire victims in residential buildings were escaping (36 percent) or sleeping (34 percent) at the time of their deaths.
- Smoking was the leading cause of fatal residential building fires.
- Males accounted for 57 percent of civilian fire fatalities in residential buildings; women accounted for 43 percent of the fatalities.
- Approximately 43 percent of civilian fatalities in residential building fires are between the ages of 40 and 69.
- Thirteen percent of civilian fire fatalities in residential buildings were less than 10 years old.
- Other equipment fires produced 138 fatalities per 100 fatal fires, the largest number of fatalities per 100 fatal fires.

Fires can strike anywhere—in structures, buildings, automobiles, and the outdoors.[1] Fires that affect our homes are often the most tragic and the most preventable. It is a sad fact, but each year over 75 percent of all civilian fatalities occur as a result of fires in residential buildings—our homes.[2] Between 2007 and 2009, civilian fire casualties in residential buildings accounted for 81 percent of all fire fatalities. This topical fire report focuses on the characteristics of these fatalities.

Civilian fire fatalities, by definition, involve people who die as a result of a fire. These fatalities generally occur when an individual is escaping, sleeping, or is unable to act during a fire.

Annually from 2007 to 2009, an estimated 2,630 civilian fire fatalities resulted from 1,700 fatal residential building fires and an estimated 374,900 residential building fires.[3,4] Fatal fires are those fires where one or more fatalities occur.

The National Fire Incident Reporting System (NFIRS) data are used for the analyses presented throughout the report. For the purpose of this report, the term "fatal residential building fires" is synonymous with "fatal residential fires" and "residential building fires" is synonymous with "residential fires." "Fatal residential fires" is used throughout the body of this report; the findings, tables, charts, headings, and footnotes reflect the full category "fatal residential building fires."

Civilian Fatality Rates for Residential Building Fires

Not all fires produce fatalities. When civilian fatalities are averaged over all residential building fires, the overall fatality rate is 5.5 civilian fatalities per 1,000 residential building fires (Table 1).[5] Fires that result in fatalities have 1,209 fatalities for every 1,000 fires or slightly more than one fatality per fatal fire. In other words, every 1 out of 5 fatal fires will result in more than one fatality.

Table 1. Fatality Rates for Residential Building Fires per 1,000 Fires (2007-2009)

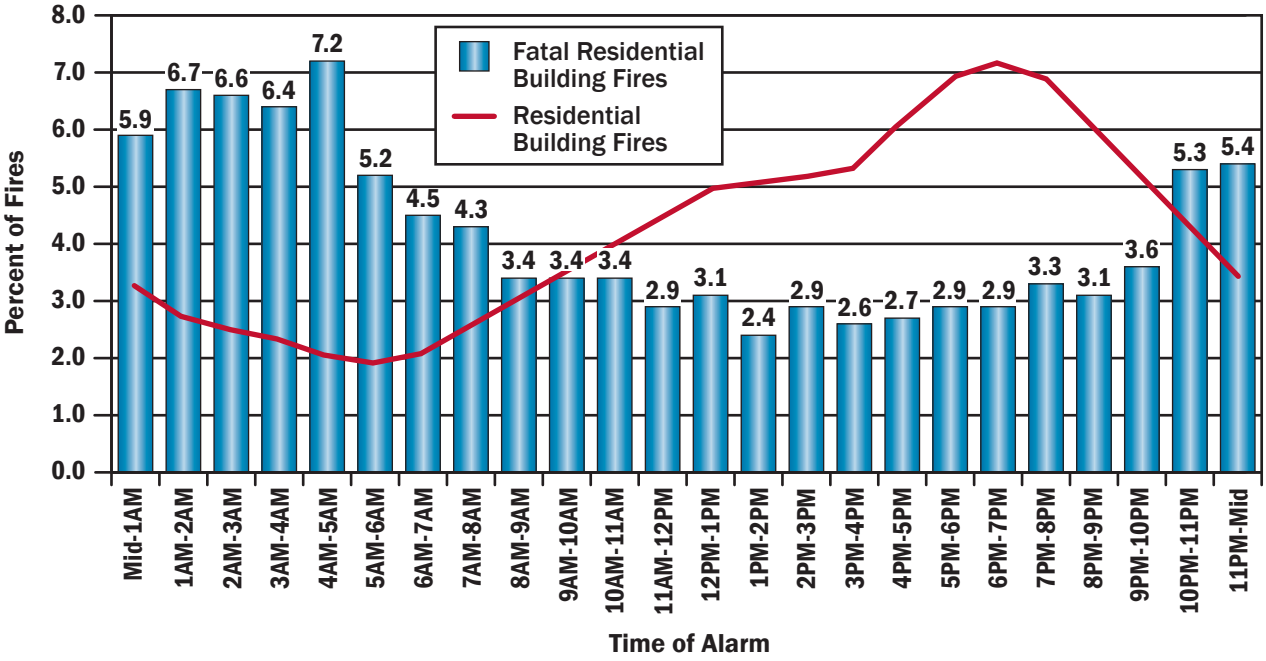
Fatalities per 1,000 Fatal Fires	Fatalities per 1,000 Residential Building Fires
1,208.9	5.5

Source: NFIRS 5.0.

When Fatal Residential Building Fires Occur

As shown in Figure 1, fatal fires occur most frequently late at night or in the very early morning when most people are sleeping, a major factor contributing to the fatality (see Table 2). From 2007 to 2009, fatal fires peaked between 4 a.m. and 5 a.m. Fatal fires are most prevalent when overall fire incidence is at its lowest, making nighttime fires the most deadly. The 8-hour peak period (10 p.m. to 6 a.m.) accounts for 49 percent of fatal fires and 51 percent of fatalities.[6]

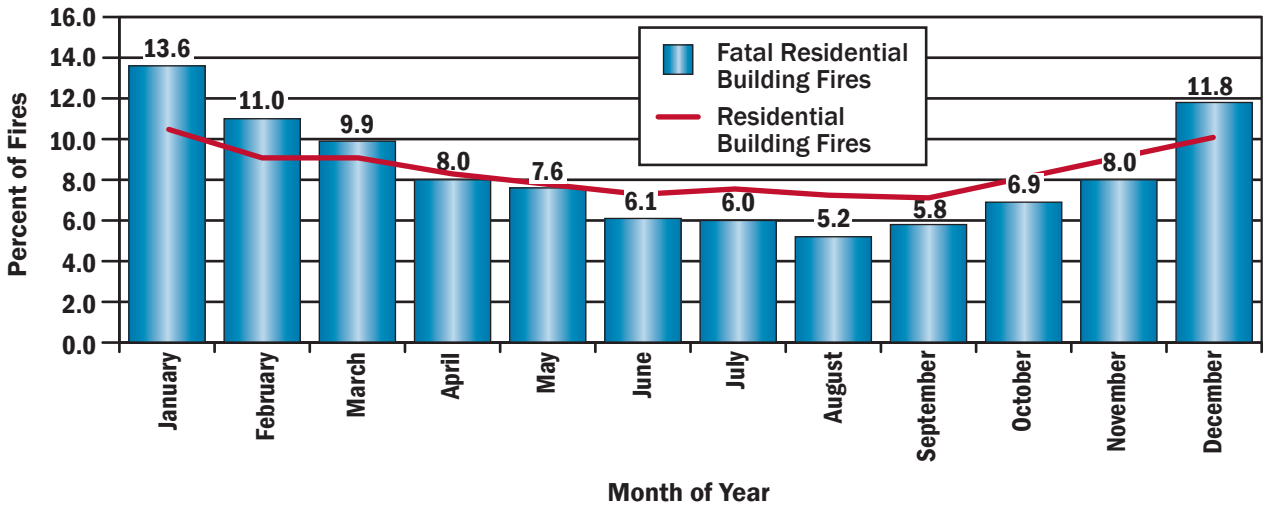
Figure 1. Fatal Fires in Residential Buildings by Time of Alarm (2007–2009)



Source: NFIRS 5.0.
Note: Total may not add to 100 percent due to rounding.

Fatal residential fires occur more frequently in the colder months, tracking the overall residential monthly fire incidence (Figure 2). The winter peak occurs during January (14 percent). Fatal residential fires are lowest in August (5 percent).

Figure 2. Fatal Fires in Residential Buildings by Month (2007–2009)

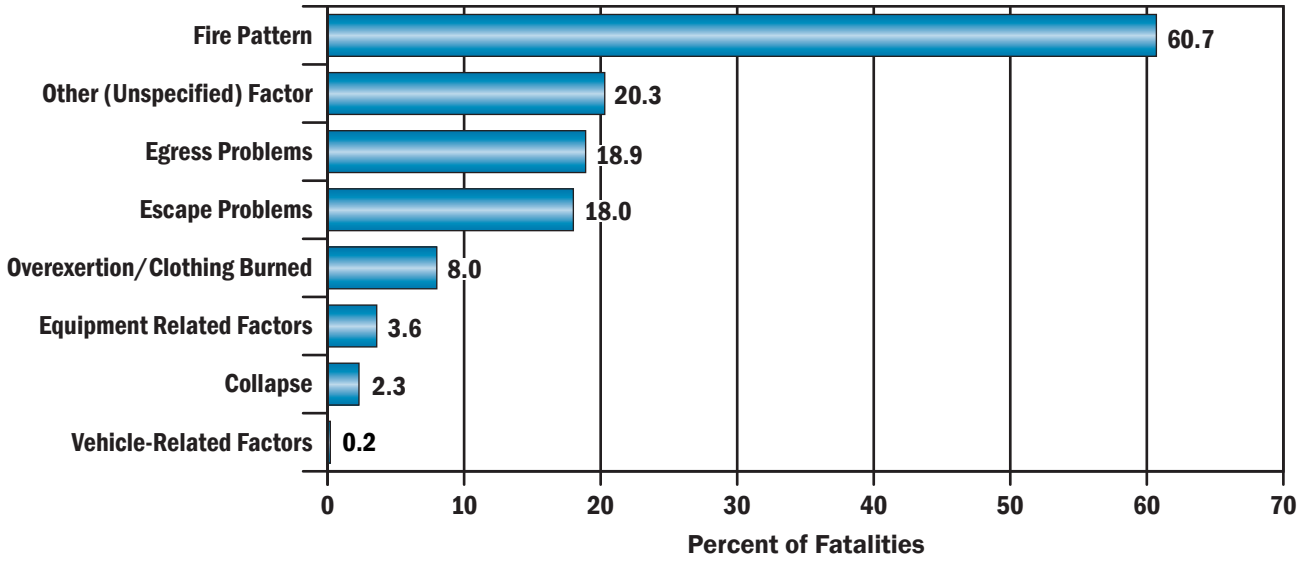


Source: NFIRS 5.0.

Factors Contributing to Civilian Fire Fatalities in Residential Buildings

The most notable factors contributing to fatalities (outside of "other unspecified factor") (Figure 3) are fire pattern (61 percent), egress (19 percent), and escape problems (18 percent). Fire pattern factors involve situations where exits are blocked by smoke and flame, vision is blocked or impaired by smoke, and civilians are trapped above or below the fire. Egress problems include such factors as crowded situations, limited exits, locked exits or other exit problems, and mechanical obstacles to the exit. Escape factors include unfamiliarity with exits, excessive travel distance to the nearest clear exit, choice of an inappropriate exit route, reentering the building, and clothing catching on fire while escaping.

Figure 3. Factors Contributing to Civilian Fire Fatalities in Residential Buildings (2007–2009)



Source: NFIRS 5.0.
Notes: 1) Includes incidents where factors contributing to the fatality were specified.
2) As multiple factors contributing to fatalities may be noted for each fatality, the total sums to more than 100 percent.

Human Factors Contributing to Civilian Fire Fatalities

Human factors play an important role in residential building fire fatalities. The leading human factor contributing to fatalities is being "asleep" (48 percent). This finding is not unexpected as the largest numbers of fatalities per fatal fire occur during the 7-hour period between midnight and 7 a.m.

"Physically disabled" is the second leading human factor contributing to fatalities (25 percent). This is followed by "possibly impaired by alcohol" and "possibly mentally disabled" at 20 percent and 9 percent, respectively.

Table 2. Human Factors Contributing to Civilian Fire Fatalities in Residential Buildings (2007–2009)

Human Factors Contributing to Fatality	Percent of Fire Fatalities in Residential Buildings (Unknowns Apportioned)
Asleep	47.6
Physically Disabled	24.7
Possibly impaired by alcohol	19.5
Possibly mentally disabled	8.8
Unconscious	8.4
Possibly impaired by other drug or chemical	8.1
Unattended or unsupervised person	6.9
Physically restrained	1.4

Source: NFIRS 5.0.
Notes: 1) Includes only incidents where human factors that contributed to the fatality were specified.
2) Multiple human factors contributing to the fire fatality may be noted for each incident; total will exceed 100 percent.

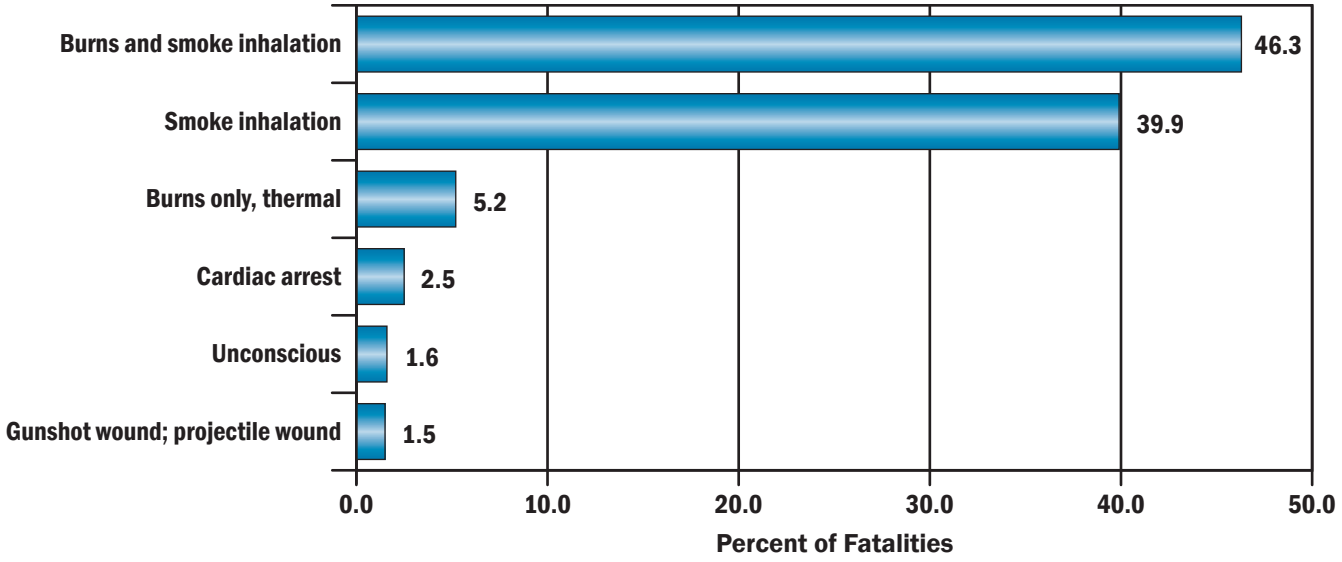
Primary Causes of Civilian Fire Deaths

Ninety-one percent of all fatalities in residential building fires involve thermal burns and smoke inhalation. Burns and smoke inhalation combined make up 46 percent of the fatalities. Smoke inhalation, by itself, accounts for 40 percent of residential building fire fatalities and thermal burns (as opposed to scalds or chemical or electrical burns), alone, account for 5 percent of fatalities (Figure 4). Cardiac arrest accounts for only 3 percent of fatalities.

Thermal burns are caused by contact with flames, hot liquids, hot surfaces, and other sources of high heat. Eighty-six percent of thermal burn fatalities were the result of thermal burns on multiple body parts.

Smoke inhalation affects the internal organs, specifically the lungs and airways within the body. It results from breathing smoke that contains harmful gases and small particles that are present in the air during a fire. These gases and particles include chemicals or toxins which can lead to inflammation and blockage of the airway.[7]

Figure 4. Leading Causes of Civilian Fire Deaths in Residential Buildings (2007–2009)



Source: NFIRS 5.0.
Note: Percentages computed only for those fatalities where symptoms were noted.

Cause of Fatal Fires in Residential Buildings

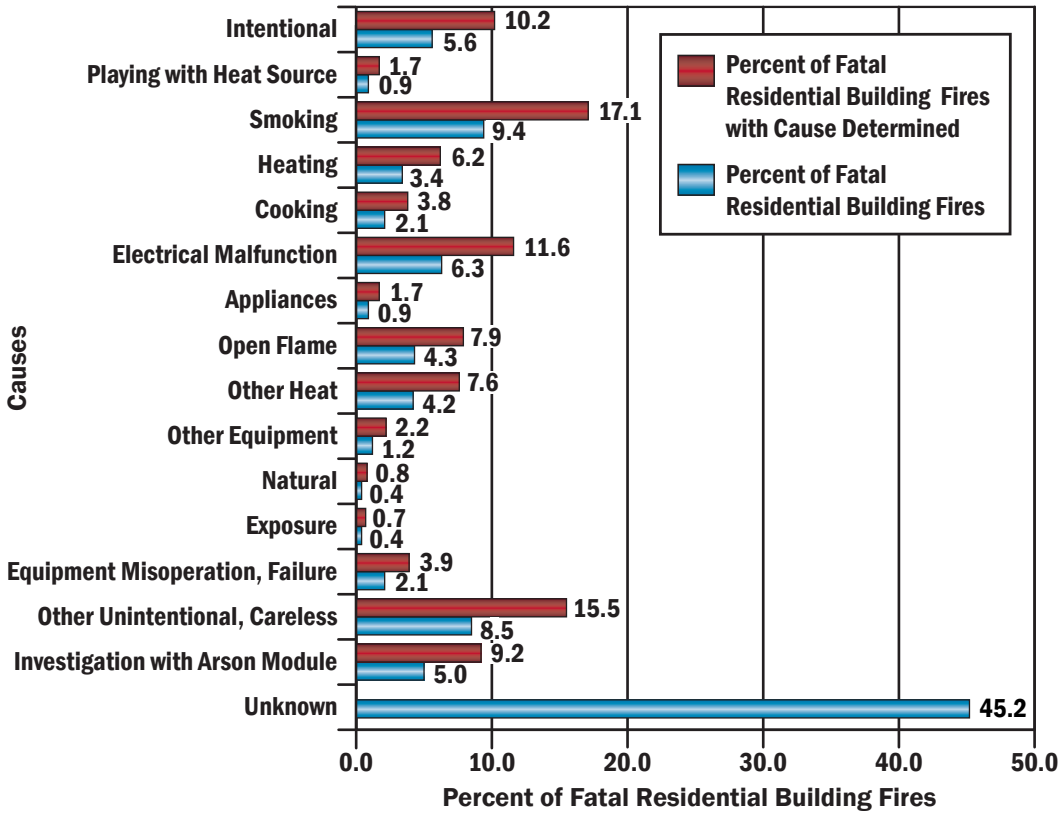
Cause of Fatal Fires

"Smoking" (17 percent) and "other unintentionally set, careless" actions (16 percent) are the leading causes of residential fires that result in fatalities—fatal fires. These two fire causes account for one-third of all fatal fires. The next two leading causes, "electrical malfunctions" (12 percent) and "intentionally set fires" (10 percent), combined, account for an additional 22 percent of fatal residential fires as shown in Figure 5.[8] The cause of the fire was "undetermined" in 45 percent of fatal fires.

Cause of Fatalities per 100 Fatal Fires

Other equipment fires produce the largest number of fatalities per 100 fatal fires, 138 fatalities per 100 fatal fires (Figure 6). This is followed by intentionally set fires (131 fatalities per 100 fatal fires), fires caused by play with the heat source (129 fatalities per 100 fatal fires), and electrical malfunctions (125 fatalities per 100 fatal fires). The least number of fatalities, 108 fatalities per 100 fatal fires, are caused by exposure fires.

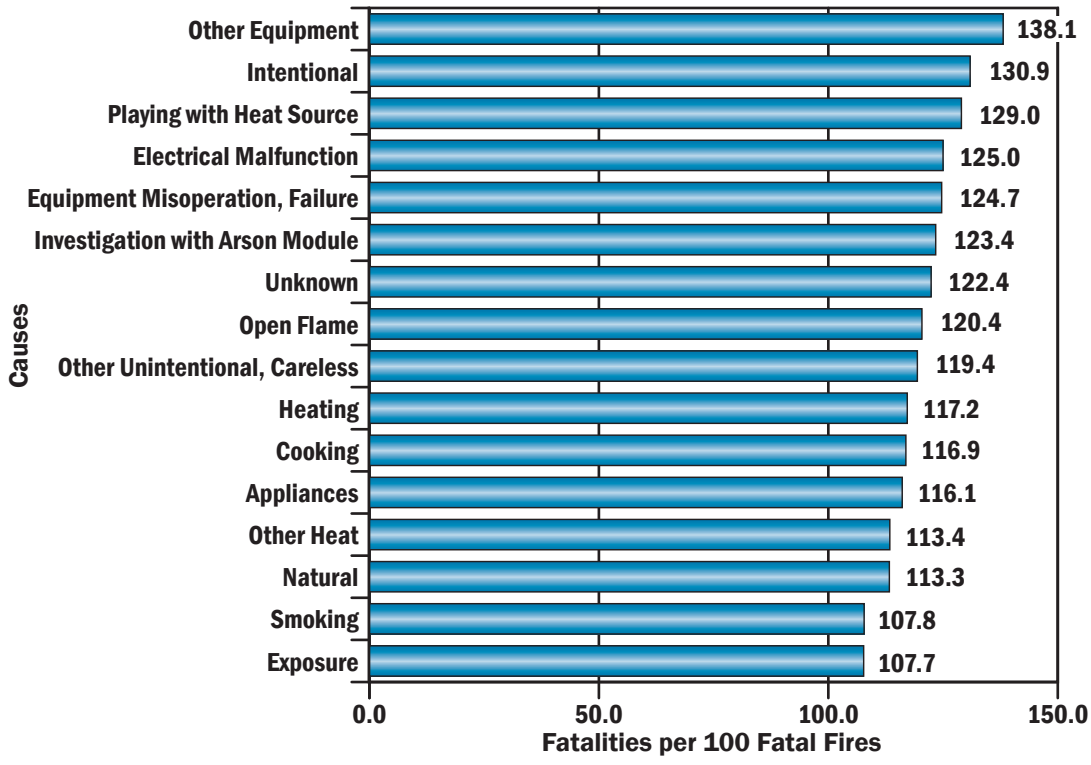
Figure 5. Causes of Fatal Residential Building Fires (2007–2009)



Source: NFIRS 5.0.

Note: Causes are listed in order of the U.S. Fire Administration (USFA) Cause Hierarchy for ease of comparison of fire causes across different aspects of the fire problem. Fires are assigned to 1 of 16 cause groupings using a hierarchy of definitions, approximately as shown in the chart above. A fire is included in the highest category into which it fits. If it does not fit the top category, then the second one is considered, and if not that one, the third, and so on. For example, if the fire is judged to be intentionally set and a match was used to ignite it, it is classified as intentional and not open flame because intentional is higher in the hierarchy.

Figure 6. Cause of Civilian Fatalities per 100 Fatal Residential Building Fires (2007–2009)

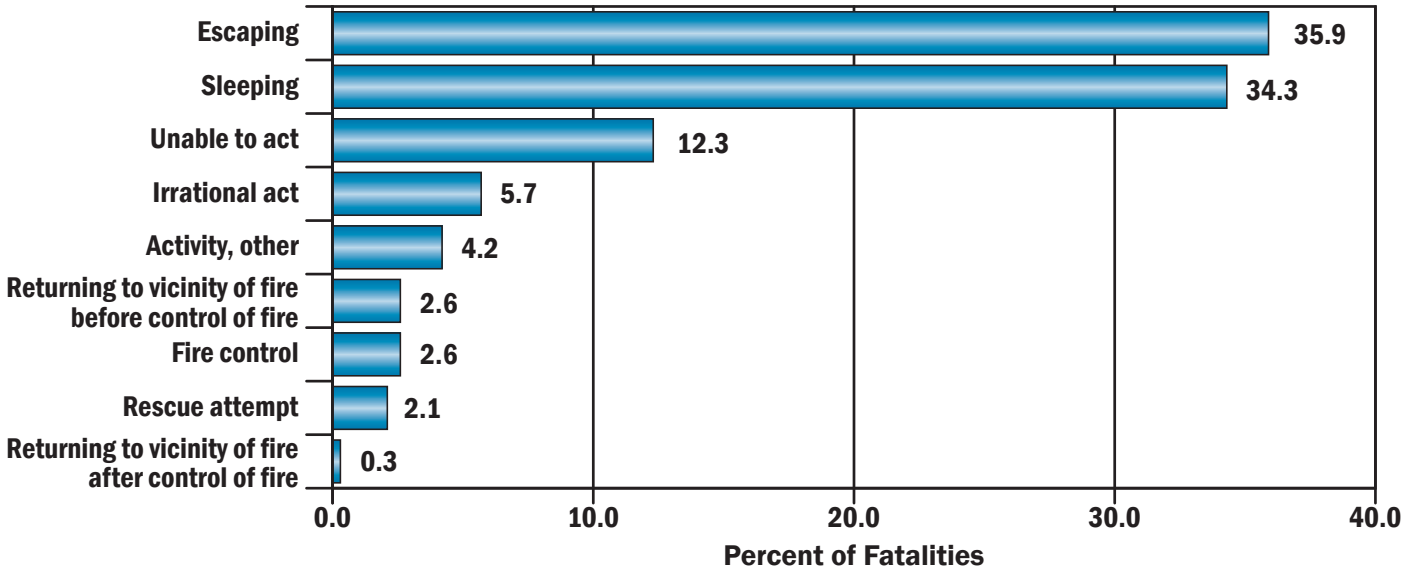


Source: NFIRS 5.0.

Civilian Activity Prior to Death

Most civilian fire fatalities occur when the victim is attempting to escape (36 percent) or is sleeping (34 percent) as shown in Figure 7. The area of a fire has tremendous heat, smoke, and a toxic atmosphere that can render a person unconscious. Smoke alarms are more effective for waking people when they are asleep during a fire than a person's sense of smell. A person does not wake up from the smell of fire while sleeping.[9]

Figure 7. Civilian Activity Prior to Death in Residential Building Fires (2007–2009)



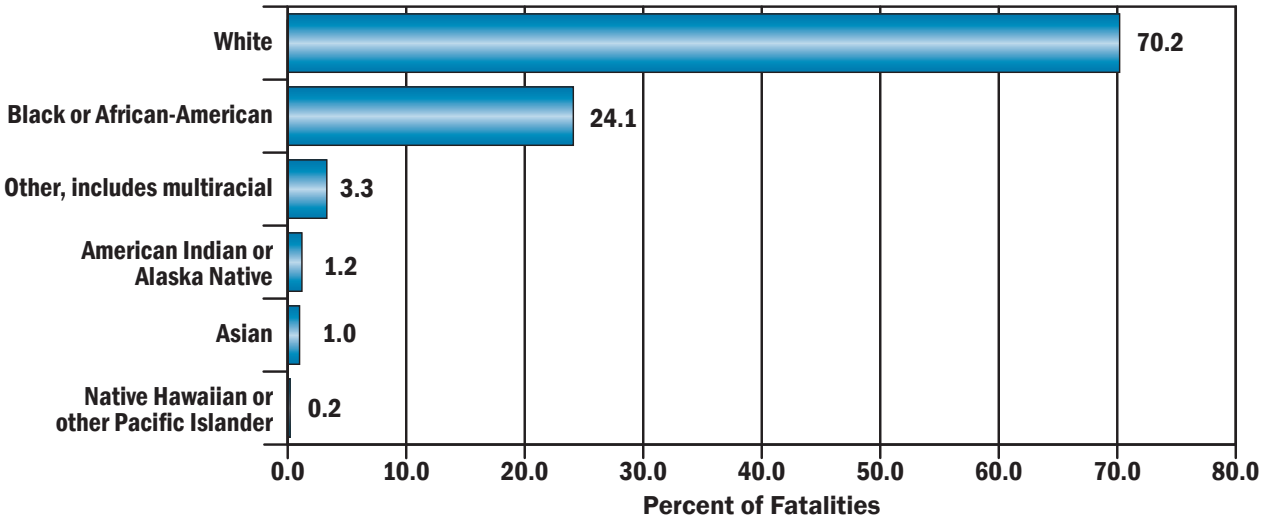
Source: NFIRS 5.0.
Note: Percentages computed for only those fatalities where activity information was available.

Gender, Race, and Ethnicity of Civilian Fire Fatalities

Males accounted for 57 percent of residential fire fatalities; women accounted for 43 percent of fire fatalities.[10] Where racial information was provided, whites constituted 70 percent of the fatalities followed by Blacks or African-Americans (24 percent). All other races accounted for 6 percent of fire fatalities (Figure 8). Race was not specified for 37 percent of the fatalities.

Where ethnicity data were provided, 92 percent of civilian fatalities were non-Hispanic or non-Latino. The remaining 8 percent were Hispanic or Latino. Ethnicity was not specified for 58 percent of the fatalities.

Figure 8. Civilian Fire Fatalities in Residential Buildings by Race (2007–2009)



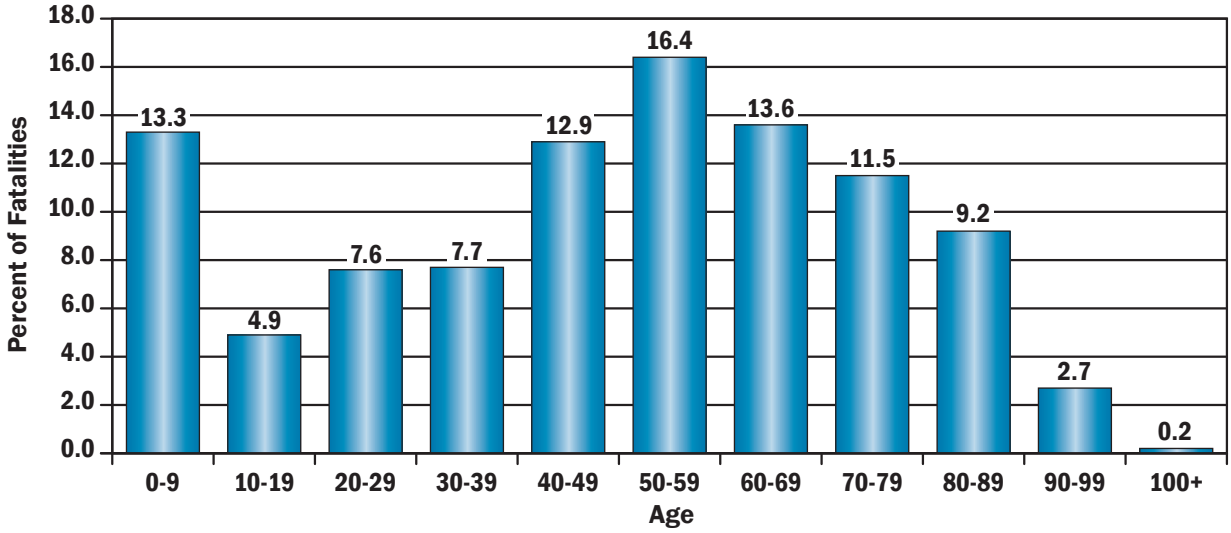
Source: NFIRS 5.0.
Note: Percentages computed for only those fatalities where race information was available.

Age and Activity Prior to Death

Approximately 43 percent of civilian fatalities in residential building fires were between the ages of 40 and 69 (Figure 9). Thirteen percent of fatalities were less than 10 years old. Adults over age 70 accounted for 24 percent of fatalities.

Where the information was reported, at the time of death, escaping (36 percent) and sleeping (34 percent) were the two leading activities that resulted in fatalities. Children aged 0 to 9, were primarily sleeping (49 percent) or trying to escape (25 percent). With the exception of adults aged 20 to 39 and older adults over age 99, civilian fatalities over the age of 10 were more likely trying to escape at the time of their deaths as opposed to sleeping (Table 3). Of all age groups, young adults between the ages of 20 to 29 were more likely than any other age group to perish during a rescue attempt (7 percent), while civilians between the ages of 70 to 79 were the most likely age group to die while trying to control a fire (7 percent). Overall, activity at the time of the fatal injury was reported for 35 percent of the fatalities.

Figure 9. Civilian Fire Fatalities in Residential Buildings by Age (2007–2009)



Source: NFIRS 5.0.
Note: Percentages computed only for those fatalities where age was valid.

Table 3. Leading Activities Resulting in Civilian Fire Fatalities in Residential Buildings by Age Group (Percent of Fatalities Where Age and Activity Reported, 2007–2009)

Age Group	Escaping	Sleeping
0-9	24.6	49.1
10-19	41.8	38.0
20-29	33.9	38.0
30-39	35.2	37.5
40-49	37.2	37.2
50-59	36.7	31.0
60-69	39.2	22.7
70-79	36.5	29.6
80-89	41.2	25.7
90-99	47.8	32.6
100 +	0.0	100.0
Overall	35.9	34.3

Source: NFIRS 5.0.
Note: Percentages computed only for those fatalities where age was valid and activity was reported.

Specific Location of Fire Fatality

Most fire fatalities occurred in bedrooms (55 percent). Common rooms, such as dens, family rooms, living rooms, or lounges (9 percent), kitchens and cooking areas (7 percent), other functional areas (6 percent), and bathrooms and lavatories (5 percent) accounted for an additional 27 percent.

While not specific rooms in the home, egress areas accounted for 10 percent of fatalities. Exits such as corridors, stairways, and doors can get filled with smoke, fire, or extreme heat making escape routes treacherous.

Examples

The following recent examples illustrate fire scenarios in which civilian fatalities have occurred.

- January 2010: An early morning house fire killed a family of three in Columbia Falls, MT. The fire was believed to have started when the heat from a woodstove ignited nearby combustible materials. The family died as a result of smoke inhalation. Three smoke alarms were found in the house but none of them had batteries.[11]
- January 2010: An improperly discarded cigarette was the cause of an apartment building fire that killed one person and injured four others in Wilmington, NC. The early morning fire took firefighters 3 hours to extinguish. The smoke alarms were disabled during the fire, since the flames quickly reached the attic, destroying the electrical wiring. The building, due to its age, had no sprinklers or battery-operated smoke alarms present. Many people were alerted about the fire when others banged on their doors.[12]
- February 2010: A fire broke out in a large apartment complex around 1:47 a.m. killing a mother, her two children, and her boyfriend. The cause of the fire is being investigated by the Houston Fire Department arson division but residents of the building believe it may have been started by a cigarette, since both adults smoked. There were smoke alarms present, according to the apartment complex manager, but she is not sure if they were working.[13]
- March 2010: An 89-year old woman died from smoke inhalation when a lamp in her home electrically malfunctioned, igniting her chair. Shortly before 2 a.m. the authorities received a call from her emergency alert device, ordering them to respond to her home in Wapakoneta, OH. When the paramedics arrived, the fire had nearly burned out due to lack of oxygen. The victim was found unresponsive near the back door of her residence and was soon after pronounced dead at the hospital.[14]
- February 2011: Investigators determined the fire that killed a 35-year-old male started as the result of careless disposal of smoking materials in a plastic trash can in the victim's second floor bedroom. The victim apparently tried to put out the flames himself, and also may have tried to rescue family pets, officials added. The coroner noted that the victim died of smoke inhalation and may have been overcome by smoke while trying to rescue pets.[15]

Escape Planning for Residential Buildings

Everyone should know how to escape from his or her residence. The U.S. Fire Administration (USFA) recommends leaving fighting a fire to trained firefighters. Instead, efforts should be focused on following a preset escape plan.

A home filled with smoke is a very dangerous situation. Smoke blocks vision, and the toxic gases can cause dizziness, disorientation, and ultimately death. Under these conditions, one can easily become lost or trapped in the home. Unfamiliarity with exits, excessive distance to the nearest exit, or an inappropriate choice of exit can hinder a crucial escape. Many civilian fatalities occur as the victim is trying to escape. With a well thought out plan and multiple escape options, your chances of survival greatly increase.

The first step in an escape plan is to make sure smoke alarms are installed on every level of the home and are in good working order. Plan and practice at least two escape routes for every room and have procedures in place for those who require additional help such as infants, the elderly, and the disabled.

NFIRS Data Specifications for Civilian Fire Casualties in Residential Building

Data for this report were extracted from the NFIRS annual Public Data Release (PDR) files for 2007, 2008, and 2009. Only version 5.0 data were extracted.

Civilian casualties in residential building fires are defined using:

- Aid Types 3 (mutual aid given) and 4 (automatic aid given) are excluded to avoid double counting of incidents.

- Incident Types 111 to 123:

Incident Type	Description
111	Building fire
112	Fires in structure other than in a building
113	Cooking fire, confined to container
114	Chimney or flue fire, confined to chimney or flue
115	Incinerator overload or malfunction, fire confined
116	Fuel burner/boiler malfunction, fire confined
117	Commercial compactor fire, confined to rubbish
118	Trash or rubbish fire, contained
120	Fire in mobile property used as a fixed structure, other
121	Fire in mobile home used as fixed residence
122	Fire in motor home, camper, recreational vehicle
123	Fire in portable building, fixed location

  Incident Type 112 is included prior to 2008, as previous analyses have shown that Incident Types 111 and 112 were used interchangeably. As of 2008 and 2009, Incident Type 112 is excluded.

  Note that Incident Types 113 to 118 do not specify if the structure is a building.

- Property use 400-464 is included to specify residential buildings:

Property Use	Description
400	Residential, other
419	One- or two-family dwelling
429	Multifamily dwelling
439	Boarding/Rooming house, residential hotels
449	Hotel/Motel, commercial
459	Residential board and care
460	Dormitory-type residence, other
462	Sorority house, fraternity house
464	Barracks, dormitory

- Structure Type:
  - For Incident Types 113-118:
    - 1—Enclosed building,
    - 2—Fixed portable or mobile structure, and
    - Structure Type not specified (null entry).
  - For Incident Types 111, 112, and 120-123:
    - 1—Enclosed building, and
    - 2—Fixed portable or mobile structure.
- Civilian casualty severity: 5 (death)
- Other civilian deaths: greater than 0

The analyses contained in this report reflect the current methodologies used by the USFA. The USFA is committed to providing the best and most current information on the United States fire problem, continually examining its data and methodology to fulfill this goal. Because of this commitment, data collection strategies and methodological changes are possible and do occur. As a result, analyses and estimates of the fire problem may change slightly over time. Previous analyses and estimates on specific issues (or similar issues) may have used different methodologies or data definitions and may not be directly comparable to the current ones.

To request additional information or to comment on this report, visit http://www.usfa.dhs.gov/applications/feedback/index.jsp

Notes:

[1] In the National Fire Incident Reporting System (NFIRS) 5.0, a structure is a constructed item of which a building is one type. The term "residential structure" commonly refers to buildings where people live. The definition of a residential structure fire has, therefore, changed to include only those fires where the NFIRS 5.0 structure type is 1 or 2 (enclosed building and fixed portable or mobile structure) with a residential property use. Such fires are referred to as "residential buildings" to distinguish these buildings from other structures on residential properties that may include fences, sheds, and other uninhabitable structures. Confined fire incidents without a structure type specified are presumed to be buildings. Nonconfined fire incidents without a structure type specified are considered to be invalid incidents (structure type is a required field) and are not included.

[2] Based on analysis of residential building fire deaths since 2003, the first year residential building estimates are available, (http://www.usfa.dhs.gov/statistics/estimates/index.shtm) and the NFPA annual estimate of fire deaths (http://www.nfpa.org/itemDetail.asp?categoryID=953&itemID=23033&URL=Research/Fire%20statistics/The%20U.S.%20fire%20problem). The consistency of the percentage of residential building fire deaths leads analysts to believe this proportion has most likely been stable for some time.

[3] NFIRS 5.0 contains both converted NFIRS 4.1 data and native NFIRS 5.0 data. This topical report includes only native 5.0 data and excludes Incident Type 110 since it is a 4.1 conversion code.

[4] National estimates are based on 2007–2009 native version 5.0 data from NFIRS, residential structure fire loss estimates from the National Fire Protection Association's (NFPA's) annual surveys of fire loss, and the U.S. Fire Administration's (USFA's) residential building fire loss estimates. Fires are rounded to the nearest 100, deaths to the nearest 5, injuries to the nearest 25, and loss to the nearest $million.

[5] The average fire fatality rates computed from the national estimates will not agree with average fire fatality rates computed from NFIRS data alone. The fire fatality rate for fatal fires computed from the national estimates would be (1,000*(2,630/1,700)) = 1,547.1 deaths per 1,000 fatal residential building fires. The fire fatality rate for all residential fires computed from the national estimates would be (1,000*(2,630/374,900)) = 7.0 deaths per 1,000 residential building fires.

[6] For the purposes of this report, the time of the fire alarm is used as an approximation for the general time the fire started. However, in NFIRS, it is the time the fire was reported to the fire department.

[7] "Smoke Inhalation." PDR health. http://www.pdrhealth.com/disease/disease-mono.aspx?contentFileName=ND7357G.xml&contentName=Smoke+Inhalation&contentId=1097&TypeId=2.

[8] The USFA cause hierarchy was used to determine the cause of fatal residential building fires: http://www.usfa.dhs.gov/fireservice/nfirs/tools/fire_cause_category_matrix.shtm.

[9] Brown University, "Scents Will Not Rouse Us From Slumber, Says New Brown University Study." *Science Daily*, May 2004, (Providence, RI) http://www.sciencedaily.com/releases/2004/05/040518075747.htm.

[10] This excludes two entries where the gender information was not provided.

[11] Dan Testa, "UPDATE: Columbia Falls House Fire Kills Three; Victims Identified," flatheadbeacon.com, January 22, 2010. http://www.flatheadbeacon.com/articles/article/columbia_falls_house_fire_kills_three/15552/ (accessed May 25, 2010).

[12] Claire Simms and Debra Worley, "Authorities say Cypress Pointe Apt. fire was accidental," wect.com, January 6, 2010. http://www.wect.com/Global/story.asp?S=11772824 (accessed May 25, 2010).

[13] James Pinkerton and Mike Glenn, "Couple, 2 kids die in smoky blaze," chron.com, February 19, 2010. http://www.chron.com/disp/story.mpl/metropolitan/6874964.html (accessed May 25, 2010).

[14] Tyrel Linkhorn, "Lamp sparked fatal Wapak fire," limaohio.com, April 15, 2010. http://www.limaohio.com/articles/wapak-49144-justify-align.html (accessed May 25, 2010).

[15] Adam Mawson, "Fatal fire ruled accidental; careless smoking to blame, officials say," morningjournal.com, February 10, 2011. http://www.morningjournal.com/articles/2011/02/10/news/mj4088560.txt (accessed March 30, 2011).