U.S. Fire Administration/National Fire Data Center

Fire in the United States 1992–2001

Thirteenth Edition

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Department of Homeland Security
Federal Emergency Management Agency
United States Fire Administration
National Fire Data Center

U.S. Fire Administration Mission Statement

As an entity of the Federal Emergency Management Agency, the mission of the United States Fire Administration is to reduce life and economic losses due to fire and related emergencies through leadership, advocacy, coordination, and support. We serve the Nation independently, in coordination with other Federal agencies and in partnership with fire protection and emergency service communities. With a commitment to excellence, we provide public education, training, technology, and data initiatives.

On March 1, 2003, FEMA became part of the U.S. Department of Homeland Security. FEMA's continuing mission within the new department is to lead the effort to prepare the Nation for all hazards and effectively manage Federal response and recovery efforts following any national incident. FEMA also initiates proactive mitigation activities, trains first responders, and manages the Citizen Corps, the National Flood Insurance Program, and the U.S. Fire Administration.

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The United States Fire Administration greatly appreciates the participation in the National Fire Incident Reporting System (NFIRS) of nearly 13,000 fire departments across the United States. The NFIRS data, on which the bulk of this report is based, are available through the work of the staffs of the various state agencies and state fire marshals' offices responsible for fire data collection and on each and every fire officer who fills out an NFIRS form. Without their efforts to collect data, this report could not exist. Although reporting to NFIRS is wholly voluntary, the information collected on nearly 600,000 fires each year represents the most comprehensive set of fire data and statistics in the world.

The National Fire Information Council (NFIC), a nonprofit organization of the state and metropolitan area participants in NFIRS, helps coordinate and specify requirements for NFIRS and its operation. NFIC represents an outstanding example of local, state, and federal cooperation on a major, long-term undertaking.

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Documents may also be ordered on the World Wide Web: http://www.usfa.fema.gov/applications/publications.

The United States Fire Administration also thanks the many state fire marshals' offices or their equivalents for their assistance with, and input to, the state fire death data presented in Chapter 2.

Executive Summary

Fire departments in the United States respond to nearly 2 million fire calls each year. The U.S. fire problem, on a per capita basis, is one of the worst in the industrial world. Thousands of Americans die each year, tens of thousands of people are injured, and property losses reach billions of dollars. There are huge indirect costs of fire as well—temporary lodging, lost business, medical expenses, psychological damage, pets killed, and others. These indirect costs may be as much as 8 to 10 times higher than the direct costs of fire. To put this in context, the annual losses from floods, hurricanes, tornadoes, earthquakes, and other natural disasters combined in the United States average just a fraction of those from fires. The public, the media, and local governments are generally unaware of the magnitude and seriousness of the fire problem to individuals and their families, to communities, and to the nation.

PURPOSE AND SCOPE

The National Fire Data Center (NFDC) of the U.S. Fire Administration (USFA) periodically publishes *Fire in the United States*—a running 10-year statistical overview of the fires in the United States with the focus on the latest year in which data were available at the time of preparation. This report is designed to arm the fire service and others with information that motivates corrective action, sets priorities, targets specific fire programs, serves as a model for state and local analyses of fire data, and provides a baseline for evaluating programs.

This Thirteenth Edition covers the 10-year period from 1992 to 2001, with emphasis on 2001. The primary source of data is from the National Fire Incident Reporting System (NFIRS). National Fire Protection Association (NFPA) annual survey results, mortality data from the National Center for Health Statistics (NCHS), data from state fire marshals offices or their equivalents, and statistics from the U.S. Census Bureau and the Consumer Price Index are also used. Because of the time it takes for states to submit data to USFA from the thousands of fire departments that participate in NFIRS, then edit and obtain corrections, and analyze and display the results, the publication lags the date of data collection. Fortunately, the fire problem does not change very rapidly so the data are usually quite representative of the situation in the year of publication as well.

The attacks on the World Trade Center and the Pentagon on September 11, 2001, resulted in the deaths of 2,451 civilians and 341 firefighters[1] and a property loss estimate of more than

[1] These 341 casualties do not include three WTC fire safety directors who received benefits from the Department of Justice's Public Safety Officers' Benefits Program.

$33 billion. For the most part, these statistics are omitted from this report as such extreme losses distort the historical picture of U.S. fires and fire losses over a period of time.

LOSSES BY PROPERTY TYPE

Annual deaths from fire in the United States were estimated at 12,000 in 1974, the year in which the USFA was established. At that time, a goal was set for reducing this number by half within a generation. This goal was met, and in 1999 civilian deaths were at their lowest level (3,570).

Table 1 presents the rate of U.S. fire losses for all property types in 2001 and the 10-year trends.[2] Deaths and injuries per million population reached 10-year lows, and fires per million population were up slightly from their 2000 low. The death rate of 13 per million population is half what it was in the late 1970s. Nevertheless, the United States has a fire death rate two to two and one-half times that of several European nations and at least 20 percent higher than many. The World Fire Statistics Centre ranks the United States as 20th of 25 industrialized nations.

Table 1. Fire and Fire Loss Rates in All Properties

Loss Measure	2001	10-Year Trend (percent)
Fires/Million Population	6,080	–23.9
Deaths/Million Population	13.1	–29.6
Injuries/Million Population	71.2	–38.3
Dollar Loss/Capita*	37.1	–6.0

*Adjusted to 2001 dollars.

Sources: NFPA, Consumer Price Index, and U.S. Census Bureau

Another way to look at the U.S. fire situation is the loss per fire. Table 2 summarizes the losses per 1,000 fires by general property type and the dollar loss per fire; the 10-years trends for these property types are also included. Deaths and injuries per 1,000 fires in 2001 in these properties were either lower or equal to those in 1998, the last year covered by the 12th edition of this publication.

The number of fires, deaths, and injuries in all properties have spiraled downward since 1974 and in the 10-year period 1992–2001, the downward trends were sharper than in the last reported 10-year cycle 1989–1998 (Table 3).

[2] Chapter 1 describes in detail the methodology used in this report, including how trends are calculated and how "unknown" records are allocated.

Table 2. Losses Per Fire in 2001 and Trends by General Property Type

General Property Type	2001			10-Year Trend (percent)		
	Deaths/ 1,000 Fires	Injuries/ 1,000 Fires	Dollar Loss/ Fire	Deaths	Injuries	Dollar Loss
Residential	7.4	36.4	$13,200	–8.8	–23.3	+3.9
Non-Residential	1.0	14.7	20,600	–31.6	–33.8	–13.7
Vehicle	1.7	4.8	3,900	+0.9	–39.8	+28.3
Outside	0.1	1.3	200	–30.0	–26.1	–5.4
Other	0.9	11.1	3,100	–53.8	–55.0	–35.3

Sources: NFIRS and Consumer Price Index

Table 3. 10-Year Trends for Property Fires and Losses (percent)

Property	Fires	Deaths	Injuries	Dollar Loss*
All Properties	**–15.5**	**–21.8**	**–31.3**	**+4.7**
Residential Properties	–21.0	–18.5	–28.9	+6.1
One-/Two-Family Dwellings	–23.1	–15.6	–27.0	+4.3
Apartments	–15.8	–25.7	–33.3	+13.9
Other Properties	–3.1	–75.8	–34.3	+27.7
Non-Residential Properties				
Structures	–21.8	–48.4	–45.7	–14.3
Mobile Properties	–17.1	–32.4	–41.8	+18.9
Outside	–13.3	–28.7**	+11.9**	–14.5
Other	+5.0			+95.1

*Adjusted to 2001 dollars.
**Combines outside and other deaths and injuries, as the "other" category was not calculated separately.
Sources: NFPA and Consumer Price Index

Residential Properties

Fire statistics for three major residential property groups were examined: one- and two-family dwellings, apartments, and other properties such as hotels/motels, rooming houses, and dormitories. A subset of one- and two-family housing, mobile properties used as fixed residences, was also studied.

One- and two-family dwellings, where 73 percent of the population lives, dominate the residential fire picture in 2001: 73 percent of fires, 78 percent of deaths, 67 percent of injuries, and 76 percent of dollar loss. Cooking is the leading cause of fires and injuries in these structures. Smoking is the leading cause of deaths, followed closely by arson. These two causes alone are responsible for 42 percent of deaths. Arson is the leading cause of dollar loss. Heating is the second leading cause of one- and two-family dwelling fires (19 percent) slightly behind cooking (25 percent). Heating plays a much less prominent role in other dwelling fires. Perhaps homeowners are not as attentive as apartment management in maintaining their heating systems. This could be an area of fire prevention focus.

The leading causes discussed above remain unchanged year after year. The children playing cause, however, has dramatically decreased. Each year in the mid 1980s, children playing was reported as the cause of up to 22,000 fires and more than 400 deaths. In 2001, children playing fires dropped to 6,000 and deaths to 89. Some of this decline may be due to definitional changes from NFIRS 4.1 to 5.0, but certainly public education efforts that have targeted this problem have played a major role in the decline.

A mobile home used as a fixed residence (also known as a type of manufactured housing) is a subset of one- and two-family dwellings. Deaths and injuries per fire incident are higher in these dwellings than in residential properties overall. Ten-year trends, however, in fires and losses have declined notably (between 48 and 57 percent) due in large part to strict standards established by HUD in 1976 for improving fire safety and by the use of improved building materials.

In 2001, apartments represented 23 percent of residential property fires, 18 percent of deaths, 29 percent of injuries, and 20 percent of dollar loss. The 10-year trend in the number of fires declined, although at a slower rate than one- and two-family residences (16 vs. 23 percent). On the other hand, the decline in the death trend was sharper in apartments. Cooking leads the causes for apartment fires by a factor of five over the next leading cause. Smoking accounts for 35 percent of apartment deaths, but its 10-year trend has declined 27 percent. Arson fires and injuries have trended down more than 40 percent, but deaths have increased 34 percent over 10 years. Apartments tend to be more regulated by building codes than one- and two-family dwellings. Most are rental properties, often falling under stringent fire prevention statutes. Because apartment buildings usually have large clusters of similar people, prevention programs can be tailored to the cause profiles of apartment buildings in different areas of the community. Further study is recommended on the cooking, smoking, and arson problems in apartments.

Other residential properties include rooming houses, dormitories, home hotels, halfway houses, hotels/motels, and miscellaneous and unclassified properties reported as residences. For all loss measures, this category represents only 3 to 5 percent of the residential fire situation. Still, in 2001, there were 13,000 estimated fires in these structures. The number of fires has decreased slightly (3 percent) over the 10-year period, but deaths and injuries have decreased 76 and 34 percent, respectively. Cooking was the leading cause of these fires by a factor of three over the next leading cause. Deaths and injuries are too few to draw meaningful comparisons.

For both one- and two-family residences and apartments, statistics were compiled for where fires started and when they occurred (time of day, month of year) to determine whether any changes in trends emerge. Findings in this report are unchanged from prior years. The kitchen is the area where more fires start than any other location in the home. This is consistent with cooking as the major cause of fires. Cooking fires and injuries in apartments, however, have a higher incidence than in one- and two-family dwellings. Deaths in both structures are highest in living/family rooms and bedrooms. This finding is consistent with smoking as the cause, perhaps because people fall asleep smoking in bed or on upholstered furniture.

In both types of homes, fires and injuries are highest between 5 and 7 p.m.—the cooking hours—and lowest from 4 to 6 a.m. when people are asleep. Deaths peak in the early morning hours from midnight to 5 a.m. Here, smoldering materials from careless smoking may ignite and trap the sleeping residents. Arson is another cause of early morning fires resulting in deaths. Fires and deaths are greatest in the winter months. This is probably because heating fires are added to other causes and because seasonal factors such as the presence of dry Christmas trees and the use of holiday candles contribute to the residential fire problem.

Non-Residential Properties

Non-residential properties include industrial and commercial properties, institutions (such as hospitals, nursing homes, and prisons), educational establishments, storage properties, and mobile properties. They are divided into three categories: structures, vehicles, and outside/other fires. Two changes have been made since the publication of the 12th edition. Detached residential garages are now considered storage structures, and vacant and under construction properties are no longer a separate property type but rather are considered with the primary property type of the new construction or the primary property type of the previous property use.

Although the 2,451 civilians killed, 800 injured, and $33 billion in property loss due to the World Trade Center and Pentagon attacks on September 11, 2001, are considered non-residential property losses, they have been omitted from the following discussion as explained previously.

As derived from NFPA's annual survey, only 7 percent of fires, 2 percent of deaths, and 8 percent of injuries are attributed to 2001 non-residential property fire incidents. These properties, however, account for a disproportionately large annual dollar loss, 31 percent. The small percentages of fires, deaths, and injuries should not obscure the fact that they represent thousands of fires and hundreds of casualties. Table 4 provides a snapshot of the percentage of non-residential structure losses in 2001 by property type. The dollar loss per fire in non-residential

Table 4. 2001 Non-Residential Structure Fires and Fire Losses by Property Type (percent)

Property Type	Fires (47,785 cases)	Deaths (47 cases)	Injuries (701 cases)	Dollar Loss ($986.2 million)
Public Assembly	4.5	2.1	3.6	5.1
Eating/Drinking	8.0	6.4	7.3	8.4
Educational	5.7	0.0	4.6	3.9
Institutional	5.9	12.8	13.1	1.4
Stores, Offices	18.1	10.6	21.7	27.8
Basic Industry	2.7	10.6	2.8	5.8
Manufacturing	7.5	10.6	16.5	20.3
Storage	18.1	23.4	13.3	16.7
Residential Garages	7.0	6.4	6.4	2.7
Other/Outside Structures	22.5	17.0	10.8	7.6

Source: NFIRS

structures is higher than in residential structures ($20,600 vs. $13,200) primarily because buildings are often larger and the contents may have high value. The per-fire dollar losses for each of the non-residential structures are shown in Chapter 4, Table 17.

Arson has always been the leading cause of all non-residential structure fires and dollar loss. In fact, arson property losses are twice those of the next leading cause category, and represent 30 percent of all property losses.

In 2001, vehicle fire incidents accounted for one in every five fire department responses. Transportation vehicles accounted for 13 percent of U.S. fire deaths, 9 percent of fire injuries, and 14 percent of dollar losses. Ten-year trends for vehicle fires have declined 17 percent, while deaths and injuries have decreased notably (32 and 42 percent, respectively). These declines probably result from the greater attention paid toward designing safety into newer vehicles. Dollar losses have increased 19 percent, largely due to the increasingly higher cost of transportation vehicles. Automobile statistics dominate the transportation vehicle category.

The outside and other properties category includes all fires that are not structure or vehicle fires. The primary components of this category are trees, brush, and grass fires; outside with value fires; and refuse fires. Trees, brush, and grass fires account for half of the outside and other fires. Outside and other fires comprise roughly 50 percent of all fires in the United States, an average of 917,000 fires each year. Although large in number, they accounted for only 1 percent of deaths and 6 percent of injuries.

Setting a value for outside fire damage is difficult. Damage from these fires often requires labor beyond that of the fire department to clean up and restore the area. They cause esthetic problems that are intangible. Some outside fires spread to structural properties and may be reported as structural fires rather than an outside fire with exposure to structures. Outside fires can also have other indirect costs, such as the financial impact on agricultural communities where a fire destroys crops. Additionally, forest fires and other wildfires are not reported to NFIRS if the state or federal agency with principal authority for fighting the fire does not participate in NFIRS.

The leading cause of all forms of outside fires is arson, with many thought to be set by children and adolescents. However, determining the cause of these fires is often difficult and results in most outside and other fires having an unknown cause. Apportioning such large numbers of "unknowns" to the "knowns" may distort the true picture.

DETECTION AND EXTINGUISHMENT SYSTEMS

Structures equipped with smoke alarms or automatic extinguishing systems (AESs)—most often sprinkler systems—are thought to account for a significant part of the decrease in reported fires and deaths over the past two decades.

Over 90 percent of U.S. households now have at least one smoke alarm. Households with no installed alarms have a greater incidence of reported fires than those with functioning smoke alarms. Either people with alarms are more safety conscious or the alarms allow early detection and extinguishment so that the fires are not reported. Anecdotal information suggests that reported fires are more prevalent in older, less well cared for homes, and these are less likely to be equipped with a smoke alarm. Table 5 shows the performance of smoke alarms in residential properties in 2001. Only 67 percent of households that had fires were reported to be equipped with a smoke alarm, slightly below the national average. Only 60 percent of households where a fire death occurred were equipped with a smoke alarm; of those, 39 percent did not operate. These results clearly indicate that smoke alarms do contribute to saving lives.

Table 5. 2001 Smoke Alarm Performance in Residences (2001) (percent)

Residential Property Type	Present/ Operated		Present/Did Not Operate		No Alarm	
	Fires	Deaths	Fires	Deaths	Fires	Deaths
All Residences	51.5	39.4	15.7	20.7	32.8	39.9
One and Two Family	45.0	34.3	16.6	19.8	38.3	46.0
Apartments	71.6	70.3	14.4	23.5	13.9	6.2

Note: "Unknowns" apportioned.

Source: NFIRS

One- and two-family homes in which fires occur have, proportionally, fewer alarms installed than in apartments that experience fires. This may be because apartment smoke alarms are often provided by landlords and are more often required by law than one- and two-family dwellings.

The fact that smoke alarms worked in 70 percent of apartments in which a death occurred is troublesome. Explanations include the possibility that hallway or apartment alarms operated after the victims were overcome or that there were fewer ways to escape, especially on higher floors. It also may be linked to the lower socioeconomic level of many apartment dwellers. This situation suggests the need to provide sprinklers in apartments and to emphasize fire prevention to occupants. Additionally, multiple false alarms may occur in apartments due to smoke from burning food or pots. Because of these repetitive incidents, tenants may be more inclined to ignore the fire alarm.

Another surprising fact is that in residences where a death occurred, a higher percentage of smoke alarms did not operate in apartments than in one- and two-family homes. This result is unexpected as apartment alarms are more likely to be hardwired into the electrical system and professionally maintained than alarms in dwellings.

Residential sprinklers were found in fewer than 3 percent of homes that had reported fires in 2001. The actual number of sprinklers installed in residences may be underestimated since an operating sprinkler could have extinguished a fire and no call was made to the fire department.

A higher percentage of apartments were equipped with sprinklers than one- or two-family dwellings (8 percent vs. 1 percent). Use of sprinklers in apartments appears to be growing.

Sprinklers and other AESs are more prevalent in non-residential structures (15 percent). This is not unexpected since commercial properties and public assembly sites tend to occupy large structures that have been built to strict construction codes. Also, owners and proprietors of such sites have a great need to protect their property.

The installation of sprinklers provides significant protection against fire. However, this conclusion cannot be drawn from NFIRS data alone since NFIRS combines properties of different size and values in the same property class. Sprinkler systems are more likely to be installed in large and highly valued properties than in small, inexpensive ones.

ETHNIC, AGE, AND GENDER CHARACTERISTICS OF VICTIMS

Fire losses affect all groups and races, rich and poor, North and South, urban and rural. But the problem is higher for some groups than for others. African Americans and American Indians have much higher death rates per capita than the national average. African Americans comprise a large and disproportionate share of total fire deaths, accounting for 25 percent of fire deaths—twice as high as their share of the overall population.

Over the past 10 years, nearly twice as many men have died in fires as women, although the proportion has narrowed slightly in recent years. The reasons for the disparity of fire injuries between men and women are not known for certain. Suppositions include the greater likelihood of men being intoxicated, the more dangerous occupations of men (most industrial fire fatalities are males), the greater use of flammable liquids by men, and the fact that risk taking is predominately a male attribute. After age 60, more females died than did males, but this is because the female-to-male ratio increases (i.e., women live longer than men). Male fire deaths, by contrast, are very much higher in the mid-life years (20–49). The pattern of injuries by gender and age is somewhat the same as the one for deaths. Smoking fires are the leading cause of death to older adults and the second leading cause of their injury, behind cooking.

People with limited physical and cognitive abilities, especially the very young and very old, are at a higher risk of death and injury from fire than other groups. In 2001 alone, USFA estimates that 2,900 children under the age of 15 and 2,200 older adults (65 and older) were injured. Fire deaths for children under the age of 15, as reported from death certificates, numbered 599; an additional 1,250 deaths were reported for older adults. These two age groups accounted for 46 percent of 2001 reported fire deaths and 25 percent of estimated fire injuries. Most of these injuries and deaths occurred in the home, and a large proportion occurred while the victims were asleep.

Children under age 5 are 40 percent more likely to die in a fire than the general population. As the age of the child increases, the likelihood of dying in a fire decreases. African American and American Indian children are nearly twice as likely to die in a fire than white or Asian children.

As baby boomers enter retirement age, the U.S. demographic profile is expected to change dramatically. Over the coming decades, the older population will increase to nearly 20 percent of the total population. Therefore, a corresponding increase in fire deaths and injuries among older adults is likely.

FIREFIGHTER CASUALTIES

The U.S. Fire Administration currently reports that a total of 449 firefighters perished in 2001, 341 of whom were victims of the World Trade Center attacks. The analysis shown here is based on the original 443 in that year's annual report, which do not include three WTC fire safety directors who received benefits from the department of Justice's Public Safety Officers' Benefits Program nor three additional firefighter fatalities that subsequently have been reported to USFA where the incident date causing the death was in 2001. Excluding the WTC deaths, 66 of the 102 firefighters who died were engaged in emergency services, and 38 of these occurred directly during fireground operations. The fatalities included 27 career firefighters and 75 volunteers; 5 were women. Unlike the previous four editions of this document in which the firefighter fatality trend decreased, the 10-year trend from 1992 to 2001 increased 30 percent. Although this jump appears acute, the total deaths are small enough that a change of even a few deaths in a year may dramatically impact the 10-year trend line.

As in all previous years, the most frequent cause of deaths was stress or overexertion. Of the 102 firefighter deaths in 2001, 44 died from heart attacks or strokes. Of these, 33 were over the age of 40, and 24 were over the age of 50. In fact, from 1996 through 2001, 256 firefighters have died as a result of heart attacks and strokes. Recognizing this danger, the USFA has outlined programs, procedures, and activities that encourage firefighters to improve their health regimen.

More firefighters died (14) in 2001 during training exercises than in any of the previous 10 years; 9 were from heart attacks.

In 2001, 82,250 firefighters were injured on duty, half of which were at the fireground. When compared to the 20,300 civilian injuries during this period, firefighters are at considerable risk. Sixty-nine percent of these injuries occurred in residential dwelling fires and 19 percent in non-residential structures. The total number of firefighter injuries in 2001, however, dipped to their lowest point in 10 years, and the overall 10-year injury trend declined 17 percent. Twenty-one firefighters were injured for every 1,000 structure fires in 2001, a cause for concern and a problem that should be investigated further.

The percentages of injuries by firefighter age have not changed much over the past 10 years. More than one-third of injuries occurred to firefighters aged 30–39. The leading cause of injury

among younger firefighters relates to smoke inhalation, and among older firefighters strains and sprains are more common injuries. These results relate to physical fitness variations with age, to the effect of age on assignments, and perhaps to the bravado of younger firefighters.

Adjusted for the unknowns, 96 percent of injuries occur at the fire scene, and 78 percent were injured extinguishing the fire, neutralizing the incident, or providing suppression support.

REGIONAL AND STATE PROFILES

The fire problem varies from region to region and state to state because of variations in climate, socioeconomic status, education, demographics, and other factors. Four states (Alaska, Arkansas, Delaware, and Mississippi) have fire death rates that exceed 25 deaths per million population; this rate is one of the worst among the world's nations. Eleven states, mostly situated in the Southeast, have death rates per million population between 17 and 25. Twenty-three states have fire death rates below the national rate of 13.1 per million population. There has been great progress by states in lowering both the absolute number of deaths and the deaths per capita. As recently as 1996, 12 states (including the District of Columbia) had 25 or more deaths per million population; in 2001, only 4 states had 25 or more.

Ten states in 2001, mostly large population states, account for 45 percent of the national total U.S. fire deaths as reported by state fire marshal offices. Unless their fire problems are significantly reduced, the national total will be difficult to lower.

CONCLUSIONS

This report clearly shows that the fire problem in the United States is improving. Ten-year trends are down. Deaths and injuries to civilians and firefighters are down. Per capita rates are down. Several factors have likely contributed to these trends:

- Smoke alarms, whose usage has become nearly universal over the past two decades.
- Sprinklers, which quickly combat incipient fires, especially in non-residential structures and recently in apartments. Public education programs could better inform homeowners of their value in residences.
- Fire codes, which have been strengthened.
- Construction techniques and materials, which have been specifically targeted to fire prevention.
- Public education at the community, county, state, and federal levels, which seems to be increasing.
- Firefighter equipment and training, which have improved.

Even considering these positive trends, the United States still has a major fire problem vis-à-vis other industrialized nations. The study and implementation of international fire prevention

programs that have proved effective in reducing the number of fires and deaths should be considered.

Other areas of concern include:

- The very young and very old continue to be at high risk.
- Certain ethnic groups are at enormous risk to fire injuries and death.
- Many deaths occur in residences with operating smoke alarms. The 70 percent of apartment fatalities where smoke alarms were operating is a subject for further study.
- Arson is an enormous problem in the United States, especially to outside and non-residential structure properties. Economically, arson accounts for 25 percent of property loss from all fires, double that of the next leading cause.
- The true effectiveness of automatic extinguishment systems needs to be examined.
- Heating is the second leading cause of fire in one- and two-family dwellings. Public awareness programs alerting residents to potential dangers from heating sources should prove effective.
- Aggressive policies need to continue in order to lessen the high proportion of firefighter deaths due to heart attacks.
- Twenty-one firefighters are injured per 1,000 structure fires. Programs to reduce this rate should be developed.
- Contiguous states often have similar fire profiles. A study to determine reasons for this could uncover severe problem areas or, conversely, reveal best practices.
- Many records submitted to NFIRS by participating fire departments provide either incomplete or no information in some of the fields. Additionally, in preparing this report, it is assumed that participating fire departments have reported 100 percent of their fire incidents; however, this is not always the case. The completeness of all the information in the NFIRS modules will contribute to the refinement and confidence level of future analyses.

If we could understand the relative importance of these factors to lessening the fire problem, resources could be better targeted to have the most impact.

chapter one

Introduction

In 1972, the President's Commission on Fire Prevention and Control published *America Burning*. This document was the first in-depth discussion of this country's fire problem, the most severe of the industrialized nations. Much progress has been made toward addressing the United States' fire problem since *America Burning*. No longer does the U.S. fire problem rank as the most severe of the industrialized nations. Nonetheless, the U.S. continues to experience fire death rates and property losses from fire twice that of most of its sister nations.[1] Many Americans are not aware of this nor of the nature of the fire problem.

This report is a statistical portrait of fire in the United States. It is intended for use by a wide audience, including the fire service, the media, researchers, industry, government agencies, and interested citizens. The report focuses on the national fire problem. The magnitude and trends of the fire problem, the causes of fires, where they occur, and who gets hurt are topics that are emphasized. One specific focus is on firefighter casualties—causes, types of injuries, etc.

This document is the thirteenth major edition of *Fire in the United States* published by the United States Fire Administration (USFA). The previous editions included:

- First edition published in 1978; included 1975–76 fire data
- Second edition published in 1982; included 1977–78 fire data
- Third through fifth editions produced as working papers, but not published
- Sixth edition published in 1987; included 1983 fire data
- Seventh edition published in 1991; included 1983–87 fire data
- Eighth edition published in 1991; included 1983–90 fire data
- Ninth edition published in 1997; included 1985–94 fire data and focused on the residential/non-residential fire problem and on firefighter casualties
- Tenth edition published in 1998; included 1986–95 fire data and provided a state-by-state profile of fires and an examination of firefighter casualties
- Eleventh edition published in 1999; included 1987–96 fire data and focused on the residential/non-residential fire problem and on firefighter casualties
- Twelfth edition published in 2001; included 1989–98 fire data; it was the last edition to use the NFIRS 4.1 data system and included analyses of all of the previous topics under

[1] "World Fire Statistics," *Geneva Association Information Newsletter*, October 2003, http://www.genevaassociation.org/FIRE%20N°19%20-%20October%202003.pdf. The United States was reported at 1.55 fire deaths per 100,000 population for 1998–2000; Switzerland has the lowest European death rate at 0.64 per 100,000 population for 1997–1999.

one cover: residential and non-residential fire problems, state-by-state profiles, and firefighter casualties

This 13th Edition addresses the 10-year period 1992–2001. For the first time, the new NFIRS 5.0 data were used for the analyses. This report addresses the residential and non-residential fire problem and firefighter casualties.

SOURCES

The report is primarily based on the National Fire Incident Reporting System (NFIRS) data, but uses other sources as well. Summary numbers for fires, deaths, injuries, and dollar loss in each section are from the National Fire Protection Association's (NFPA's) annual survey of fire departments and NFPA's *Journal* articles on firefighter casualties.[2] It also uses mortality data from the National Center for Health Statistics (NCHS), population data from the U.S. Census Bureau, inflation adjustments from the Consumer Price Index, state statistics from state fire marshal offices or their equivalents, product information from the Consumer Product Safety Commission (CPSC), and health data from the NCHS. The USFA gratefully acknowledges the use of their information. Data sources are cited for each graph and table in this report.

National Fire Incident Reporting System

An indirect outgrowth of *America Burning*, the National Fire Incident Reporting System was established in 1975 as one of the first programs of the National Fire Prevention and Control Administration, which later became the United States Fire Administration (USFA). The basic concept of NFIRS has not changed since the system's inception. All states and all fire departments within them have been invited to participate on a voluntary basis. Participating fire departments collect a common core of information on fire and casualty reports using a common set of definitions. The data may be written by hand on paper forms or entered directly through a computer. Local agencies forward the completed NFIRS modules to the state agency responsible for NFIRS data. The state agency combines the information with data from other fire departments into a statewide database and then transmits the data to the National Fire Data Center (NFDC) at USFA. Data on individual fire incidents and casualties are preserved incident by incident at local, state, and national levels.

From an initial six states in 1976, NFIRS has grown in both participation and use. Over the life of the system, all 50 states, the District of Columbia, and more than 40 major metropolitan areas have reported to NFIRS. Over the life of the system, more than 30,000 fire departments have been registered by their states to participate in NFIRS. On a yearly basis, approximately

[2] A second approach for these summary numbers is to use the relative percentage of fires (or other loss measures) from NFIRS and scale up (multiply by) the NFPA estimate of total fires. The results would be somewhat different from those using the NFPA subtotals. NFPA totals have been used as the basis for the summary numbers in each section because they are consistent with the total number of fires from NFPA. Better estimates of fire loss measures from NFIRS will not be available until a more robust method of estimation is developed.

600,000 fire incidents and more than 7 million nonfire incidents are added to the database. NFIRS is the world's largest collection of incidents to which fire departments respond. Since 1985, the level of participation has remained relatively constant. A few states come in or leave the system each year. From 1992 to 1999, at least 39 states and the District of Columbia reported to NFIRS (Table 6). In 2000, the number of states increased to 43 and in 2001 an all-time high of 49 reporting states was achieved. The number of fire departments participating within the states has remained relatively constant as well, with a slight dip in participation during the system migration from version 4.1 to 5.0 in 1999 and 2000. Fire department participation has now returned to nearly 13,000 in 2001 (Figure 1). Within participating states, approximately 38 percent of the fire departments report (Table 7). The reporting departments represent a very large sample that enables us to make good estimates of various facets of the fire problem.[3] Although participation in NFIRS is voluntary, some states do require their departments to participate in the state system. The national goal is voluntary reporting by all states and the District of Columbia.

Table 6. States Reporting to NFIRS (1992–2001)

State	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Alabama	X	X	X	X	X	X	X	X	X	X
Alaska	X	X	X	X	X	X	X	X	X	X
Arizona		X	X	X						X
Arkansas	X	X	X	X	X	X	X	X	X	X
California	X	X	X	X	X		X			
Colorado	X	X	X	X	X	X		X	X	X
Connecticut	X	X	X	X	X	X	X	X	X	X
Delaware				X	X	X				X
District of Columbia	X	X	X	X	X	X	X	X		
Florida	X	X	X	X	X	X	X	X	X	X
Georgia	X	X	X	X	X	X	X	X	X	X
Hawaii	X				X	X	X	X	X	X
Idaho	X	X	X	X	X	X	X	X	X	X
Illinois	X	X	X	X	X	X	X	X	X	X
Indiana	X	X				X	X	X	X	X
Iowa	X	X	X	X	X	X	X	X	X	X
Kansas	X	X	X	X	X	X	X	X	X	X
Kentucky	X	X	X	X	X	X	X	X	X	X
Louisiana	X	X	X	X	X	X	X	X	X	X
Maine						X	X	X	X	X
Maryland	X	X	X	X	X	X	X	X	X	X
Massachusetts	X	X	X	X	X	X	X	X	X	X
Michigan	X	X	X	X	X	X	X	X	X	X
Minnesota	X	X	X	X	X	X	X	X	X	X
Mississippi									X	X
Missouri								X	X	X
Montana	X	X	X		X	X	X	X	X	X

[3] Data on the number of fire departments were provided by each state fire marshal office or equivalent organization.

Table 6. States Reporting to NFIRS (1992–2001) (continued)

State	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Nebraska	X	X	X	X	X	X	X	X	X	X
Nevada							X	X	X	X
New Hampshire	X	X	X	X	X	X	X		X	X
New Jersey	X	X	X	X	X	X	X	X	X	X
New Mexico			X		X				X	X
New York	X	X	X	X	X	X	X	X	X	X
North Carolina									X	X
North Dakota										X
Ohio	X	X	X	X	X	X	X	X	X	X
Oklahoma	X	X	X	X	X	X	X	X	X	X
Oregon	X	X	X	X				X	X	X
Pennsylvania										X
Rhode Island	X	X	X	X						X
South Carolina	X	X	X	X	X	X	X	X	X	X
South Dakota	X	X	X	X	X	X	X	X	X	X
Tennessee	X	X	X	X	X	X	X	X	X	X
Texas	X	X	X	X	X	X	X	X	X	X
Utah	X	X	X	X	X	X	X	X	X	X
Vermont	X	X	X	X	X	X	X	X	X	X
Virginia	X	X	X	X	X	X	X	X	X	X
Washington	X	X	X	X	X	X	X	X	X	X
West Virginia	X	X	X	X	X	X	X			X
Wisconsin		X	X	X	X	X	X	X	X	X
Wyoming	X	X	X	X	X	X	X	X	X	X
Total	40	41	41	40	40	40	40	40	43	49

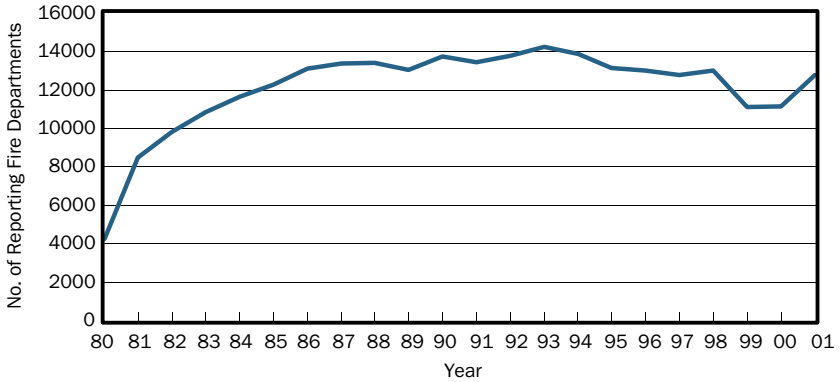

Figure 1. NFIRS Participation (1980–2001)

Table 7. Fire Departments Reporting to NFIRS in 2001

State	No.of Reporting Fire Departments	No. of Fire Departments in State	Fire Departments Reporting (percent)
Alabama	98	1,100	9
Alaska**	14	320	4
Arizona*	3	350	1
Arkansas*	400	985	41
California*	0	1,186	0
Colorado	18	394	5
Connecticut	203	304	67
Delaware	19	61	31
District of Columbia	0	1	0
Florida*	263	672	39
Georgia	128	674	19
Hawaii*	3	4	75
Idaho	153	236	65
Illinois	721	1,253	58
Indiana	429	959	45
Iowa	431	860	50
Kansas*	505	666	76
Kentucky	447	827	54
Louisiana*	272	604	45
Maine	32	421	8
Maryland	341	367	93
Massachusetts	309	365	85
Michigan*	855	1,079	79
Minnesota	660	786	84
Mississippi*	100	754	13
Missouri	245	916	27
Montana	159	368	43
Nebraska	236	478	49
Nevada**	20	210	10
New Hampshire	90	245	37
New Jersey*	423	810	52
New Mexico*	8	366	2
New York	1,307	1,857	70
North Carolina*	170	1,316	13
North Dakota	147	386	38
Ohio*	1,126	1,240	91
Oklahoma	88	904	10
Oregon	259	335	77
Pennsylvania*	17	2,164	1
Rhode Island	3	79	4
South Carolina	86	740	12
South Dakota	147	363	40
Tennessee*	265	662	40
Texas	614	1,964	31
Utah*	146	250	58
Vermont*	115	243	47
Virginia*	326	596	55
Washington	171	544	31

Table 7. Fire Departments Reporting to NFIRS in 2001 (continued)

State	No. of Reporting Fire Departments	No. of Fire Departments in State	Fire Departments Reporting (percent)
West Virginia*	11	446	2
Wisconsin*	52	880	6
Wyoming	101	154	66
Total	12,735	33,744***	38

* The number of state fire departments was not available from state fire marshal offices (or equivalent agencies) at the time of publication. For these states, the number of fire departments was taken from the 12th Edition of *Fire in the United States, 1989–1998.*

** Alaska reported 240 fire departments in the state to USFA, and Nevada has reported 147 departments. Because these totals may be incomplete, the totals given in the 12th Edition are used.

*** This total differs from the 2001 NFPA estimate of 30,020 fire departments. The NFPA estimate is the official estimate used by USFA in its National Fire Department Census.

Sources: NFIRS and state fire marshal offices or equivalent organizations

The USFA established the National Fire Department Census in the fall of 2001 when the USFA launched a nationwide campaign for voluntary registration of fire departments by means of direct mailing, coordination with fire service organizations and state offices, referencing existing data sources, and conference promotions. By September 2004, more than 22,800 fire departments have registered with the census—approximately 75 percent of the estimated number of U.S. fire departments.

The database created by the census is intended for use by the fire protection and prevention communities, allied professions, the general public, and the USFA. USFA will use the database to conduct special studies, guide program decisionmaking, and improve direct communication with individual fire departments. The database provides a current directory of registered fire departments and includes basic information such as addresses and department types, Web site addresses (if applicable), and number of stations. The survey also collects information that will be released in summary format only: number of personnel and specialized services. For more information about the National Fire Department Census, visit http://www.usfa.fema.gov/applications/fdonline.

Corresponding to increased participation, the number of fires, deaths, and injuries as well as estimates of dollar loss reported to NFIRS has also grown—an estimated 33 percent of all U.S. fires to which fire departments responded in 2001 were captured in NFIRS.

There are, of course, many problems in assembling a real-world database, and NFIRS is no exception. Although NFIRS does not represent 100 percent of incidents reported to fire departments each year, the enormous sample size and good efforts by the fire service result in a huge amount of useful information. Because of advances in computer technology over the past 25 years and improvements suggested by participants, NFIRS has been revised periodically in response. The newest revision, NFIRS 5.0, became operational in January 1999.

NFIRS 5.0 captures information on all incidents, not just fires, to which a fire department responds. In addition to many data coding improvements, Version 5.0 provides five new mod-

ules that recognize the increasingly diverse activities of fire departments today: an Emergency Medical Service (EMS) Module, a Wildland Fire Module, an Apparatus Module, a Personnel Module, and an Arson Module. Other modules have been extensively revised.

The modular design of NFIRS 5.0 makes the system easier to use than previous NFIRS versions because it captures only the data required to profile the extent of the incident. Some fires, for example, require just basic information to be recorded, whereas others require considerably more detail. The accuracy and reliability of the collected data are improved because of the way questions are asked and data are coded.

States' participation is voluntary, and each state specifies requirements for its fire departments. States have the flexibility to adapt their state reporting systems to their specific needs. As a result, the design of a state's data collection system varies from state to state. NFIRS 5.0 was designed so that data from state systems can be converted to a single format that is used at the national level to aggregate and store NFIRS data.

Uses of NFIRS

NFIRS data are used extensively at all levels of government for major fire protection decisions. At the local level, incident and casualty information is used for setting priorities and targeting resources. The data now being collected are particularly useful for designing fire prevention and educational programs and EMS-related activities specifically suited to the real emergency problems the local community faces.

At the state level, NFIRS is used in many capacities. One valuable contribution is that state legislatures use these data to justify budgets and to pass important bills on fire-related issues such as sprinklers, fireworks, and arson. Many federal agencies, in addition to USFA, make use of NFIRS data. NFIRS data are used, for example, by the Consumer Product Safety Commission to identify problem products and to monitor corrective actions. The Department of Transportation uses NFIRS data to identify fire problems in automobiles, which has resulted in mandated recalls. The Department of Housing and Urban Development uses NFIRS to evaluate safety of manufactured housing (mobile homes). The USFA uses the data to design prevention programs, to order firefighter safety priorities, to assist in the development of training courses at the National Fire Academy, and for a host of other purposes. Thousands of fire departments, scores of states, and hundreds of industries have used the data. The potential for even greater use remains. One of the purposes of this report is to give some idea of the types of information available from NFIRS. The information here is highly summarized; much more detail is available. The USFA report, *Uses of NFIRS: The Many Uses of the National Fire Incident Reporting System*, further describes the uses of the data. It may be ordered directly from the USFA or is available online at http://www.usfa.fema.gov/applications/publications.

METHODOLOGY

Each edition of *Fire in the United States* refines and improves upon the last. In this edition, as in previous ones, an attempt has been made to keep the data presentation and analysis as straightforward as possible. It is also the desire of the USFA to make the report widely accessible to many different users, so it avoids unnecessarily complex methodology. Throughout this report, the term *fire casualties* refers to deaths and injuries; the term *fire losses* collectively includes fire casualties and dollar loss.

September 11, 2001 Casualties

The tragic events of September 11, 2001 resulted in 2,451 civilian and 341 firefighter casualties.[4] Due to the circumstances of the event, these casualties are necessarily considered fire and explosion casualties and are included in the overall totals reported in this document. These casualties, however, are not included in trends or fire cause distributions.

National Estimates

With the exception of the summary totals at the beginning of each section, the numbers in this report are scaled up national estimates or percentages, not just the raw totals from NFIRS. Many of the estimates are derived by computing a percentage of fires in a particular category using NFIRS and multiplying it by the total number of fires, deaths, injuries, or dollar loss from the NFPA annual survey. For example, the national estimate for the number of residential cooking fires was computed by taking the percentage of NFIRS residential fires (with known causes) that were attributed to cooking and multiplying it by the estimated total number of residential fires from the NFPA survey. This methodology is the accepted practice of national fire data analysts.

Ideally, one would like to have all of the data come from one consistent data source. But because the "residential population protected" is not reported to NFIRS by many fire departments and the reliability of that data element is suspect in many other cases, especially where a county or other jurisdiction is served by several fire departments that each report their population protected independently, this data element was not used. Instead, extrapolations of the NFIRS sample to national estimates are made using the NFPA survey for the gross totals of fires, deaths, injuries, and dollar loss.

One problem with this approach is that the proportions of residential, non-residential, mobile property, and outside fires and fire deaths differ between the large NFIRS sample and the NFPA survey sample. To be consistent with approaches being used by the CPSC and NFPA, we have used the NFPA estimates of fires, deaths, injuries, and dollar loss for residential, non-residential, mobile, and outside properties as a starting point. The details of the national fire

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[4] These 341 firefighter casualties do not include 3 WTC fire safety directors who received benefits from the Department of Justice's Public Safety Officers' Benefits Program based on the *Report of Public Safety Officer's Death* submitted by FDNY.

problem below this level are based on proportions from NFIRS. One will not get the same numbers starting from the total NFIRS proportions of residential, non-residential, etc., as from the NFPA proportions. This inconsistency will remain until all estimates can be derived from NFIRS alone.

Unknowns

On a fraction of the incident reports or casualty reports sent to NFIRS, the desired information for many data items is either not reported or reported as "unknown." The total number of blank or unknown entries is often larger than some of the important subcategories. For example, 47 percent of residential fires with fatalities reported in 2001 do not have sufficient data reported to NFIRS to determine cause. The lack of data, especially for fatal fires, masks the true picture of the fire problem. Many prevention and public education programs use NFIRS data to target at-risk groups or to address critical problems, fire officials use the data in decisionmaking that affects the allocation of firefighting resources, and consumer groups and litigators use the data to assess product fire incidence. When the unknowns are large, the credibility of the data suffers. Fire departments need to be more aware of the effect of incomplete reporting.

Adjusted Percentages

In making national estimates, the unknowns should not be ignored. The approach taken in this report is to provide not only the "raw" percentages of each cause category, but also the "adjusted" percentages computed using only those incidents for which the cause was provided. This in effect distributes the fires for which the cause is unknown in the same proportion as the fires for which the cause is known, which may or may not be approximately right. That is the best we can do without additional knowledge of the nature of the unknowns.

To illustrate: Smoking was reported as the fire cause for 3.6 percent of all reported residential fires in 2001; another 33.7 percent of reported fires had cause unknown. Thus, the percent of fires that had their cause reported was $100 - 33.7 = 66.3$ percent. With the unknown causes proportioned like the known causes, the adjusted percent of residential fire fatalities caused by smoking can then be computed as $3.6/66.3 = 5.4$ percent.

In this edition, both the reported data and the adjusted data for causes are plotted on the bar charts.

Representativenessof the Sample

The percentage of fire departments participating in NFIRS varies from state to state, with some states not participating at all. To the best that USFA can determine, the distribution of participants is reasonably representative of the entire nation, even though the sample is not random. The sample is so large—33 percent of all fires—and so well distributed geographically and by size of community that there is no known major bias that will affect the results. In a current study effort, USFA and NFPA are examining the biases in NFIRS participation, specifically

whether the fire experience of NFIRS reporting departments differs systematically from the fire experience of other nonreporting departments within the same population.

Most of the NFIRS data exhibit stability from one year to another, without radical changes, as will be observed from most of the 10-year trend lines presented throughout this report. Results based on the full data set are generally similar to those based on part of the data, another indication of data reliability. Although improvements could be made—the individual incident reports could and should be filled out more completely and more accurately than they are today (as can be said about most real-world data collections as large as NFIRS), and all participating departments should have the same reporting requirements—the overall portrayal is a reasonably accurate description of the fire situation in the United States.

NFIRS 5.0 Changes

Another area to consider is the effect that the differences between the current NFIRS and older versions have, or may have, on analysis of fire topics. These differences, the result of both coding changes and data element design changes, have necessitated revisions to long-standing groupings and analyses used in this report. The definitions of some property types, the cause methodology, smoke alarm performance, and streamlined reporting for qualified incidents are among those areas that required attention. These revisions may have resulted in subtle changes in overall trends.

For property types, several notable changes are reflected in this edition. Detached residential garages, a subset of non-residential storage properties previously included in the discussion of residential structures, are now included with non-residential properties. Vacant and under construction is now an attribute of a structure and is no longer considered a separate property type. Fires occurring in vacant or under construction structures on non-residential properties are included in a separate discussion; vacant or under construction residential structures are not addressed in this edition.

A new cause methodology that accommodates NFIRS 5.0 variables in the cause hierarchy was developed. Overall, the transition in cause trends between the NFIRS 4.1 database and the 5.0 database has been seamless.

The new, limited reporting of confined, no-loss structure fires allows the fire service to capture incidents that either might have gone unreported prior to the introduction of NFIRS 5.0 or were reported, but as a nonfire fire incident as no loss was involved.[5] In 2001, these confined fires accounted for 18 percent of structure fires. More than 75 percent of these confined fires were no-loss cooking fires (55 percent) and heating fires (23 percent). Except where noted, these confined fires are included in analyses. The addition of these fires results in increased proportions of cooking and heating fires in analyses of fire cause. In other analyses, the inclusion of

[5] Some states routinely reported such non-loss fires as smoke scares. The result, from a reporting viewpoint, is that the incident is reported but not coded as a fire incident.

confined fires may result in larger unknowns than in previous editions of this report as detailed reporting of fire specifics (e.g., room of origin) is not required.

One of the most important changes is in the data format itself. All data in the system, regardless of its entry mechanism, are in NFIRS 5.0 format; non-NFIRS 5.0 data are converted to the 5.0 format. The proportion of native 5.0 data has steadily increased since the introduction of NFIRS 5.0 in 1999 (Table 8). At the time of publication, this proportion rose to 69 percent in the preliminary 2002 data.

Table 8. NFIRS Fire Data Reporting by Version

Year	NFIRS 4.1 (converted to 5.0 format)	Native NFIRS 5.0
1999	93%	7%
2000	79%	21%
2001	52%	48%
2002*	31%	69%

*Preliminary

All charts with multiyear data points distinguish between the years in which NFIRS 4.1 format data (1992–1998) and NFIRS 5.0 format data (1999–2001) were used.

Trend Data

A frequently asked question is how much a particular aspect of the fire problem has changed over time. The usual response is in terms of a percentage change from one year to another. As we are dealing with real-world data that fluctuate from year to year, a percent change from one specific year to another can be misleading. This is especially true when the beginning and ending data points are extremes—either high or low. For example, in Figure 31, "Trends in One- and Two-Family Dwelling Fires and Fire Losses," the percent change from 1992 of 3,160 deaths to 2001 of 2,650 would be a decrease of 16.1 percent. Yet, if we were to choose 1994 as the beginning data point (2,785 deaths), this change would show a 4.8 percent decrease. As we are interested in *trends* in the U.S. fire problem, this edition of *Fire in the United States* reports the overall change in a data series as a trend. We have computed the best-fit linear trend line (which smooths fluctuations in the year-to-year data) and present the change over time based on this trend line. In this example, the overall 10-year trend is a decrease in deaths of 15.6 percent. As noted above, trends that incorporate NFIRS data from the new 5.0 system may have subtle changes as a result of the system design and not a true trend change.

New in this edition is the plotting of the 10-year trend line juxtaposed with the actual data points.

Cause Categories

The causes of fires are often a complex chain of events. To make it easier to grasp the "big picture," 13 major categories of fire causes such as heating, cooking, and children playing are used by the U.S. Fire Administration here and in many other reports. The alternative is to present scores of detailed cause categories or scenarios, each of which would have a relatively small percentage of fires. For example, heating includes subcategories such as misuse of portable space heaters, wood stove chimney fires, and fires involving gas central heating systems. Experience has shown that the larger categories are useful for an initial presentation of the fire problem. It then can be followed by more detailed analysis.

The cause categories displayed in the graphs are listed in the same order to make comparisons easier from one to another. The x-scale varies from figure to figure depending on the largest percentage that is shown; the x-scale on a figure with multiple charts, however, is always the same. The order here also is the same as used in previous *Fire in the United States* editions.

The cause categories used throughout most of this report were designed to reflect the causes of structure fires—where the majority of fatal fire deaths occur. While these categories have usefulness for the other property types, there are limitations. For example, in vehicle fires, these limitations are such that the cause categories are not used.

An additional problem to keep in mind when considering the rank order of causes in this report is that sufficient data to categorize the cause were not reported to NFIRS for all fatal fires in the database. The rank order of causes might be different than shown here if the cause profile for the fires whose causes were not reported to NFIRS were substantially different from the profile for the fires whose causes were reported. However, there is no information to indicate that there is a major difference between the knowns and the unknowns, and so our present best estimate of fire causes is based on the distribution of the fires with known causes.

Fires are assigned to one of the 13 general cause groupings using a hierarchy of definitions, approximately as shown in Table 9.[6] A fire is included in the highest category into which it fits on the list. If it does not fit the top category, then the second one is considered, and if not that one, the third, and so on. (See Table 9 footnote (*) for examples.)

In the transition from NFIRS 4.1 to 5.0, most coding definitions for the causes transferred well. Incendiary and suspicious fires and children playing fires are the exceptions and required a new coding approach to capture these causes. For example, suspicious fires are no longer captured directly and included in the arson totals, and children playing is generally defined by whether "age was a factor" with an age less than 10. In the trend charts presented in this report,

[6] The exact hierarchy and specific definition in terms of the NFIRS 5.0 codes may be found at http://www.nfirs.fema.gov/download/50causematrix01012004.xls The actual hierarchy involves a large number of subcategories that are later grouped into the 13 major categories.

Table 9. Hierarchy of Cause Groupings Used in This Report

Cause Category*	Definition
Exposure	Caused by heat spreading from another hostile fire
Incendiary/Suspicious	Fire deliberately set or suspicious circumstances
Children Playing	Includes all fires caused by children playing with any materials contained in the categories below
Natural	Caused by Sun's heat, spontaneous ignition, chemicals, lightning, static discharge
Smoking	Cigarettes, cigars, pipes as accidental heat of ignition
Heating	Includes central heating, fixed and portable local heating units, fireplaces and chimneys, water heaters as source of heat
Cooking	Includes stoves, ovens, fixed and portable warming units, deep fat fryers, open grills as source of heat
Electrical Distribution	Includes wiring, transformers, meter boxes, power switching gear, outlets, cords, plugs, lighting fixtures as source of heat
Appliances (including air conditioning/ refrigeration)	Includes televisions, radios, phonographs, dryers, washing machines, vacuum cleaners, hand tools, electric blankets, irons, electric razors, can openers, dehumidifiers, water cooling devices, air conditioners, refrigeration equipment as source of heat
Other Equipment	Includes special equipment (radar, x-ray, computer, telephone, transmitters, vending machine, office machine, pumps, printing press), processing equipment (furnace, kiln, other industrial machines), service, maintenance equipment (incinerator, elevator), separate motor or generator, vehicle in a structure, unspecified equipment
Open Flame, Spark (heat from)	Includes torches, candles, matches, lighters, open fire, ember, ash, rekindled fire, backfire from internal combustion engine as source of heat
Other Heat	Includes fireworks, explosives, heat or spark from friction, molten material, hot material, all other fires caused by heat from fuel-powered objects, heat from electrical equipment arcing or overloading, heat from hot objects not covered by above groups
Unknown	Cause of fire undetermined or not reported

* Fires are assigned to a cause category in the hierarchical order shown. For example, if the fire is judged incendiary and a match was used to ignite it, it is classified as incendiary and not open flame because incendiary is higher on the list. One minor deviation: If the fire involves air conditioning or refrigeration, it is included in appliances and not in electrical distribution.

changes in these two (or any other) causes since 1999 may be the result of a coding definitional change rather than a real-world change.

NFIRS fire data can be analyzed in many ways such as by the form of the heat of ignition, the material ignited, the ignition factor, or many other groupings. The hierarchy used in this report has proved useful in understanding the fire problem and targeting prevention, but other approaches are certainly useful too. Because the NFIRS database stores records fire by fire and not just in summary statistics, a very wide variety of analyses are possible.

Rounding

Percentages on each chart are rounded to one decimal point. Textual discussions cite these percentages as whole numbers. Thus, 13.4 percent is rounded to 13 percent and 13.5 percent is rounded to 14 percent.

Differences Between NFIRS and NFPA Data

There is an inconsistency between the NFIRS sample and the NFPA annual survey data: In nearly every year, the deaths reported to NFIRS are a larger fraction of the NFPA estimate of deaths than the NFIRS fires are of the NFPA estimate of fires. NFIRS injuries and dollar loss are even larger fractions of the NFPA totals than are deaths or fires. This issue is discussed further in Appendix A.

UnreportedFires

NFIRS only includes fires to which the fire service responded. In some states, fires attended by state fire agencies (such as forestry) are included; in other states, they are not.

NFIRS does not include fires from all states nor from many fire departments within participating states. However, if the fires from the reporting departments are reasonably representative, this omission does not cause a problem in making accurate national estimates for any but the smallest subcategories of data.

An enormous number of fires are not reported to the fire service at all. Most are small fires in the home or in industry which go out by themselves or are extinguished by the occupant. Based on a study done in the early 1970s, these unreported fires collectively cause a great deal of property loss and a large number of injuries requiring medical attention. The latest study of this problem was a 1984 report by CPSC.[7]

Perhaps the most disturbing type of unreported fires are those not submitted by fire departments that are participating in NFIRS. Some departments submit information on most but not all of their fires. Sometimes the confusion is systematic, as when no-loss cooking fires or chimney fires are not reported. Sometimes it is inadvertent, such as when incident reports are lost or accidentally not submitted. The information that is received is assumed to be the total for the department and is extrapolated as such. Although there was no measure of the extent of this problem in the past, the new NFIRS 5.0 provides fire departments with the capability to report this information in a simplified, more straightforward manner.

ORGANIZATION OF REPORT

This report is organized similarly to previous editions of *Fire in the United States*. Chapter 2 presents an overview of the national fire problem in terms of the total number of fires, deaths, injuries, and dollar loss—the four principal measures used to describe the fire problem.

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[7] *1984 National Sample Survey of Unreported Residential Fires: Final Technical Report*, prepared for the U.S. Consumer Product Safety Commission, Contract No. C–83–1239, Audits & Surveys, Inc., Princeton, NJ (1985).

Chapters 3 and 4 address the residential and non-residential fire problem, respectively. Chapter 5 addresses firefighter casualties. USFA resources that provide in-depth information on specific topics are listed at the end of these chapters.

Appendix A discusses the differences between NFPA and NFIRS data.

Most of the data are presented graphically for ease of comprehension. The specific data associated with the graphs are provided directly with the chart. In those instances in which it was impractical to fit the data, references are made to data tables that are presented in Appendix B.

This edition of *Fire in the United States* concludes with a topical index.

chapter two

The National Fire Problem

OVERVIEW

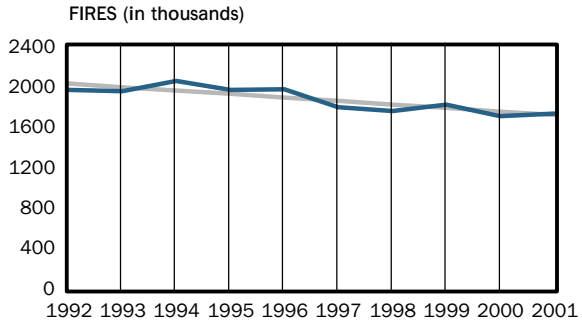
The United States has a severe fire problem, more so than is generally perceived. Nationally, there are millions of fires, thousands of deaths, tens of thousands of injuries, and billions of dollars lost—which make the U.S. fire problem one of great national importance. The indirect costs of fire increase the magnitude of economic loss tenfold.

Although we have made much progress in the last decade, the United States continues to have fire death rates and property losses that are among the largest of the industrialized nations. Although the United States had a yearly average of 1,872,800 fires and 4,266 fire deaths from 1992 to 2001 (Figure 2), the number of fires and fire fatalities continues to decline. There were 3,745 fire fatalities in 2001. Including the tragic events of September 11, 2001, the loss of life from fire climbs to 6,196.

Injury statistics in Figure 2 are not as clear cut as the death totals because of ambiguity about the completeness of defining and reporting minor injuries and the fact that many injured people go directly to a medical care facility themselves without being reported to or treated by the fire department or local EMS responders. Civilian injuries from reported fires averaged 24,900 per year over the 10-year period. Firefighter injuries averaged 46,200 from those fires, as shown in Chapter 5. Past studies suggest that the number of civilian injuries associated with fires that are not reported to the fire service might be several times that of the number from reported fires, as discussed in Chapter 1. Fire-caused injuries to civilians trended down by 31 percent over the 10 years, despite an 11 percent increase in the national population over the period.

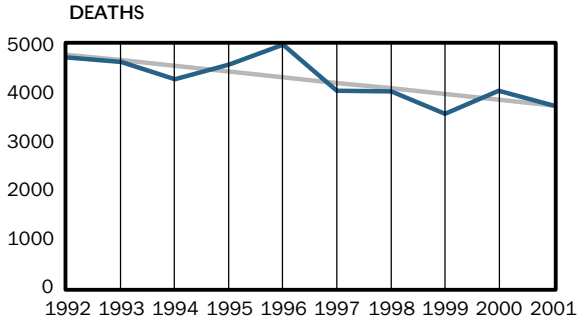
In terms of dollar loss, the estimated direct value of property destroyed in fires was $11 billion for 2001 ($44 billion if the World Trade Center losses are included). The total cost of fire (direct losses, the cost of fire departments, built-in fire protection in new buildings, insurance overhead, and other annual fire protection expenditures) is considerably higher, perhaps as much as 8 to 10 times the direct losses. The direct dollar loss increased 32 percent from 1992 to 2001, with much of the increase due to inflation. Using constant 2001 dollars, the loss was up only 5 percent over this period. Still, the direct dollar loss was enormously high at an average of $10 billion a year in 2001 dollars.

These casualties and losses come from an average of nearly 2 million fires annually. Fire incidents have declined 16 percent since 1992. In 2000, reported fires reached their lowest point since national fire data have been recorded. Reported fires increased slightly in 2001.



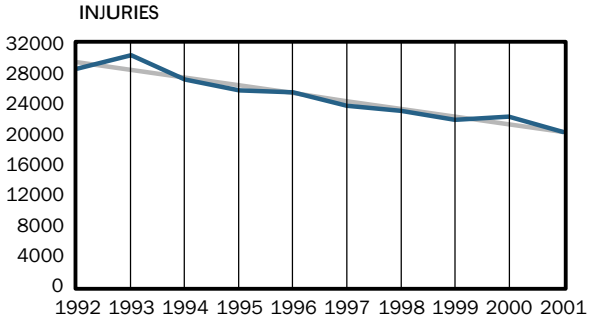
1992	1,964.5	1997	1,795.0
1993	1,952.5	1998	1,755.5
1994	2,054.5	1999	1,823.0
1995	1,965.5	2000	1,708.0
1996	1,975.0	2001	1,734.5

10-Year Trend = –15.5%



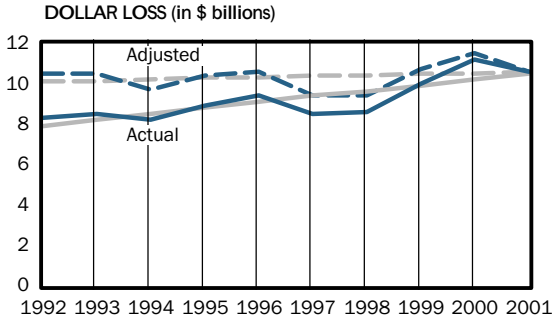
1992	4,730	1997	4,050
1993	4,635	1998	4,035
1994	4,275	1999	3,570
1995	4,585	2000	4,045
1996	4,990	2001	3,745
		2001 (incl. 9/11)	6,196

10-Year Trend = –21.8%



1992	28,700	1997	23,750
1993	30,475	1998	23,100
1994	27,250	1999	21,875
1995	25,775	2000	22,350
1996	25,550	2001	20,300
		2001 (incl. 9/11)	21,100

10-Year Trend = –31.3%



	Actual	Adjusted to 2001 Dollars
1992	$ 8.3	$10.5
1993	8.5	10.5
1994	8.2	9.7
1995	8.9	10.4
1996	9.4	10.6
1997	8.5	9.4
1998	8.6	9.4
1999	10.0	10.7
2000	11.2	11.5
2001	10.6	10.6
2001 (incl. 9/11)	44.0	44.0

10-Year Actual Trend = +32.1%
10-Year Adjusted Trend = +4.7%

Sources: NFPA and Consumer Price Index

Figure 2. Trends in Fires and Fire Losses

When the U.S. Fire Administration was established in 1974, annual fire deaths were estimated at 12,000. The goal was to reduce deaths by 50 percent within 25 years; that goal was met.

On a per capita basis, the fire problem appears less severe today than 10 years ago, partially because the population has been increasing and partially because of the overall decline in numbers of reported fires and fire casualties (Figure 3).[1] Over the 10 years, fires per million population declined 24 percent. Fire deaths per million population declined 30 percent, and the injury rate declined 38 percent, with most of the decline starting in 1993. In both 1999 and 2001, the 13 deaths per million population represented the lowest death rate in NFPA survey history. Dollar loss per capita was up 18 percent unadjusted. When adjusted for inflation over the 10 years, however, this loss declined 6 percent.

THE BROADER CONTEXT

Fires constitute a much larger problem than is generally known. Deaths and injuries from all natural disasters combined—floods, hurricanes, tornadoes, earthquakes, etc.—are just a fraction of the annual casualties from fire. For example, deaths from disasters are on the order of 200 to 250 per year versus more than 4,000 deaths from fires.[2]

Most fires are relatively small, and their cumulative impact is not easily recognized. Only a few fires each year have the huge dollar losses that are associated with tornados, hurricanes, or floods. The southern California wildland fires in the fall of 1993 resulted in over $800 million in losses. The Oakland East Bay Hills fire of October 1991 was estimated to have caused $1.5 billion in losses. The 1998 Florida wildland fires resulted in $390 million in timber loss. But because most of the losses from fire are spread over the nearly 2 million fires that are reported each year, the total loss is far more than the impression many people have of it from the anecdotal reporting of local fires in the media.

Fires also are an important cause of accidental deaths. For 2001, the National Safety Council ranks fires as the fifth leading major category of accidental deaths, behind vehicle accidents, falls, poisonings, and accidental threats to breathing, which include suffocation, accidental ingestion or inhalation of objects that obstruct the airway, and the like—accidental drownings are not included.[3]

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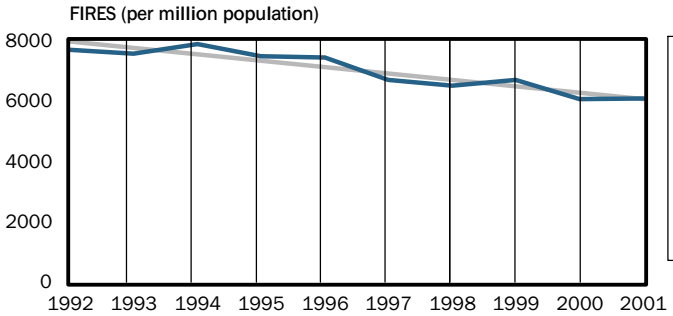
[1] *Per capita rates* are determined by the number of deaths or injuries occurring to a specific population group divided by the total population for that group. This ratio is then multiplied by a common population size. For the purposes of this report, per capita rates for fire deaths and injuries are measured per 1 million persons. Per capita rates are used in the computation of relative risk (Figure 11).

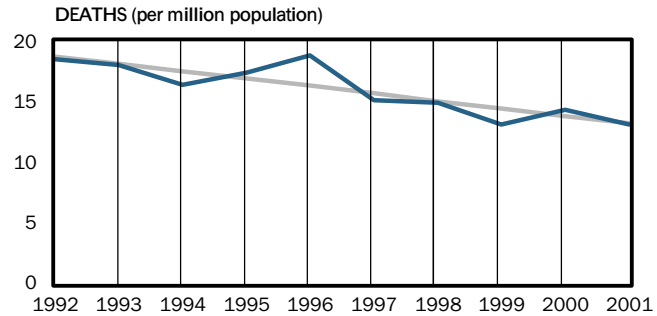
[2] U.S. Census Bureau, *Statistical Abstract of the United States: 2003*, Table No. 386; and U.S. Geological Survey, Earthquake Hazards Program data as listed at http://neic.usgs.gov/neis/eqlists/us_deaths.html.

[3] National Safety Council, "What Are the Odds of Dying?" http://www.nsc.org/lrs/statinfo/odds.htm.



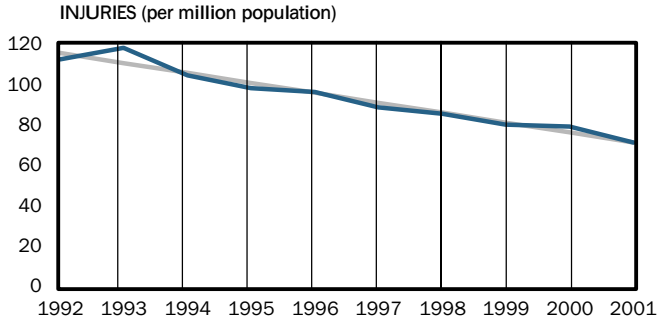
1992	7,700	1997	6,700
1993	7,570	1998	6,500
1994	7,890	1999	6,690
1995	7,480	2000	6,050
1996	7,440	2001	6,080

10-Year Trend = –23.9%



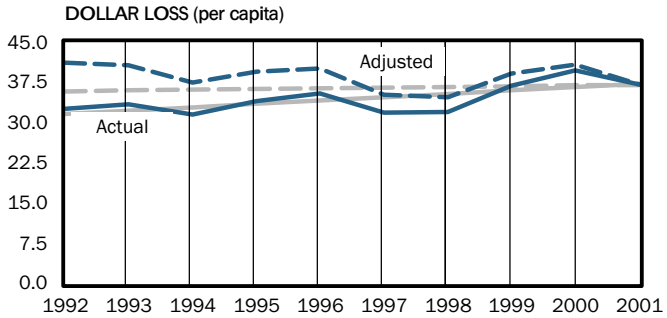
1992	18.5	1997	15.1
1993	18.0	1998	14.9
1994	16.4	1999	13.1
1995	17.4	2000	14.3
1996	18.8	2001	13.1

10-Year Trend = –29.6%



1992	112.5	1997	88.7
1993	118.2	1998	85.5
1994	104.7	1999	80.2
1995	98.1	2000	79.2
1996	96.3	2001	71.2

10-Year Trend = –38.3%



	Actual	Adjusted to 2001 Dollars
1992	32.5	41.1
1993	33.4	40.6
1994	31.5	37.4
1995	33.9	39.4
1996	35.4	40.0
1997	31.8	35.1
1998	31.9	34.7
1999	36.8	39.1
2000	39.7	40.8
2001	37.1	37.1

10-Year Actual Trend = +18.3%
10-Year Adjusted Trend = –6.0%

Sources: NFPA, Consumer Price Index, and U.S. Census Bureau

Figure 3. Trends in Fire and Fire Loss Rates

Fire-related injuries to civilians and firefighters are reported with too much uncertainty to properly rank them with confidence, but it is clear that they number over 100,000 and possibly two or three times that many when injuries from unreported fires and unreported injuries from reported fires are taken into account. Burn injuries are particularly tragic because of the tremendous pain and suffering they cause. Serious burns tend to cause psychological damage as well as physical damage, and they may well involve not only the victims but also their family, friends, and fellow workers.

U.S. Fire Deaths Versus Other Nations

Although the United States no longer has one of the most severe fire problems among the industrialized nations, it continues to experience fire death and property loss rates in excess of its sister industrialized nations. Much progress has been made in 25 years—the death rate is less than half what it was in the late 1970s, and down 30 percent since 1992. International data, however, indicate that the United States still has a fire death rate two to two and a half times that of several European nations and at least 20 percent higher than many. The U.S. fire death rate, averaged for 1998–2000, was reported at 15.5 deaths per million population.[4] Switzerland's rate, the lowest of the European nations, was 6.4 per million population; Sweden's was 15.3. Of the 25 industrial nations examined by the World Fire Statistics Centre, the U.S. rate is still in the upper tier—20th out of the 25. This general status has been unchanged for the past 20 years.

The declining U.S. trend in fire death rate is not an extraordinary event; this broad declining trend applies to western European nations and selected industrialized nations of southeastern Asia. Nonetheless, the United States has placed greater emphasis on fire suppression than other nations, but these nations tend to surpass the U.S. in practicing fire prevention. The United States would be well served by studying and implementing international fire prevention programs that have proved effective in reducing the number of fires and deaths. The United States has excellent building technology; public buildings generally have good records. It is the combination of safety built into homes and safety behavior in homes where we fall short of some nations. We have the technology in home sprinkler systems and knowledge of compartmentalization, but they are not widely used.

Total Cost of Fire

The total cost of fire to society is staggering—over $165 billion per year.[5] This includes the cost of adding fire protection to buildings, the cost of paid fire departments, the equivalent cost of volunteer fire departments ($20 billion annually), the cost of insurance overhead, the direct

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[4] World Fire Statistics, *GenevaAssociation Information Newsletter*, October 2003, http://www.genevaassociation.org/FIRE%20N°19%20-%20October%202003.pdf Using NFPA estimates and U.S. Census Bureau data, however, the 1998–2000 average U.S. fire death rate is computed at 14.1 per million population. The 2001 death rate is computed at 13.1 per million population.

[5] Meade, William P., *A First Pass at Computing the Cost of Fire in a Modern Society*, The Herndon Group, Inc., February 1991. Meade estimated the cost of fire at $115 million in this publication. The figure quoted here is adjusted for inflation.

cost of fire-related losses, the medical cost of fire injuries, and other direct and indirect costs. Even if these numbers are high by as much as 100 percent, the total cost of fire ranges from $50 to $100 billion, still enormous, and on the order of 1 to 1.5 percent of the gross domestic product, which was $10.1 trillion in 2001.[6] Thus from an economic viewpoint, fire ranks as a significant national problem.

FIRE CASUALTIES BY POPULATION GROUP

The fire problem is more severe for some groups than others. People in the Southeast, males, the elderly, African Americans, American Indians, and the very young all are at higher risk from fires than the rest of the population. These groups have remained at risk despite continuing downward trends.

State and Regional Profiles

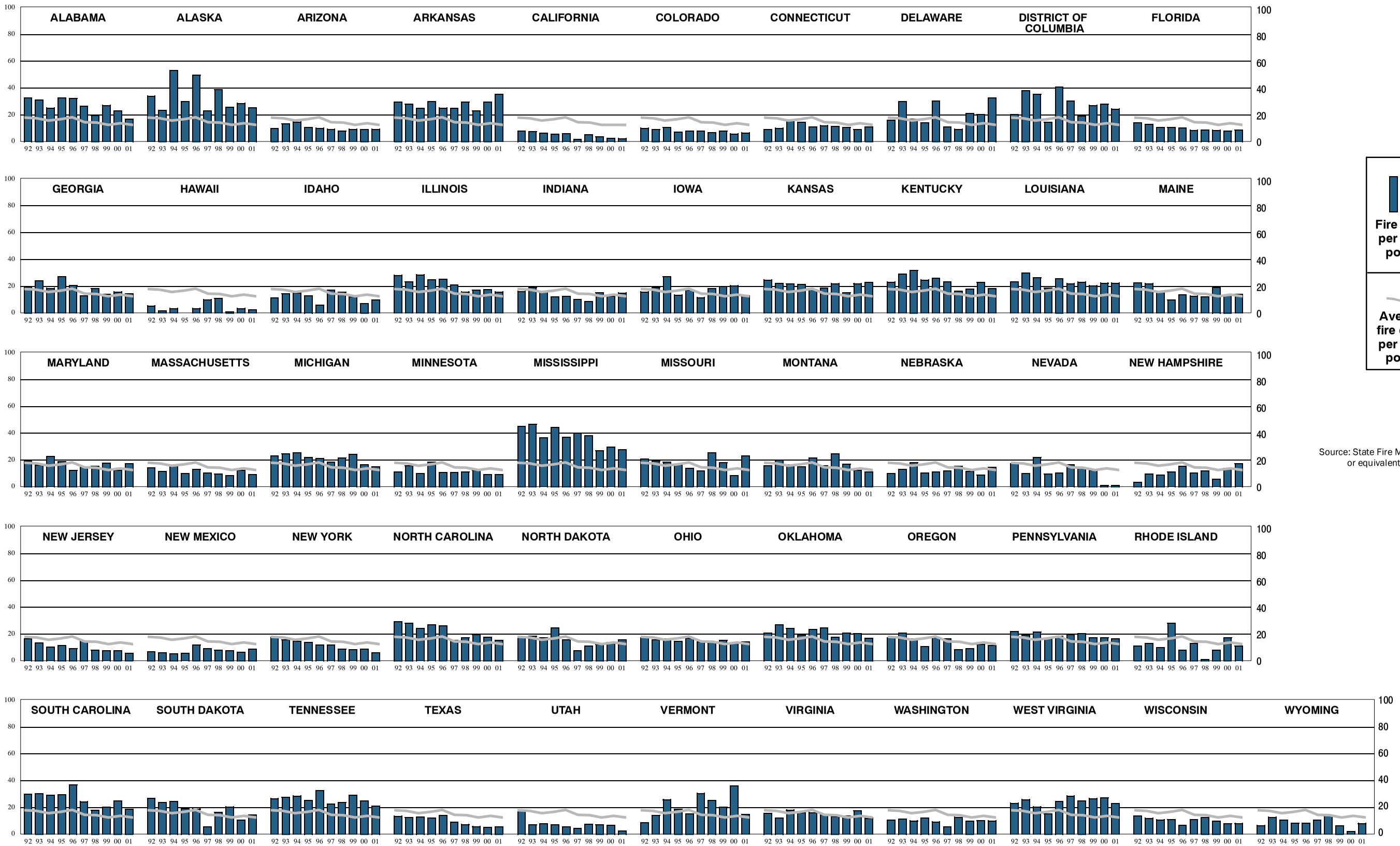
Fire death rates for each state for 1992–2001 are shown in Figure 4. An overlay plot on each state chart shows the national fire death rate. Twelve states are consistently above the national average and 14 states are consistently below it.

The rank order of state fire deaths per million population is shown in Figure 5. States with relatively small populations may move up and down on the list from year to year as a result of only a few deaths; their death rate is better viewed as an average over time. For example, the District of Columbia changed from one of the highest death rates in 1994 to among the lowest in 1995; in 2001, it returned to one of highest. Rhode Island went from best (1994) to worst (1995) and back to best (1998). The highest states in 2001 were Arkansas, Delaware, Mississippi, and Alaska. The lowest were Nevada, California, Hawaii, and Utah.

Figure 6 shows the rank order of states in terms of the absolute number of fire deaths. Not surprisingly, large population states are at the top of the list. A notable exception in 2001 is California, traditionally one of the 10 states with a high number of deaths. In 1998, California was the third highest state with 191 fire fatalities; in 2001, only 78 deaths were reported by the state fire marshal. As in previous years, the 10 states with the most fire deaths account for nearly half of the national total. Unless their fire problems are significantly reduced, the national total will be difficult to lower.

The sum of the state death estimates in Figure 6 (3,291) is over 450 deaths below the estimate of 3,745 from the NFPA survey for 2001. This difference may be due to some states underreporting their fire deaths (or not reporting them at all) or an overestimate from the extrapolation of the NFPA sample of fire departments, or a combination of both. Analysis of a third source, the National Center for Health Statistics (NCHS) mortality data, results in 4,007

[6] U.S. Department of Commerce, Bureau of Economic Analysis, http://www.bea.gov/bea/newsrelarchive/2004/gdp204a.xls



Source: State Fire Marshal Offices or equivalents

Note: This chart does not include state deaths incurred during the September 11, 2001, attacks on the World Trade Center and the Pentagon.

Figure 4. 10-Year Fire Death Rate by State Compared to National Average

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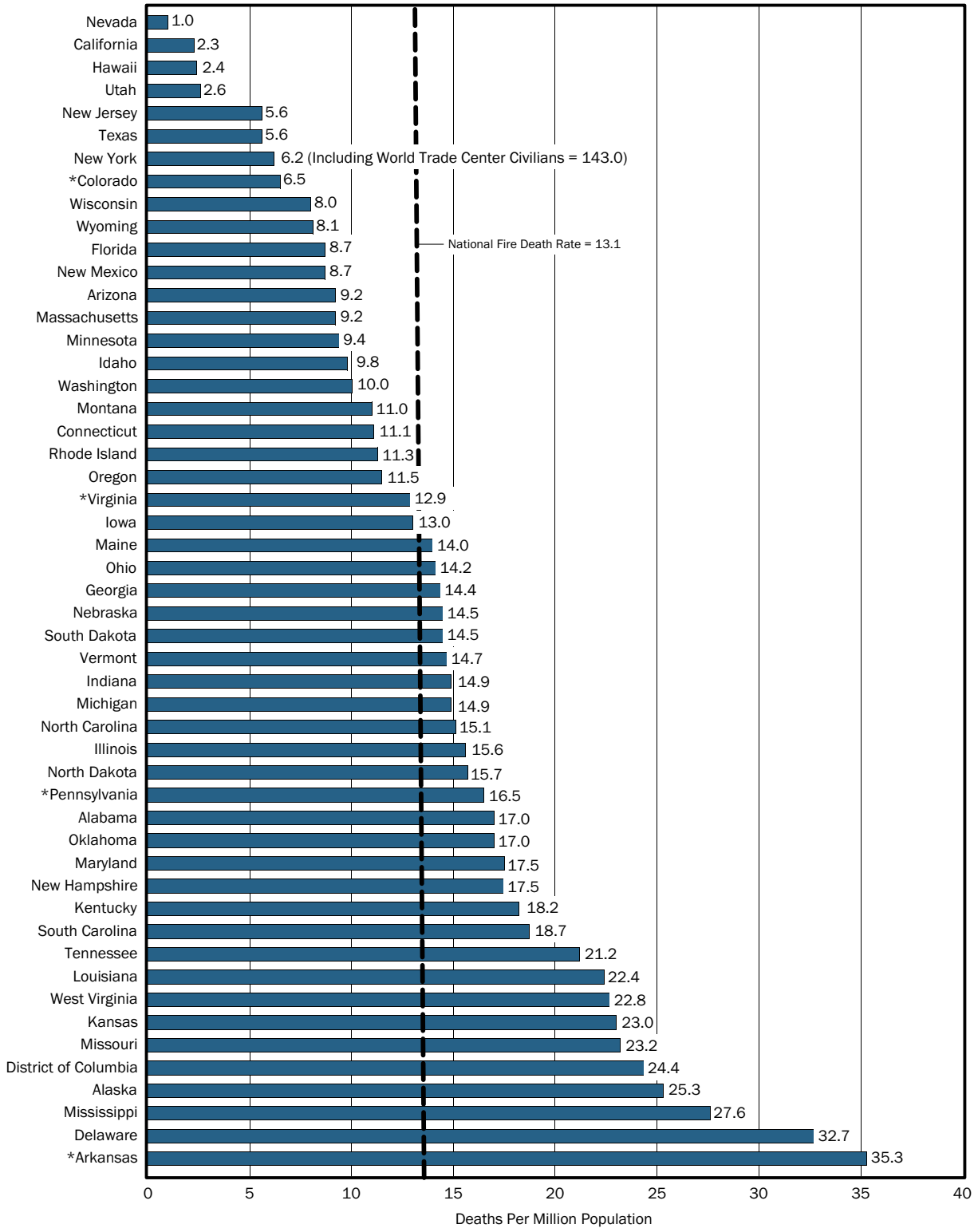
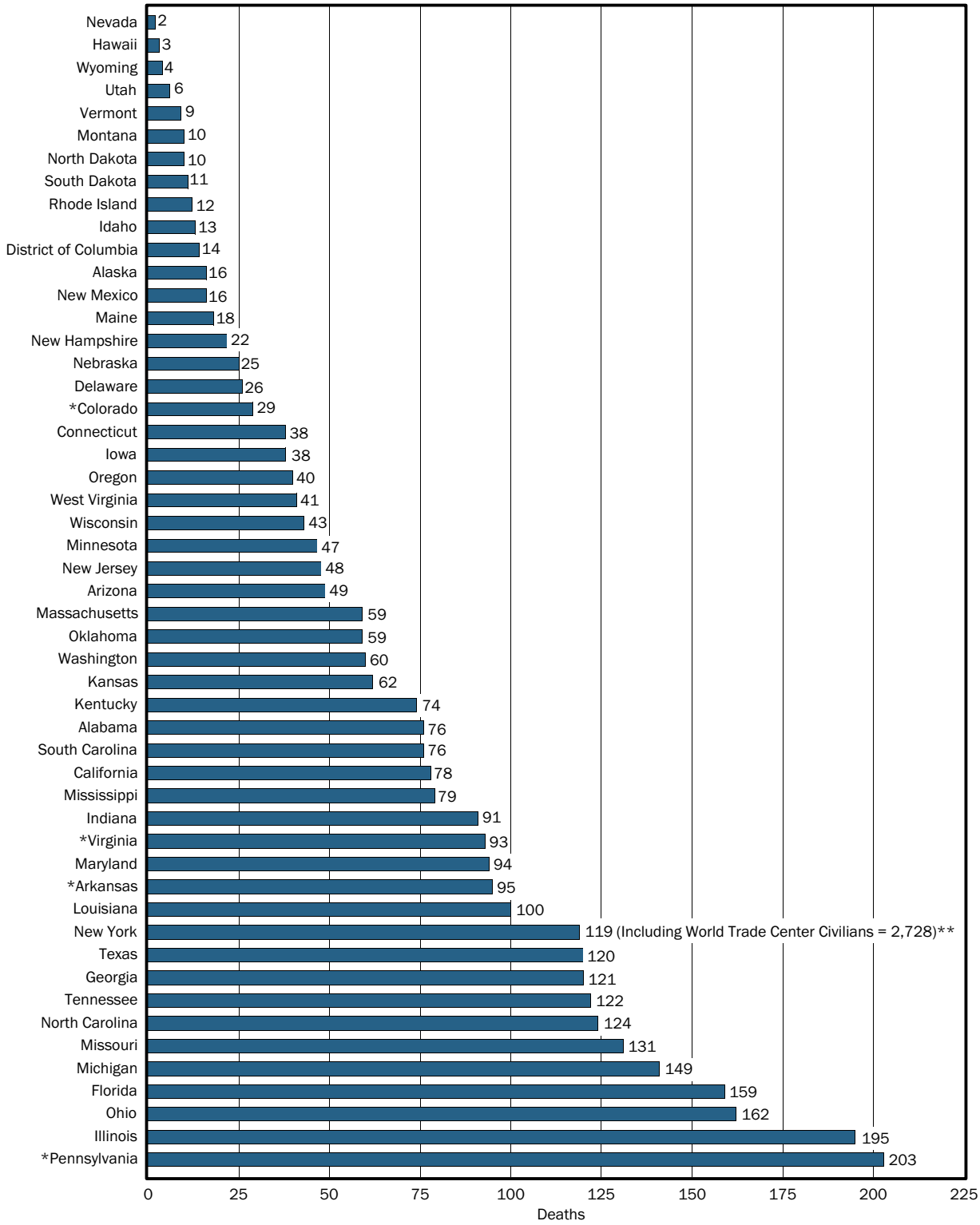
Figure 4.



Sources: State fire marshal offices or equivalents. No data were provided by the four states marked with an (*); data from NCHS were used instead.

Figure 5. Rank Order of States by Civilian Fire Deaths Per Million Population (2001)



Note: Total deaths reported by states = 3,291; total deaths reported by the National Fire Protection Association = 3,745.

**This estimate yields a higher WTC estimate (2,609) than that reported by NFPA (2,451).

Sources: State fire marshal offices or equivalents. No data were provided by the four states marked with an (*); data from NCHS were used instead.

Figure 6. Rank Order of States by Civilian Fire Deaths (2001)

deaths from exposure to fire, fire products, and explosion.[7] NCHS has recently revised its cause of death methodology and comparisons with other estimates may not be valid.[8,9] Nevertheless, the correspondence between the sources, while not exact, should be considered good.

The Southeast of the United States continues to have the highest fire death rate in the nation and one of the highest in the world. Figure 7 shows the states with the highest fire death rates for 2001. As can be seen from the map, blocks of contiguous states often have similar death rates. A special study on the commonality among these similar states might provide useful insights into the reasons for this.

Although the fire death rates of the southeastern states continue to decrease along with the overall U.S. rate, most still have death rates of 17 or more deaths per million population, with the notable exception of Florida. In addition to two states in the Southeast (Arkansas and Mississippi), Alaska and Delaware were in the highest fire death rate category in 2001. The Southeast and Alaska have been among the highest fire death rate areas for many years.

At the other extreme are the states with no shading—less than 11 deaths per million population. This death rate is in the same range as the nations of Europe and the Far East. They tend to be states in the Southwest and West, but there are some noteworthy exceptions: Florida, New York, New Jersey, Massachusetts, Minnesota, and Wisconsin all had low rates in 2001. California and Florida continue to have the lowest death rates among the high population states as they have had for many years.

Gender

More men die in fires than women, although the relative difference has narrowed. Figure 8 shows that the high proportion of male-to-female fire deaths has been remarkably steady. Males have a higher fire death and injury rate per million population than females for all age groups. Males aged 15–50 have twice the fire death rate as women in 2001 (Figure 9). Males in general have fire death rates 1.5 to 2 times that of females.

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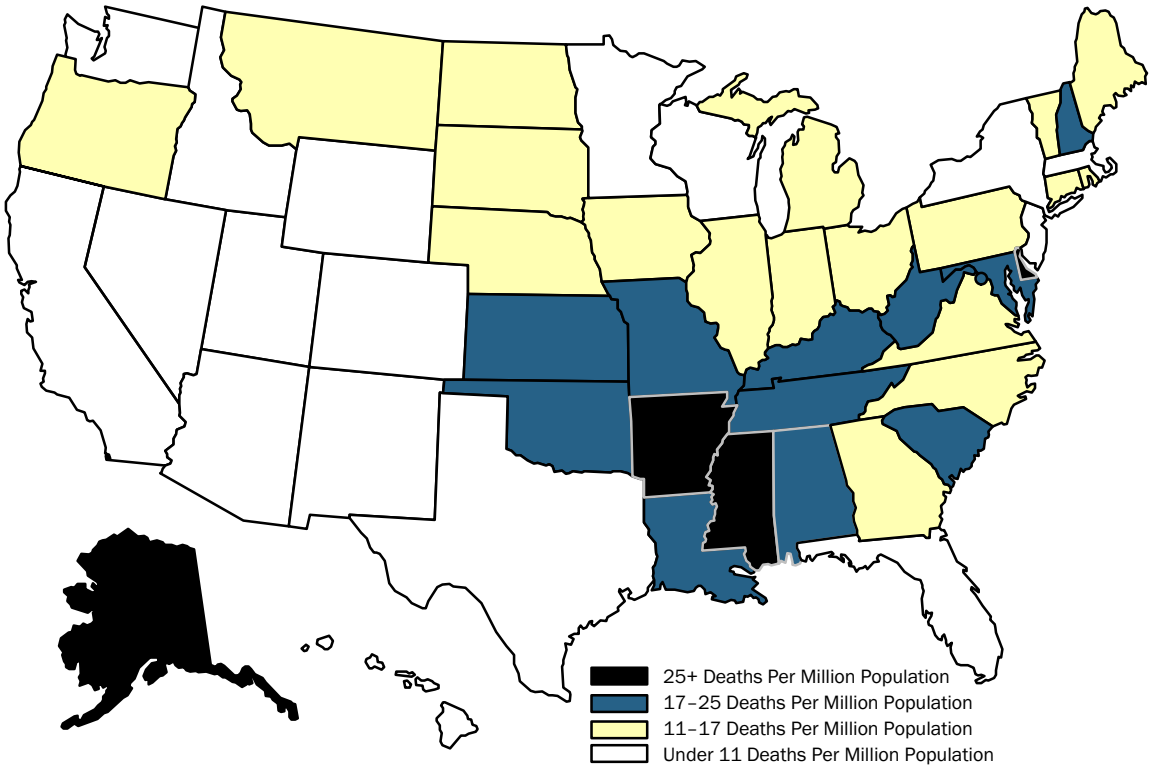
[7] Although these sources for fire death data may seem quite far apart, they are statistically close. The 95 percent confidence intervals for the NFPA estimate of fire deaths result in a range of 3,385 to 4,105. The state data are still low, but the NCHS count is within the statistical range.

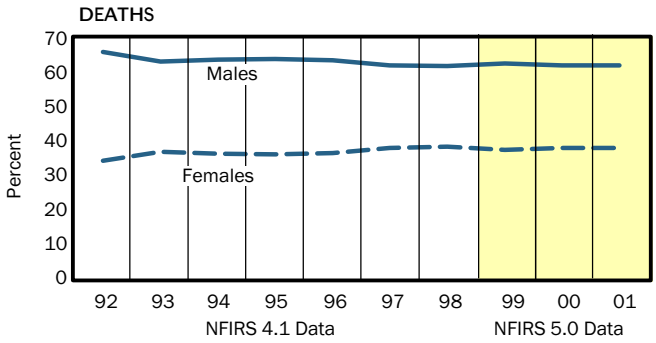
[8] For each reported death certificate in the United States, NCHS assigns codes for all reported conditions leading to death. Based on NCHS mortality data, there were 4,007 fire-related deaths in 2001, where both age and race were recorded. These include all deaths in which fire or explosion was the underlying cause of death or was a contributing factor in the chain of events leading to death. This latter condition is an expanded approach to capturing fire and fire-related deaths. With this current approach, deaths where such exposures were a contributing factor (i.e., the death may not have occurred without the exposure) can be captured. Previous data and methodologies resulted in the ability to capture only those deaths that directly resulted from the exposure to fire and fire products and yielded more conservative numbers. The most conservative definition (fire and flame only, International Classification of Disease codes X00-09) yields 3,326 fire-related deaths for 2001. The codes included in this report's mortality statistics are F63.1, W39-W40, X00-X09, X75-76, X96-97, Y25-26, and Y35.1.

[9] In measuring USFA's operational objectives, USFA extracts only the NCHS death records from the underlying cause field using the following NCHS mortality codes: X00, X01, X02, X03, X04, X05, X06, X08, X09, X76, X97, Y26, F63.1, and W39. For 2001, this methodology resulted in 3,698 civilian fire deaths.

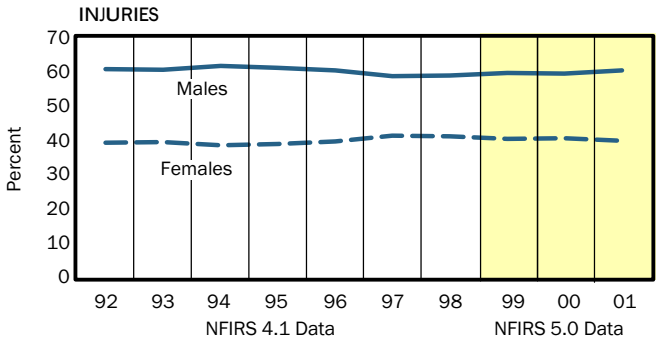


Sources: State fire marshal offices or equivalents and the U.S. Fire Administration; fire death data for Arkansas, Colorado, Pennsylvania, and Virginia are from NCHS.

Figure 7. Fire Death Rate by State (2001)

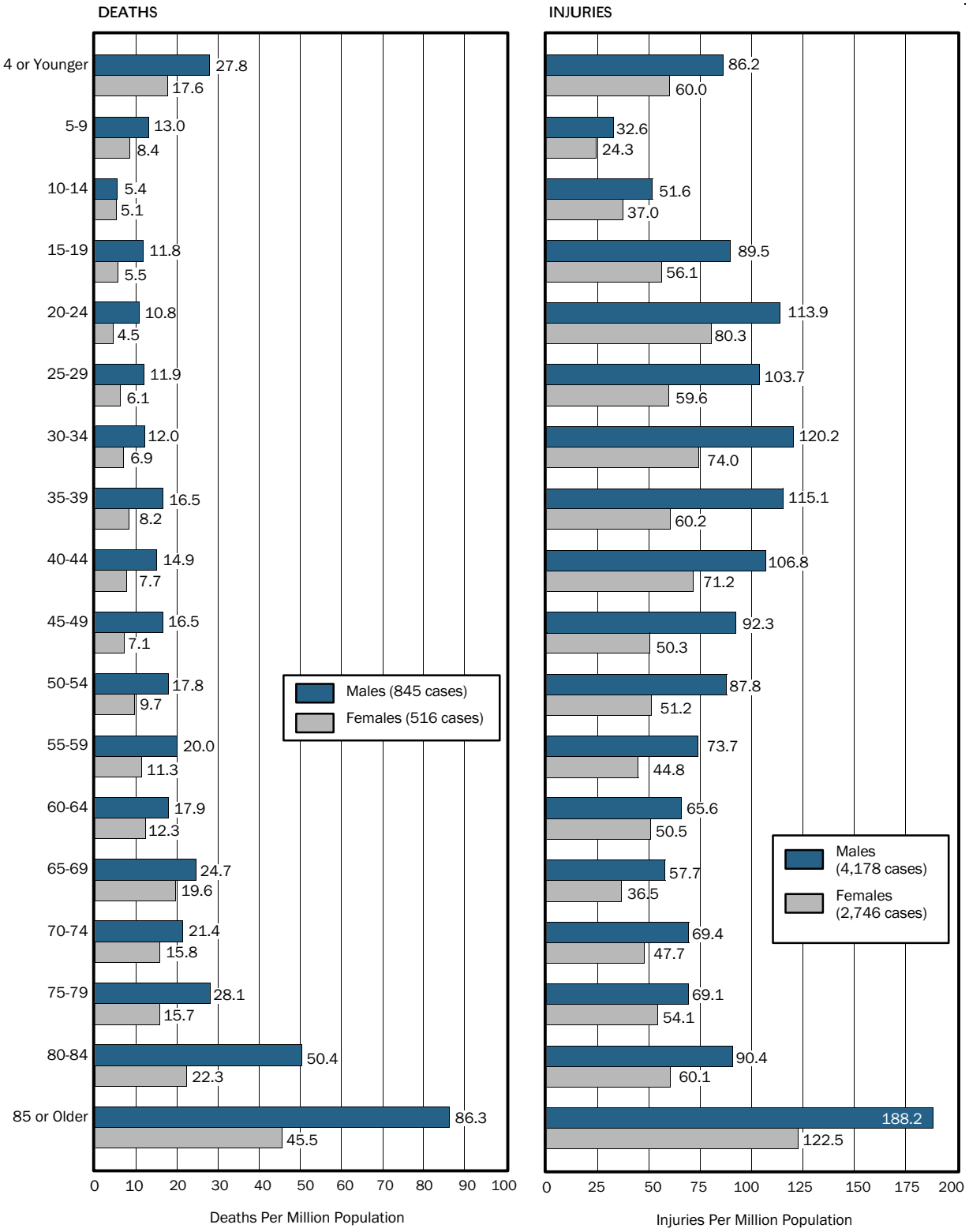


	Males	Females		Males	Females
1992	65.9	34.1	1997	62.1	37.9
1993	63.2	36.8	1998	61.8	38.2
1994	63.7	36.3	1999	62.6	37.4
1995	64.0	36.0	2000	62.1	37.9
1996	63.6	36.4	2001	62.1	37.9



	Males	Females		Males	Females
1992	60.8	39.2	1997	58.7	41.3
1993	60.6	39.4	1998	58.9	41.1
1994	61.6	38.4	1999	59.7	40.3
1995	61.1	38.9	2000	59.5	40.5
1996	60.4	39.6	2001	60.3	39.7

Figure 8. Trends in Male vs. Female Fire Casualties



Note: Data have been adjusted to account for unknown or unspecified ages.

Sources: NFIRS, NFPA, and U.S. Census Bureau

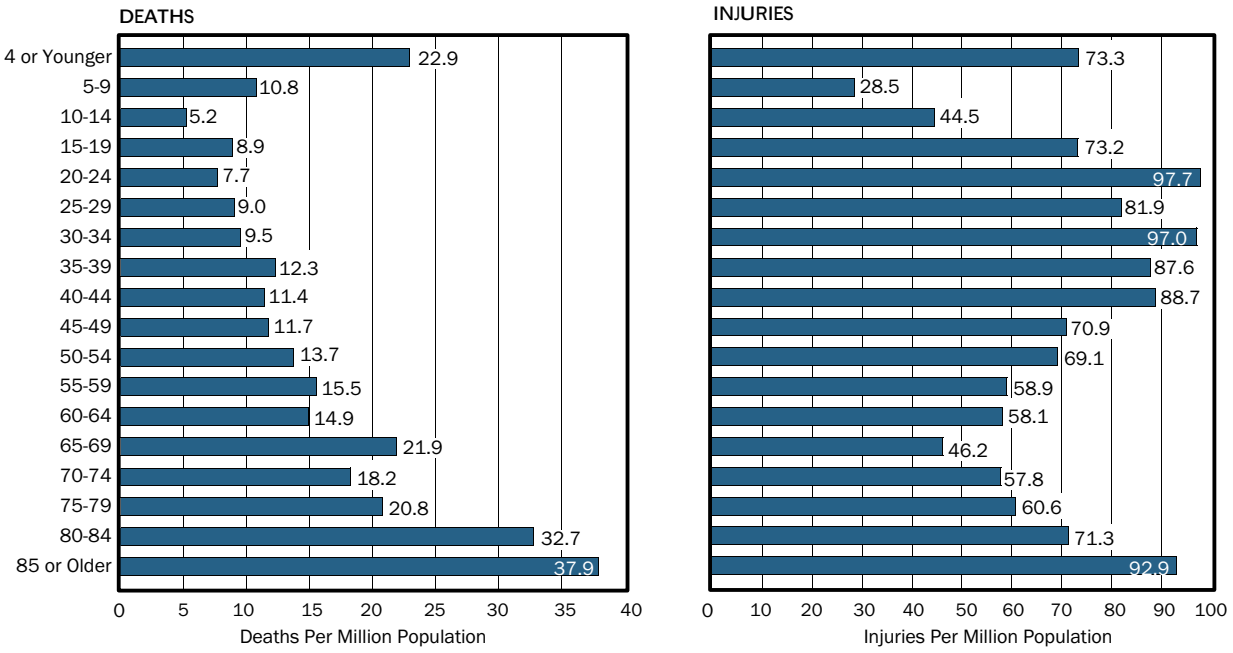
Figure 9. Rate of Fire Casualties by Age and Gender (2001)

Figure 8 also shows that the male-to-female ratio for fire injuries is similar to that for fire deaths except that the gender gap has been narrower. Injuries per million population for males are generally one and one-half times the female rate (Figure 9).

The reasons for the disparity of fire injuries between men and women are not known for certain. Suppositions include the greater likelihood of men being intoxicated, the more dangerous occupations of men (most industrial fire fatalities are males), and the frequent handling of gasoline and other flammable liquids by men. We also know that men have more injuries trying to extinguish the fire and rescue people than do women.

Age

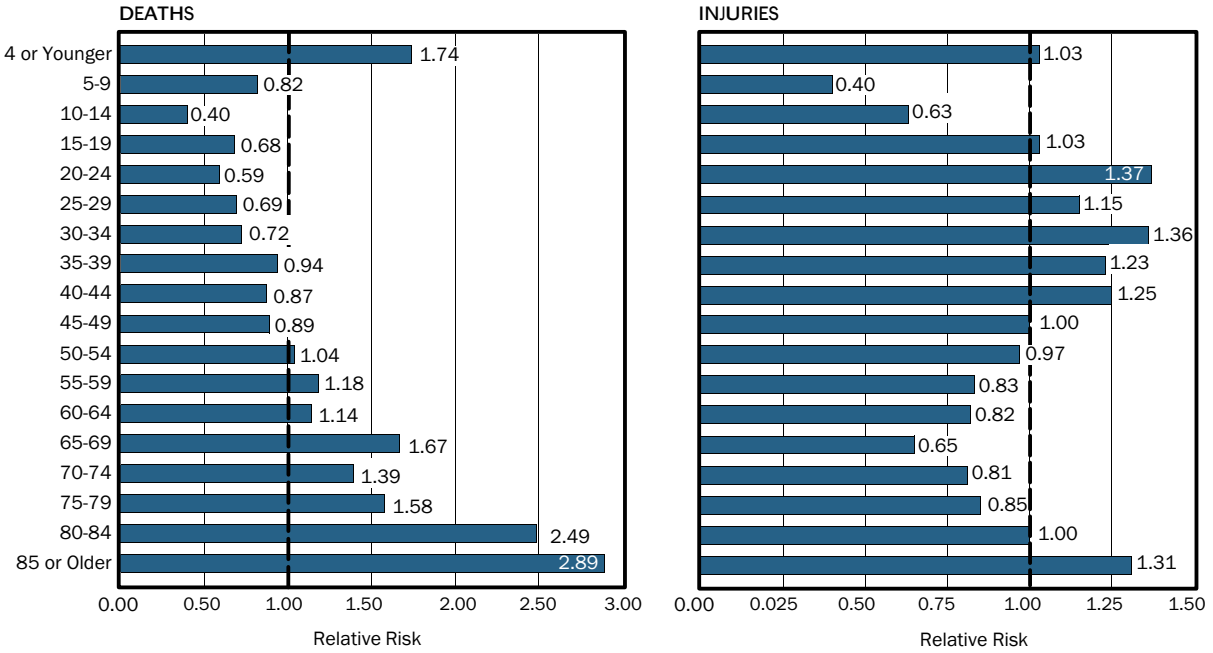
People over 65 have a much higher fire death rate than the average population, as shown in Figure 10. At the other end of the age spectrum, the very young (under 5) also have a higher-than-average problem, but not as high as the elderly. The relative risk of dying and being injured in a fire for various age groups is shown in Figure 11. Children under 5 have a much greater risk of death than other children; children over 5 have less than average risk. In 2001, the risk of fire death dropped off sharply between 5 and 14, then slowly increased until age 64. At age 65, the risk of death rose substantially above average and continued increasing as the population aged. These profiles have remained relatively constant from year to year.



Note: Data have been adjusted to account for unknown or unspecified ages.

Sources: NFIRS, NFPA, and U.S. Census Bureau

Figure 10. Casualty Rates by Age (2001)



Notes: (1) *Relative risk* compares the per capita rate (Figure 10) for a particular group (here, an age group) to the overall per capita rate (i.e., the general population). For the general population, the relative risk is set at 1.

(2) Data have been adjusted to account for unknown or unspecified ages.

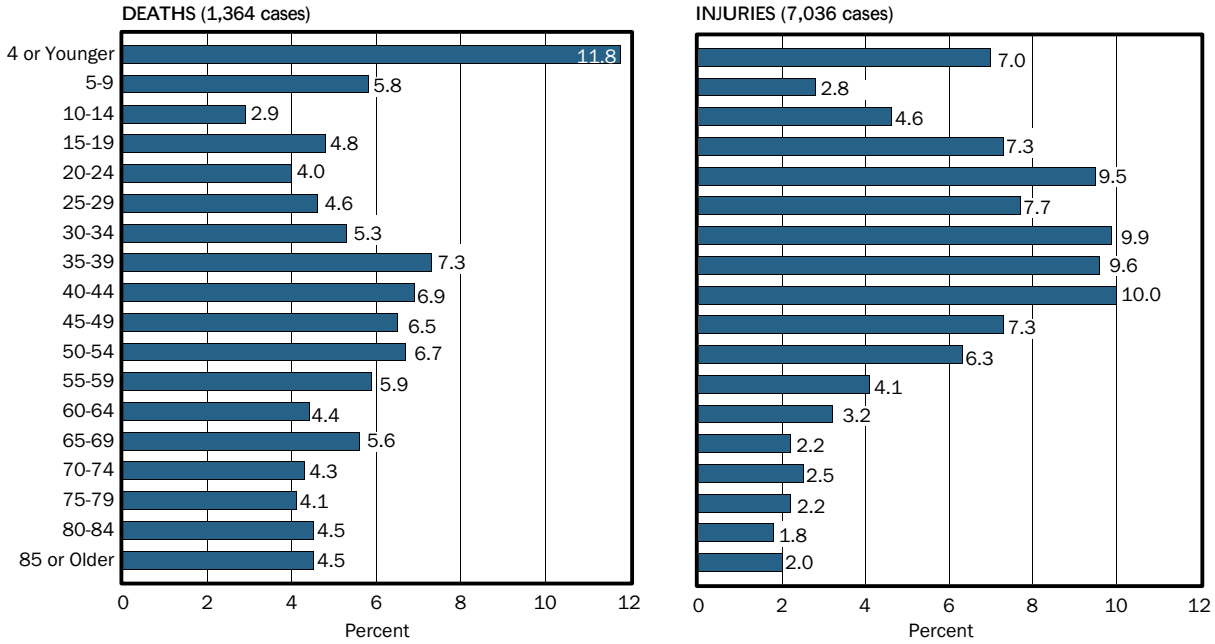
Sources: NFIRS, NFPA, and U.S. Census Bureau

Figure 11. Relative Risk of Fire Casualties by Age (2001)

Contrary to what might be expected, the age profile for injuries is very different from that for deaths (Figures 9–11). In 2001, the risk of injury in a fire was highest for adults aged 20–44 and the elderly over 85. The risk of injury is below average for children aged 5–14 and for those aged 50–79.

Figure 12 shows the percent of 2001 fire deaths and injuries falling into each age group. (This is not the same as risk.) Those under age 5 account for 12 percent of the deaths with age reported—the highest proportion for any age group. This unfortunately represents a 3 percentage point increase from 1998 for this young age group. Those 65 and over comprise 23 percent of the fire deaths. These two peak risk groups represent over one-third of all fire deaths. On the other hand, two-thirds of fire deaths fall in age groups that are not at high risk (Figure 11). The bulk of fire deaths occur to the not so young and not so old. Programs aimed only at the highest risk groups will not reach the majority of potential victims.

Unlike the age distribution of deaths, the injury age distribution tracks closely to the relative risk profile by age. The exception to this, however, is the elderly (Figure 12). Ages 20–44 account for nearly half of the 2001 fire injuries. The young, under age 10, account for 10 percent; the elderly over age 70 account for 9 percent. Although the elderly are at high risk, there are fewer of them in the total population. If their risk continues to be the same, we could expect more and more elderly fire injuries and deaths as the elderly proportion of the population



Note: Data have been adjusted to account for unknown or unspecified ages.

Source: NFIRS

Figure 12. Fire Casualties by Age (2001)

increases. In the meantime, the focus for injury prevention should be on adults 20–44. It is believed that males in this age group are greater risk takers during fires, resulting in a higher proportion of injuries.

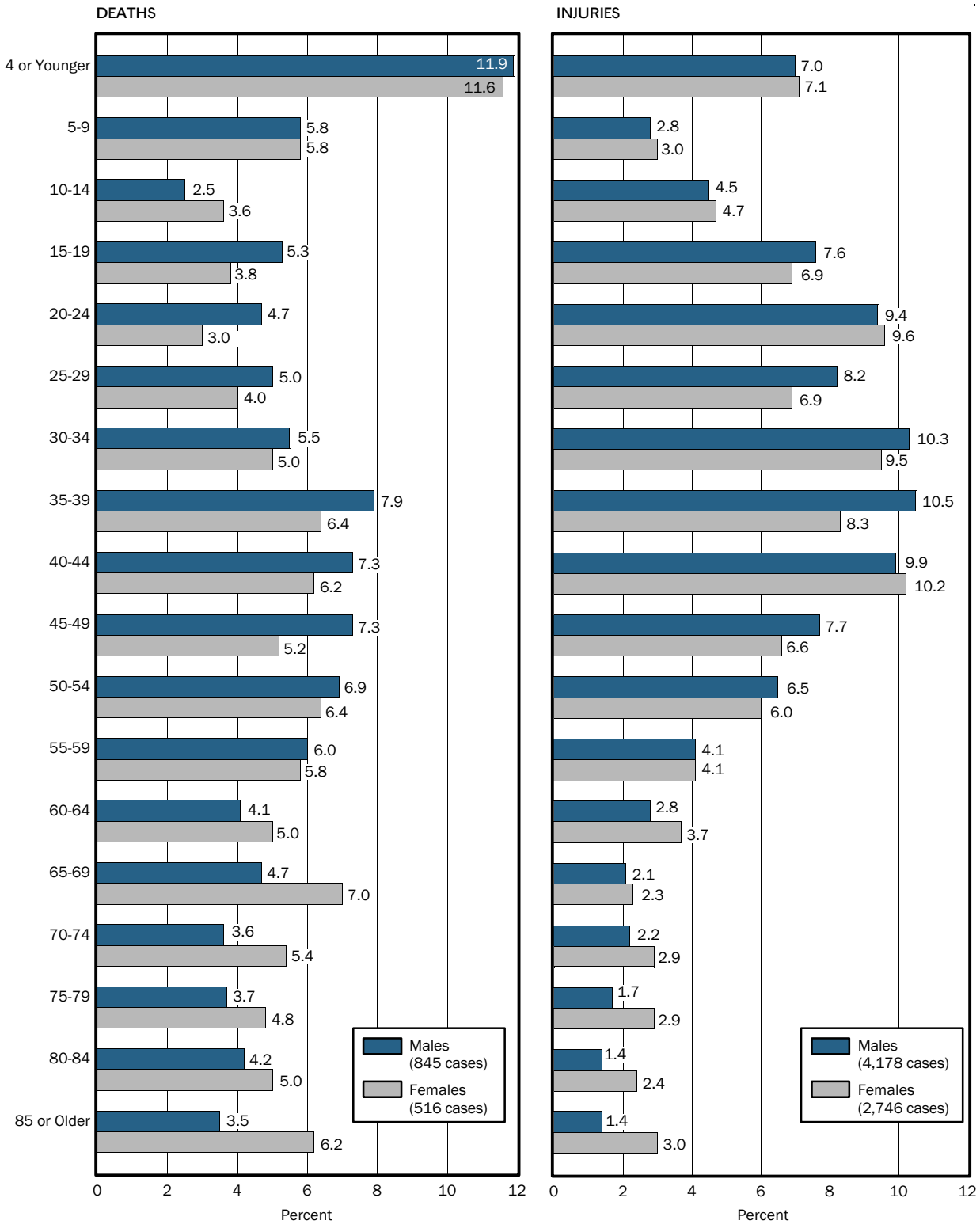
The distribution of fire deaths and injuries by age is somewhat different for males versus females (Figure 13). Males tend to have a slightly higher proportion of deaths and injuries until age 60. After 60, the male/female proportions are reversed. The proportion of male fire deaths is higher in the mid-life years, ages 15 to 60. By contrast, elderly females have twice the proportion of both deaths and injuries than elderly males.

Ethnic Groups

The fire problem cuts across all groups and races, rich and poor, North and South, urban and rural. But it is higher for some groups than for others.

Data on race or ethnic group of victims are somewhat ambiguous in a society where many people are of mixed heritages. And many citizens, including firefighters, find it distasteful to report on race. On the other hand, there does seem to be a higher fire problem for some groups, and it can be helpful to identify their problems for use within their own communities and by fire educators.

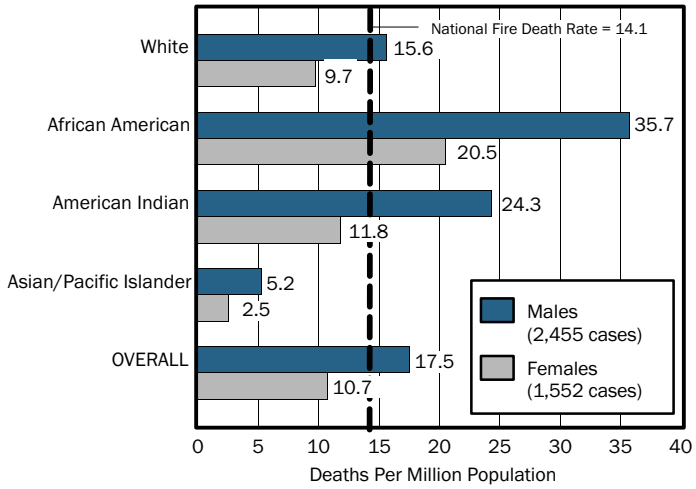
African Americans and American Indians have higher fire death rates per capita than the national average (Figure 14). African American fire death victims comprise a large and



Note: Data have been adjusted to account for unknown or unspecified ages.

Source: NFIRS

Figure 13. Fire Casualties by Age and Gender (2001)



Sources: National Center for Health Statistics and U.S. Census Bureau

NUMBER OF FIRE DEATHS

Race	Males	Females	Total
White	1,777	1,131	2,908
African American	616	390	1,006
American Indian	33	16	49
Asian/Pacific Islander	29	15	44
Total	2,455	1,552	4,007

Notes
(1) The overall male and female estimates include individuals with "2+ races" per the Census. The "2+ races" category accounts for approximately 1.4 percent of the population. NCHS does not include this race category.

(2) This figure uses NCHS data in the computation of the national fire death rate for data consistency within this chart. With NFPA fire death estimates, this rate is 13.1 and is the rate used throughout this report.

(3) Only deaths where both age and gender were specified were used in this analysis.

Figure 14. Death Rate by Race and Gender (2001)

disproportionate share of total fire deaths. Although African Americans comprise 12.7 percent of the population, they accounted for 25 percent of fire deaths. On the other hand, Asians have a very low death rate—male fatalities are less than 40 percent and women fatalities are less than 20 percent of the overall average for their respective genders.

As noted earlier, male fire death rates exceed that of females by 1.5 to 2 times, and the elderly of all ethnic groups have the highest fire death rates. The result of these statistics is that elderly African Americans (85 and older) have the highest fire death rate in the nation at more than 14 times the U.S. average fire death rate. This situation has continued to worsen. In 2001, elderly African American males had by far the highest relative risk at 21.5 times the U.S. average.

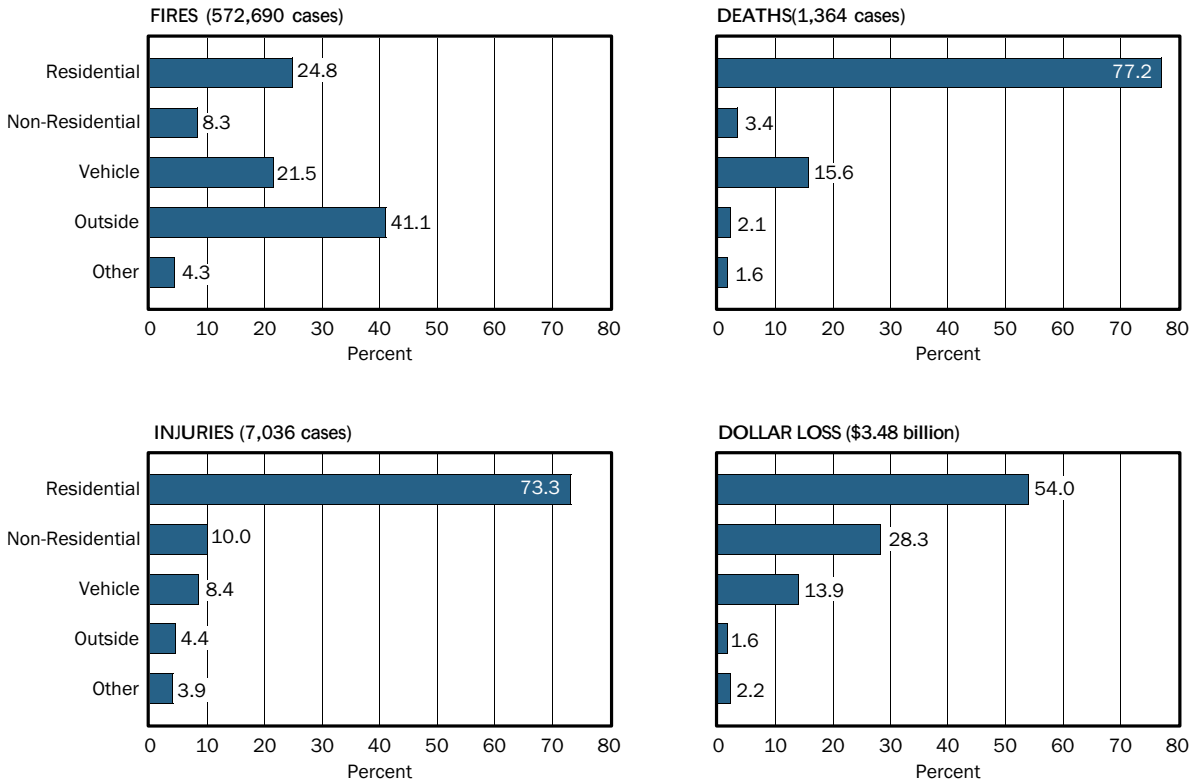
KINDS OF PROPERTIES WHERE FIRES OCCUR

This section describes the proportions of the fire problem by property type: residential structures, non-residential structures, vehicles, outside properties, and other or unknown properties.[10]

Property Types

Over the years, there has been little change in the proportion of fires, deaths, injuries, and dollar loss by the type of property involved. In terms of numbers of fires, the largest category continues to be outside fires (41 percent)—in fields, vacant lots, trash, etc. (Figure 15). Many of these fires are intentionally set but do not cause much damage. Residential and non-residential structure fires together comprise only one-third of all fires, with residential fires outnumbering

[10] The percentage of fire deaths in the major property types differs somewhat between NFIRS and the NFPA annual survey. These differences are discussed in Appendix A.



Source: NFIRS

Figure 15. Fires and Fire Losses by General Property Type (2001)

non-residential structure fires by three to one. What may surprise some is the large number of vehicle fires. In fact, one out of every five fires to which fire departments respond involves a vehicle.

By far the largest percentage of deaths, 77 percent in 2001, occurs in residences, with the majority of these in one- and two-family dwellings. Vehicles accounted for the second largest percentage of fire deaths at 16 percent. Great attention is given to large, multiple-death fires in public places such as hotels, nightclubs, and office buildings. But the major attention-getting fires that kill 10 or more people are few in number and have constituted only a small portion of overall fire deaths. Firefighters generally are doing a good job in protecting public properties in this country. Furthermore, these properties are generally required by local codes to have built-in fire suppression systems. The area with the largest problem is where it is least suspected—in people's homes. More fire prevention efforts should be focused on this part of the overall fire problem.

Only 3 percent of the 2001 fire deaths occurred in commercial and public properties. Outside and other miscellaneous fires, including wildfires, were also a small factor (4 percent combined) in fire deaths.

As Figure 15 shows, the picture is generally similar for fire injuries, with 73 percent of all injuries occurring in residences. Fire injuries are distributed to the other property types as follows: non-residential structures, 10 percent; vehicles, 8 percent; and outside and other fires, 8 percent.

The picture changes somewhat for dollar loss. While residential structures are the leading property for dollar loss, non-residential structures play a considerable role. These two property types account for 82 percent of all dollar loss. The proportion of dollar loss from outside fires may be understated because the destruction of trees, grass, etc., is often given zero value in fire reports if it is not commercial cropland or timber.

As a final observation on property types, structures (residential and non-residential) account for only one-third of fires, but they account for more than 80 percent of fire deaths, injuries, and property loss. Prevention efforts continue to be focused on home safety.

Trends

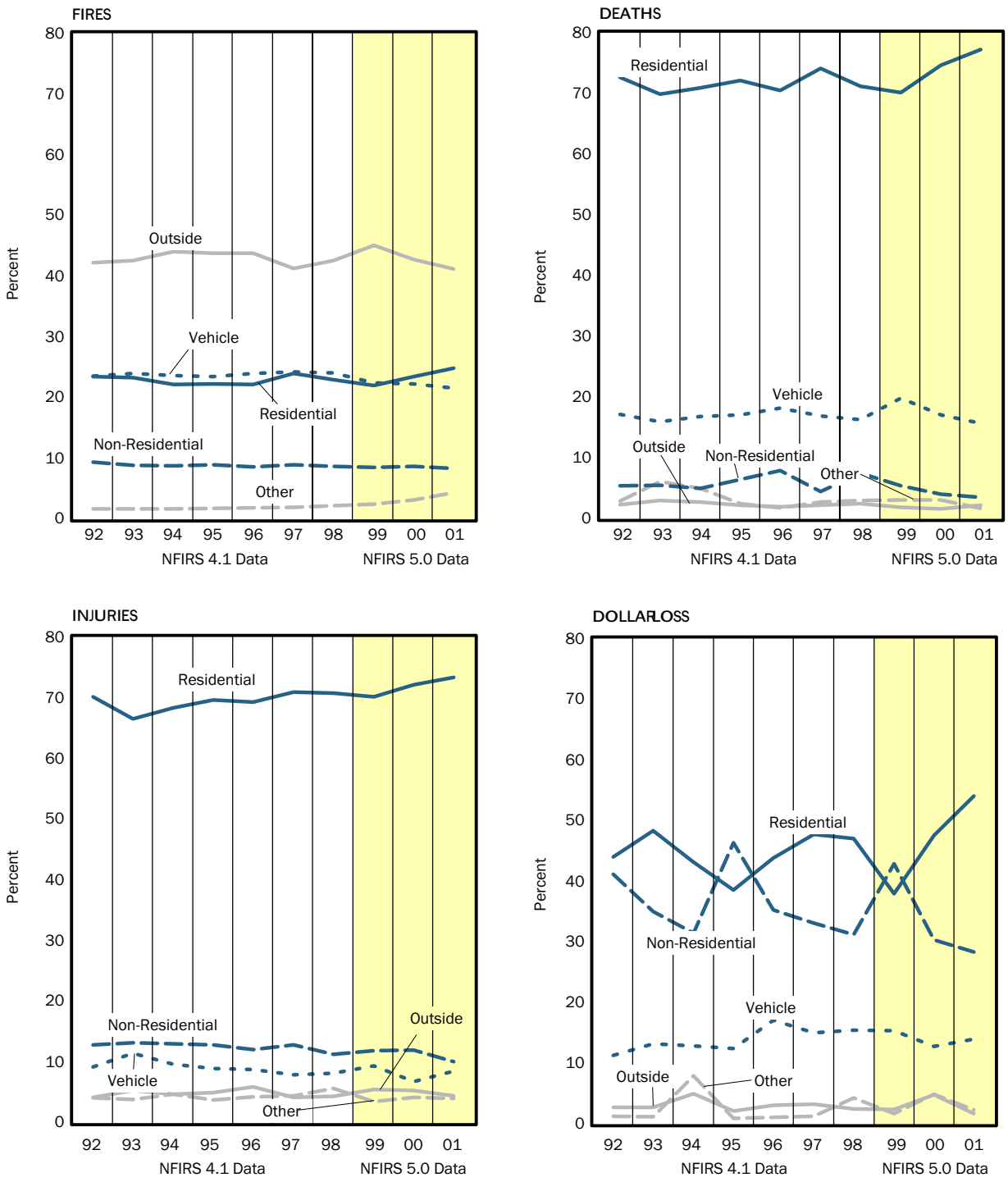
The fire problem by property type has remained quite steady over time. In terms of numbers of fires, the proportion of the problem due to non-residential structures and vehicles has declined slightly over the 10-year period. The proportion of other miscellaneous fires, although small, has more than doubled over the 10 years, likely the result of a small data set. Residential structures and outside fires have been relatively flat (Figure 16);[11] the trend increases and decreases are shown in Table 10.

Over the 10-year period, residential property fires caused an average of 73 percent of total fire deaths with sharp increases in 2000 and 2001. The trend in the proportion of vehicle fire deaths has risen slightly (4 percent). Non-residential structure fires represent a small, but decreasing, proportion of deaths. The proportion of outside and other fire deaths has declined substantially as well.

The proportion of injuries in residential properties and other fires have increased 6 and 9 percent, respectively; injury trends have decreased for the other three property types.

Dollar loss has greater trend fluctuations because this measure is highly sensitive to a few very large fires and whether they are included or omitted in the sample of fires on which estimates are based. The 10-year trends in the proportion of residential structure fire dollar losses have increased 12 percent, reversing the previous downward trend, while the proportion of non-residential dollar losses decreased 19 percent. Vehicle losses have continued to trend upward, currently at 20 percent. Dollar losses in the other property type category increased by 21 percent over the 10-year period. This jump is due to a $300 million loss in 1992 and a $390 million loss in 1998, both a result of large timber fires.

[11] The data for each point on this figure are presented in Appendix B. Similar tables are presented in Appendix B for other graphs where data cannot conveniently be shown on the graph itself.



Note: Data for all five property types are provided in Appendix B, Table B-1.

Figure 16. Trends in Proportions of Fires and Fire Losses by General Property Type

Table 10. Trends in Proportion of Fires and Fire Losses by General Property Type (1992–2001) (percent)

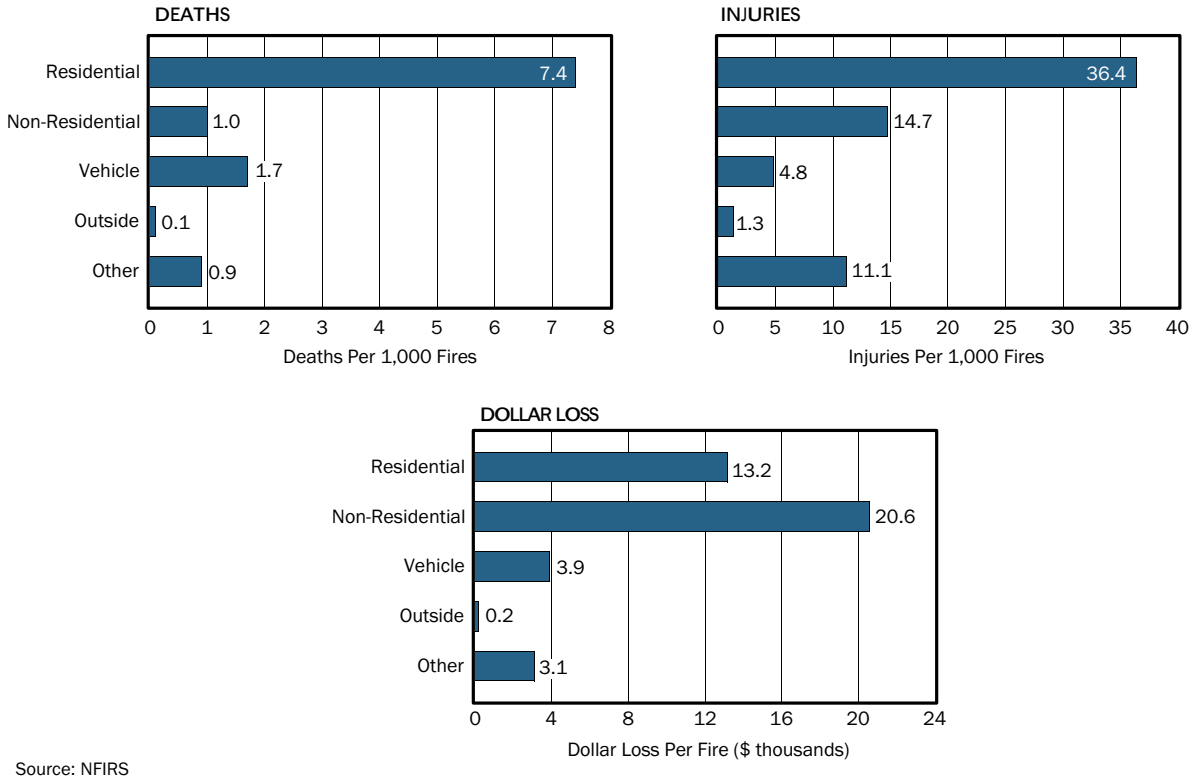
Property Type	Fires	Deaths	Injuries	Dollar Loss
Residential	+3.6	+5.6	+6.4	+12.0
Non-Residential	–8.4	–30.9	–17.9	–19.4
Vehicle	–7.6	+4.3	–23.1	+20.3
Outside	–0.4	–21.5	–2.0	–15.7
Other	+141.1	–54.2	+9.4	+20.7

Sources: NFIRS and Consumer Price Index; data provided in Appendix B, Table B-1.

Losses

Figure 17 shows casualties and losses per fire. These indicators represent the severity of fires but are somewhat ambiguous because they can increase if there are more casualties or damage per fire (the numerators) or if fewer minor fires are reported (the denominators).

Residential fires have the highest number of deaths and injuries per fire—another important reason for prevention programs to focus on home fire safety. Non-residential structure fires have by far the highest dollar loss per fire.



Source: NFIRS

Figure 17. Fire Casualtis and Dollar Loss Per Fire by General Property Type (2001)

The per fire trends over the 10-year period are shown in Figure 18; the trend increases and decreases are shown in Table 11. Residential deaths per fire continued its 10-year decline (9 percent). Non-residential deaths and injuries per fire both decreased by about one-third. Other fires (including unspecified property types) have relatively high deaths and injuries per fire, but this category represents only small numbers of fires, fire deaths, and injuries; it is a miscellaneous category.

Table 11. Trends in Fire Casualties and Dollar Loss Per Fire by General Property Type (1992–2001) (percent)

Property Type	Deaths	Injuries	Dollar Loss
Residential	–8.8	–23.3	+3.9
Non-Residential	–31.6	–33.8	–13.7
Vehicle	+0.9	–39.8	+28.3
Outside	–30.0	–26.1	–5.4
Other	–53.8	–55.0	–35.3

Sources: NFIRS and Consumer Price Index; data provided in Appendix B, Table B-2.

While deaths and injuries per 1,000 fires decreased, dollar loss per fire was less consistent. Non-residential fires averaged $27,300 per fire over the 10 years with wide fluctuations: from a low of $20,600 per fire in 2001 to a high of $38,700 per fire in 1999. The 10-year trend decreased 14 percent. Dollar loss increased considerably for all vehicle fires (28 percent). Residential dollar losses per fire increased slightly (4 percent) while outside losses decreased by a similar small margin (5 percent). Despite fluctuations in losses from other fires, notably the large losses in 1994, the dollar loss per fire decreased by over one-third.

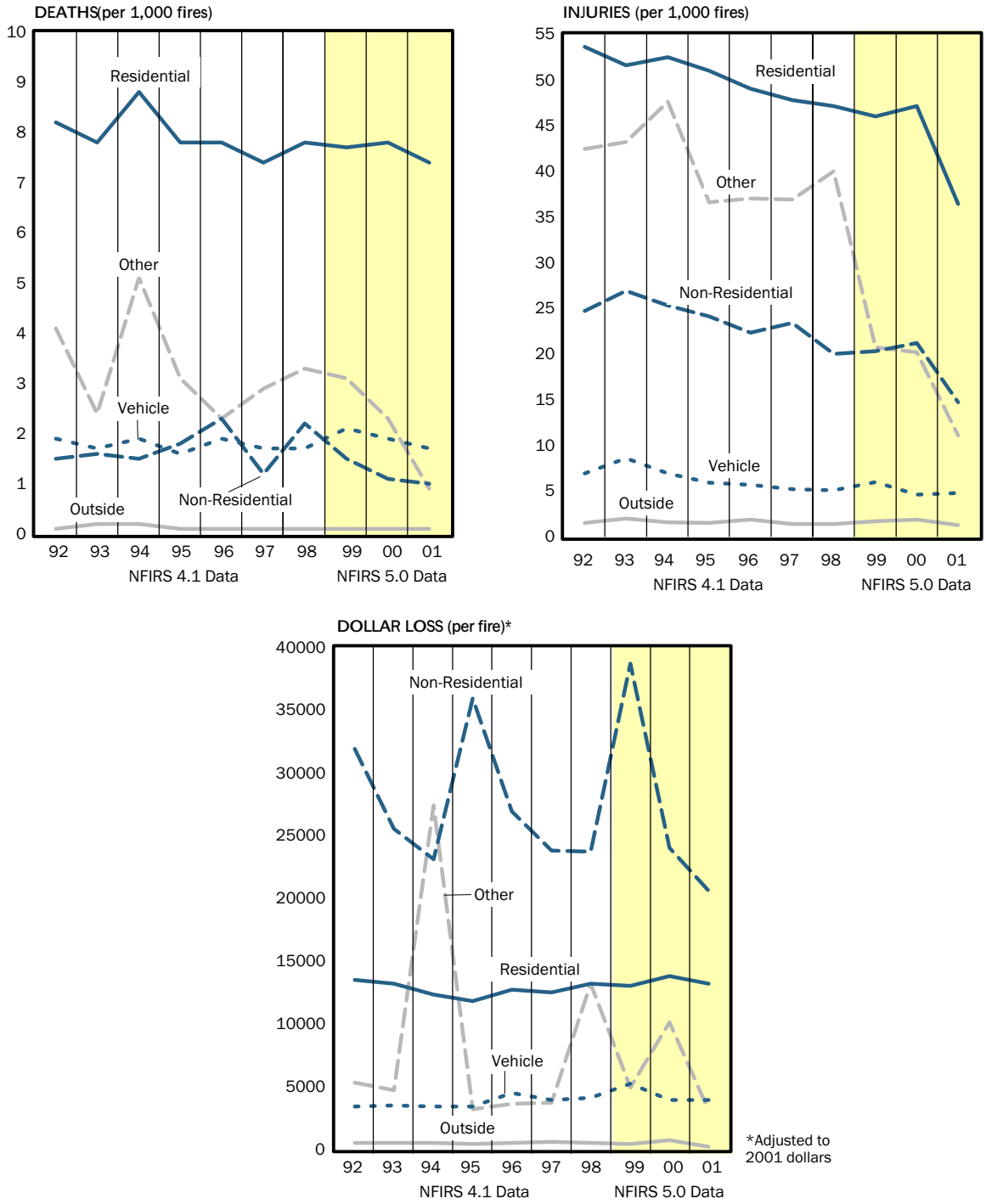
CAUSES OF FIRES AND FIRE LOSSES

Figure 19 shows the profile of the major causes of fires, fire deaths and injuries, and direct dollar loss in 2001 for all property types grouped together. At 25 percent, incendiary and suspicious (arson) is the leading cause of fires. Cooking fires cause another 15 percent.

The two leading causes of civilian deaths are smoking and arson at 23 percent each. Cooking is the third leading cause of fire deaths (10 percent). These percentages are adjusted, which proportionally spreads the unknowns over the other 12 causes.[12] The leading cause of injuries is cooking (23 percent), followed by open flame (14 percent) and arson (13 percent).

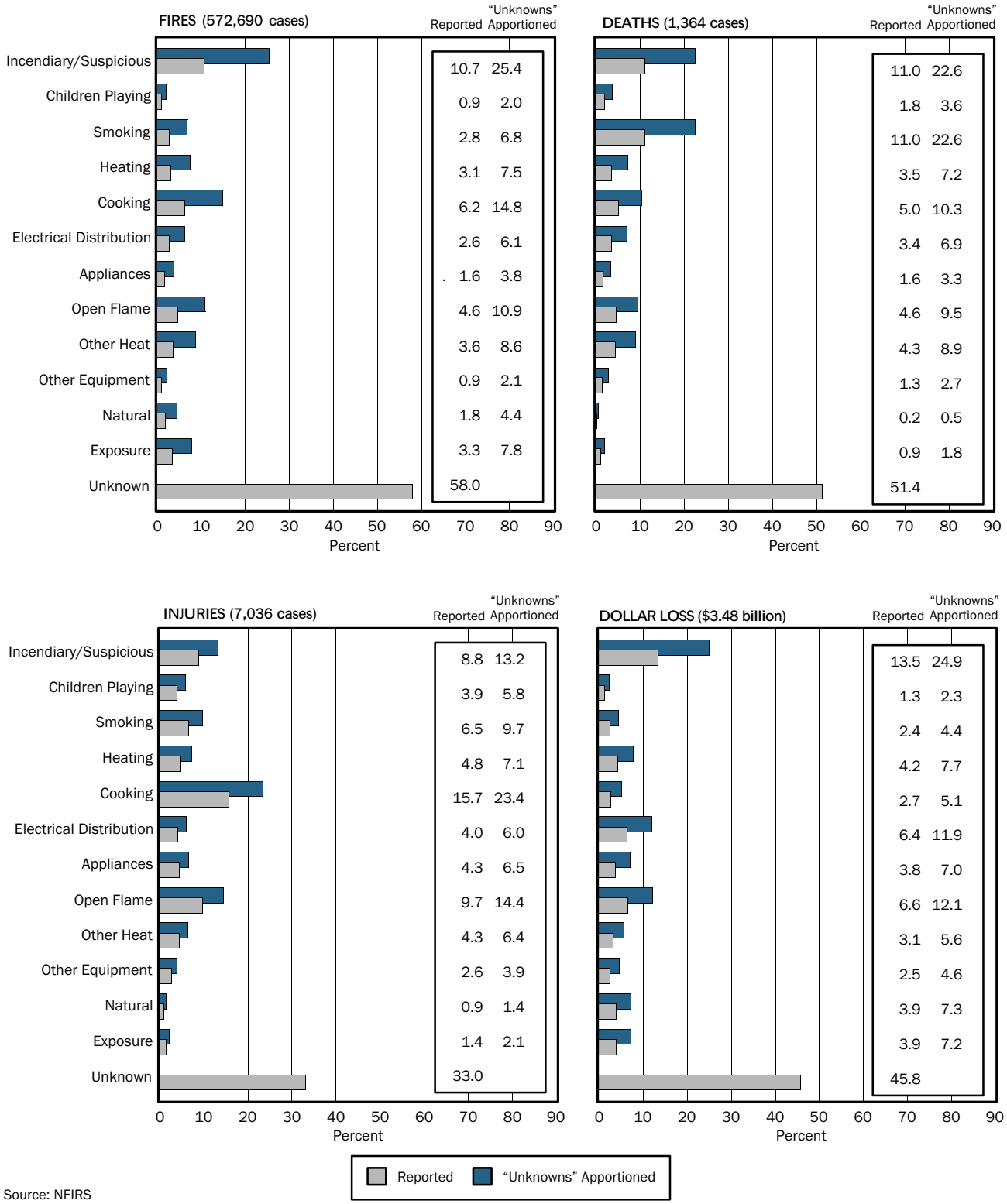
The causes of fire deaths and injuries are similar for both males and females (Figure 20). For deaths, the most notable differences are (1) in open flame and other heat fires, where male deaths are one-third greater than female deaths; and (2) in electrical distribution fires, where female deaths are 40 percent higher than male deaths. A higher proportion of men are injured in arson fires, and a higher proportion of women are injured in cooking fires.

[12] The unknowns here are quite large. The adjusted percentages may not accurately reflect the true distributions.



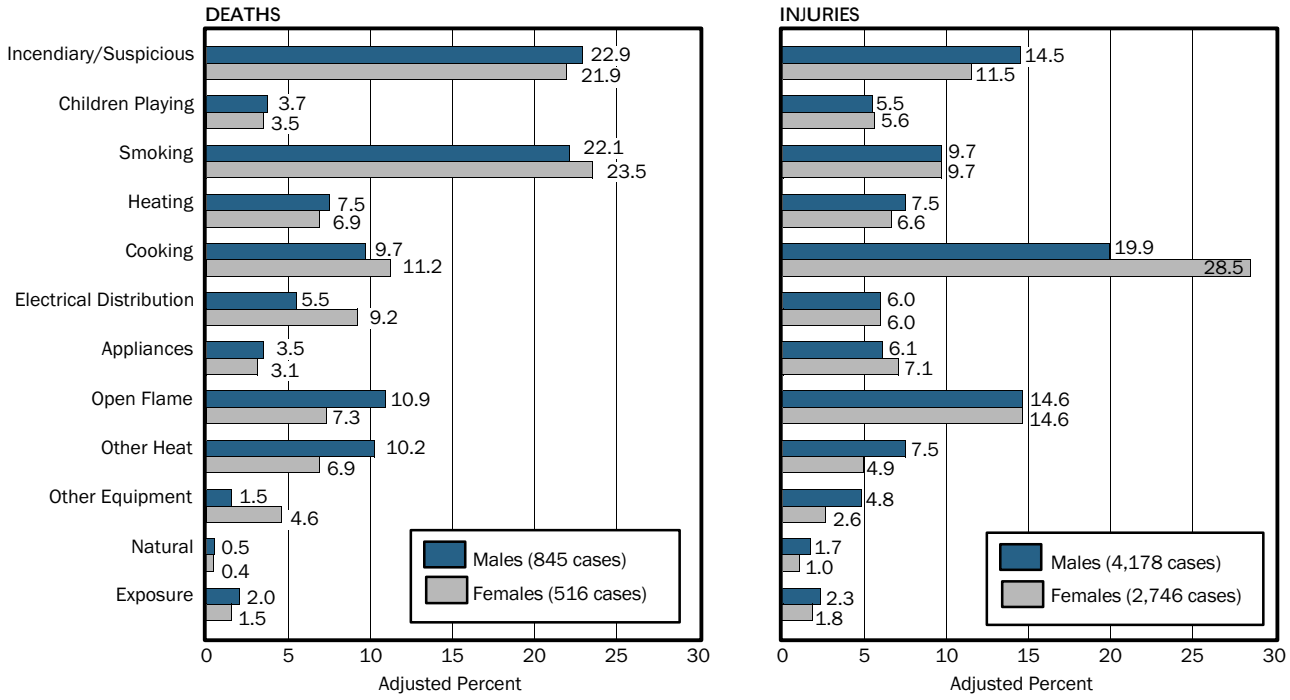
Sources: NFIRS and Consumer Price Index; data for all five property types are provided in Appendix B, Table B-2.

Figure 18. Trends in Fire Casualties and Dollar Loss Per Fire by General Property Type



Source: NFIRS

Figure 19. Causes of Fires and Fire Losses (2001)



Note: Data have been adjusted to account for unknown or unspecified causes.

Source: NFIRS

Figure 20. Causes of Fire Casualties by Gender (2001)

For both men and women, the two leading causes—arson and smoking—account for 45 percent of fire deaths. The two leading causes of injuries—cooking and open flame—account for 43 percent of female injuries and only 35 percent of male injuries.

USFA RESOURCES ON THE NATIONAL FIRE PROBLEM

The National Fire Data Center has a wealth of publications available free of charge that address the fire problem in the United States. In addition to ordering through the online catalog, publications may be ordered by calling the Publications Center at (800) 561–3356 between 7:30 a.m. and 5:00 p.m. EST/EDT. To order publications by mail, write to:

Publications Center
United States Fire Administration
16825 South Seton Avenue
Emmitsburg, Maryland 21727

Please include your name, mailing address, daytime telephone number, date required, title(s) of the publication, and the quantity you need when ordering by phone or mail. Also, publications may be ordered online at http://www.usfa.fema.gov/applications/publications. Please include the parenthetical publication number, if given, in your request.

The following reports provide insight into the magnitude of the fire problem in the United States; each can be downloaded at the above Web site:

A Profile of Fire in the United States: 1989–1996 (Twelfth Edition) (FA–214)
A Profile of Fire in the United States: 1987–1996 (Eleventh Edition) (FA–193)
A Profile of the Rural Fire Problem in the United States (FA–181)
Arson in the United States (FA–174)
Children and Fire in the United States: 1994–1997
Establishing a Relationship Between Alcohol and Casualties of Fire (FA–200)
Fire in the United States: 1989–1998 (Twelfth Edition) (FA–216)
Fire in the United States: 1987–1996 (Eleventh Edition) (FA–194)
Fire in the United States: 1986–1995 (Tenth Edition) (FA–183)
Fire in the United States: 1985–1994 (Ninth Edition) (FA–173)
Multiple-Fatality Fires Reported to NFIRS 1994–1996 (FA–201)
Profile of the Urban Fire Problem in the United States (FA–190)
Rural Fire Problem in the United States (FA–180)
Socioeconomic Factors and the Incidence of Fire (FA–170)

A *Fire Risk* series of reports, also downloadable, identifies fire risks for four at-risk populations:

Fire Risks for the Blind or Visually Impaired (FA–205)
Fire Risks for the Deaf or Hard of Hearing (FA–202)
Fire Risks for the Mobility Impaired (FA–204)
Fire Risks for the Older Adult (FA–203)

A *Topical Fire Research* series focuses on specific aspects of the national fire problem; download at http://www.usfa.fema.gov/inside-usfa/nfdc/pubs/tfrs.shtm:

All Structure Fires in 2000
Arson in the United States
Case Study: Contribution of Alcohol to Fire Fatalities in Ontario
Case Study: Contribution of Alcohol to Fire Fatalities in Minnesota
Children and Fire
Child Fire Casualties
Establishing a Relationship Between Alcohol and Casualties of Fire
Fatal Fires
Halloween Fires
Multiple Fatality Fires
Older Adults and Fire
The Dangers of Fireworks
The Seasonal Nature of Fire Incidents in 2000

Two USFA reports have attracted nationwide attention. *America Burning* is probably the most widely quoted fire protection publication. This report sets the stage for national consciousness-raising about the need for as much focus on fire prevention as on fire suppression. *Fire Death Rate Trends: An International Perspective* (FA–169) explores the magnitude and the nature of the fire death

problem in the United States. It provides a statistical portrait of fire death rates for 14 industrialized nations and presents observations about key institutional and attitudinal differences between the United States and industrialized countries with significantly lower fire death rates.

The *Fire Data Analysis Handbook, 2nd Edition* (FA–266) describes statistical techniques for analyzing data typically collected in fire departments. The *Uses of NFIRS: The Many Uses of the National Fire Incident Reporting System* (FA–171) details the variety and types of analyses possible using NFIRS data.

The following data reports can be downloaded from the USFA Web site:

Babies and Toddlers: Fire Death Data Report:
http://www.usfa.fema.gov/downloads/usfaparents/data-report.pdf

African American Babies and Toddlers: Fire Death Data Report:
http://www.usfa.fema.gov/downloads/usfaparents/data-report-aa.pdf

People 50-Plus Fire Death and Risk Report:
http://www.usfa.fema.gov/50plus/materials/50stateriskreport.pdf

Other USFA USFA reports and investigations that can be ordered or downloaded from the USFA Web site http://www.usfa.fema.gov/applications/publications include:

ARSON AND FIRE INVESTIGATION:

Arson Prosecution Issues (FA–78)
Basic Tools and Resources for Fire Investigators (FA–127)
Church Threat Assessment Guide (FA–207)
Establishing an Arson Strike Force (FA–88)
Field Index Guide (Fire and Arson Investigators' Field Index Directory) (FA–91)
Fire Apparatus/Train Collision (Catlett, VA – September 1989) (USFA–TR–048)
Fire/Arson Investigation Training Resource Catalog (FA–131)
Grems Case: How an Arson Case Was Solved and Prosecuted (USFA–TR–047)
Protecting Structures from Arson (L–241)
Two-Fatality Board and Care Facility Fire Salvation Army Rehabilitation Center (Miami, FL – November 1995) (USFA–TR–090)
View of Management in Fire Investigation Units (Volumes 1 and 2) (FA–93 and FA–116)

JUVENILE FIRE PROBLEM:

Children and Fire—A Growing Concern (FA–244)
Juvenile Firesetter Intervention Handbook (FA–210)
Juvenile Firesetters—What You Can Do! (FA–245)
National Juvenile Firesetter/Arson Control and Prevention Program (FA–239)

FIRE DATA:

America Burning Revisited
NFIRS Analysis: Investigating City Characteristics and Residential Fire Rates (FA–179)
What is NFIRS? (National Fire Incident Reporting System) (L–222)

OTHERS:

After the Fire: Returning to Normal (FA–46)
Directory of National Community Volunteer Fire Prevention Programs (FA–92)
Fire Safety Education Resource Directory (FA–172)
Funding Alternatives for Fire and Emergency Services (FA–141)
Get Alarmed South Carolina—Lessons Learned From Its Success (USFA–TR–044)
Mutual Aid: Lessons Learned from the California System (USFA–TR–042)
New Home Construction and Life Safety Sprinklers (FA–258)
Prevent the Unthinkable Brochure (FA–251)
Prevent the Unthinkable Brochure (Spanish) (FA–251–S)
Public Fire Education Planning: A 5-Step Process (FA–219)
Recruitment and Retention in the Volunteer Fire Service: Final Report (FA–185)
Smoke Alarms: What You Need to Know (FA–250)
United States Fire Administration Brochure (L–230)
USFA FY 2000 Accomplishments–Summary

The USFA Web site (http://www.usfa.fema.gov) also offers a wide variety of information on fire-related issues. This site also features sections on Press Releases, Fire Academy, Data Center, Fire Safety, Kids' Page, Wildfire, Arson Prevention, Facts on Fire, and NFIRS.

chapter three

Residential Properties

This chapter addresses residential properties over the 10-year period from 1992 to 2001, with specific focus on 2001. Significant changes from the last published statistics on residential properties—the 12th Edition, 1989–1998—are noted. Residential properties are discussed in four sections: an overview of all residential structures, one- and two-family homes (including mobile homes used as fixed residents, a subset of one- and two-family dwellings), apartments, and other residences such as rooming houses, hotels/motels, and other property types reported as residences.

OVERVIEW

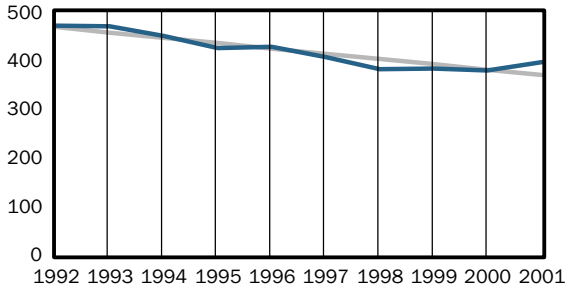
The residential portion of the fire problem continues to account for the vast majority of civilian casualties. NFPA estimates reflect that 84 percent of fire deaths and 77 percent of fire injuries are in residential structures.[1] This section reviews the residential fire problem overall. Subsequent sections of this chapter present details of the fire problem for major subcategories of residential properties (one- and two-family structures, apartments, and other types).

The term *residential* as used in NFIRS includes what is commonly referred to as homes, whether they are one- or two-family dwellings or multifamily apartment buildings. It also includes manufactured housing, hotels and motels, residential hotels, dormitories, and much of what might be considered "halfway houses" for the care of people with problems but who are able to operate in the community. The term does not include institutions such as prisons, homes for the elderly, juvenile care facilities, or hospitals, though many people may reside in them for short or long periods of time.

Figure 21, based on the NFPA annual surveys of fire departments, shows the 10-year trend in residential fires, deaths, injuries, and dollar loss. The trend in number of residential fires, deaths, and injuries declined 21, 19, and 29 percent, respectively. These decreases continue the downward trends estimated in past editions of this report. The decreases would be even greater if they were weighted against the number of residences that existed in 1992 versus the much higher number in 2001. Property losses, which had been declining, increased 6 percent over the 1992–2001 period. This increase may be attributed to the change in the way NFIRS 5.0 collects property losses. NFIRS 5.0 includes separate estimates for the value and loss of the building and its contents; NFIRS 4.1 provided one overall estimate.

[1] These percentages are derived from summary data presented in NFPA's annual survey, 2001.

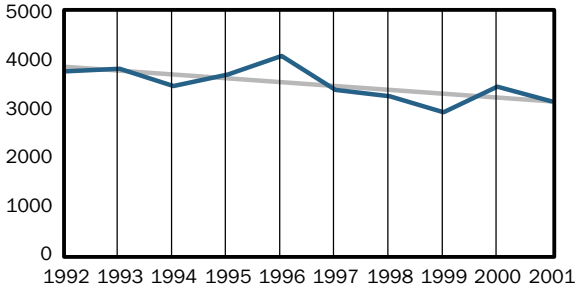
FIRES (in thousands)



1992	472.0	1997	406.5
1993	470.0	1998	381.5
1994	451.0	1999	383.0
1995	425.5	2000	379.5
1996	428.0	2001	396.5

10-Year Trend = –21.0%

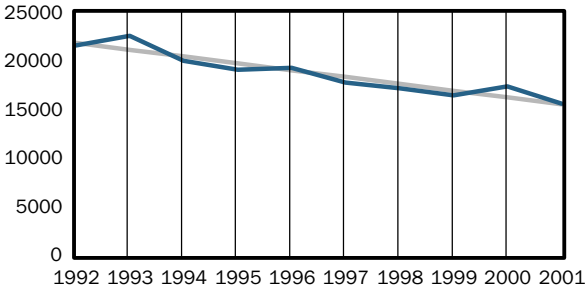
DEATHS



1992	3,765	1997	3,390
1993	3,825	1998	3,250
1994	3,465	1999	2,920
1995	3,695	2000	3,445
1996	4,080	2001	3,140

10-Year Trend = –18.5%

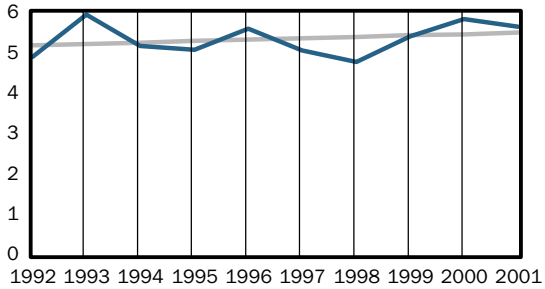
INJURIES



1992	21,600	1997	17,775
1993	22,600	1998	17,175
1994	20,025	1999	16,425
1995	19,125	2000	17,400
1996	19,300	2001	15,575

10-Year Trend = –28.9%

DOLLAR LOSS (in $ billions)*



1992	$4.90	1997	$5.06
1993	5.94	1998	4.77
1994	5.16	1999	5.41
1995	5.07	2000	5.84
1996	5.60	2001	5.64

10-Year Trend = +6.1%

*Adjusted to 2001 dollars

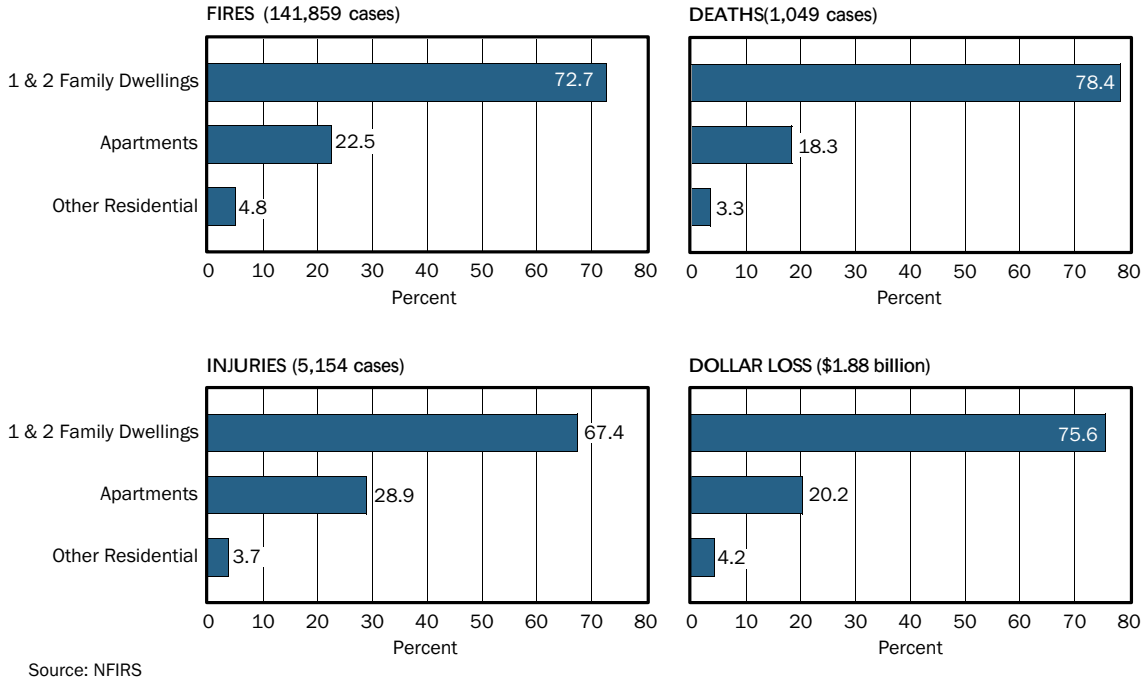
Sources: NFPA and Consumer Price Index

Figure 21. Trends in Residential Fires and Fire Losses

Because an average of 3,500 civilians die, 18,700 are injured, and property losses amount to an annual average of $5.34 billion, the fire problem in U.S. residences is of significant concern.

Types of Residences

Figure 22 shows the relative proportions of fires and losses among the three major residential categories in 2001. (Each of these categories is discussed in subsequent sections of this chapter.) The percentages shown are relatively consistent over each of the previous 9 years.[2]



Source: NFIRS

Figure 22. Residential Fires and Fire Losses by Property Type (2001)

One- and two-family dwellings, where the majority of the U.S. population live, dominate the residential statistics: 73 percent of residential fires, 78 percent of residential fatalities, 67 percent of residential injuries, and 76 percent of residential dollar loss. Manufactured housing, a subset of one- and two-family structures, are included in these statistics.[3]

Apartments account for 23 percent of residential fires, 18 percent of residential deaths, 29 percent of injuries, and 20 percent of residential dollar loss. The relatively high incidence of injuries in apartments may be because the total space is significantly less in apartments than in dwellings, and people are more quickly exposed to fire products than in a house. Other factors

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[2] The analyses in this chapter exclude information from NFIRS on two unconfirmed large loss fires. The combined losses from these two fires was reported at $190 million.

[3] In this report, *manufactured housing* includes only mobile homes situated on semipermanent sites and used as fixed residences.

may also influence apartment injuries. Potential deaths could become injuries because apartments may be built to strict codes, sprinklers may be installed, or smoke alarms may be hardwired to a fire station that generates an automatic fire department response when the alarm goes off.

Other residential properties (mostly hotel and motel fires) account for between 3 and 5 percent of the residential fire problem in the various measures.

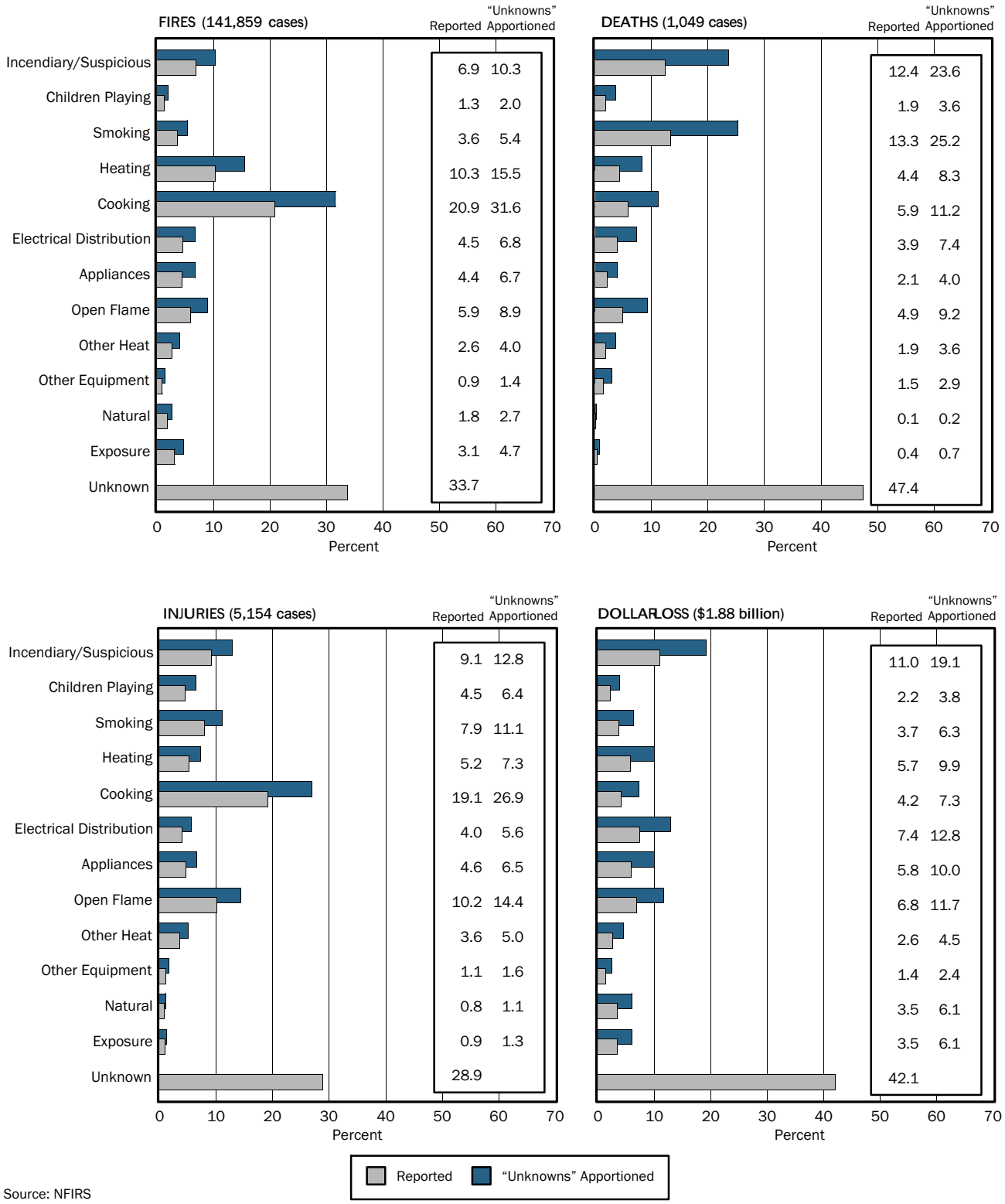
Causes

Figure 23 shows the causes of fires, deaths, injuries, and dollar loss in 2001. These statistics are driven by the one- and two-family dwelling property type, which accounts for the majority of residential fires. As a result, the overall residential figures and those for one- and two-family dwellings (Figure 34) are quite similar. Larger differences from the overall residential causes are found as one looks at the smaller subcategories of residences—apartments, mobile homes used as fixed residences, and hotels/motels.

With the introduction of limited reporting of confined, no-loss structure fires in NFIRS 5.0, the cause profiles for structure fires, especially residential structure fires, have undergone an important change. This new reporting feature allows the fire service to capture incidents where the fire was confined to the vessel or object of origin and caused no loss. These are fires that are thought to have gone unreported prior to the introduction of NFIRS 5.0 or were reported, but as a nonfire fire incident as no loss was involved. These confined fires, generally of three types (cooking, heating related (primarily chimney), or trash related), now account for 18 percent of residential fires. Cooking (11 percent) and heating-related (5 percent) confined fires account for 16 of this 18 percent. As a result, cooking and heating fires show increases—cooking fires show large increases while heating fires show more modest ones.

Cooking has been the leading cause of residential fires most of the years since the inception of NFIRS. In 2001, largely as a result of confined cooking fires, cooking fires were double that of the next leading cause. Heating passed cooking for a few years in the late 1970s when there was a surge in the use of alternative space heaters and wood heating, but that heating problem has since subsided. Not surprisingly, cooking is also the leading cause of fire injuries, nearly twice that of the next leading cause. Many cooking fires come from unattended cooking where grease or oil ignites or flammable materials in proximity to burners catch fire. These fires can be lessened by emphasizing the importance of vigilance while cooking and by informing the public on how to extinguish small cooking fires (e.g., cover with a pot lid, douse it with baking soda). Wearing loose-fitting clothing such as bathrobes can be dangerous around cooking areas. Cooking in 2001 is the third leading cause of fire deaths, as it was in 1998.

Incendiary and suspicious, which is called "arson" here even though that term has a narrower legal definition, is the leading cause of dollar loss, the second leading cause of deaths, and the third leading cause of fires and injuries in residences. That arson is so prominent a factor in the residential fire problem may be a surprise to many. There are a number of factors to residential arson fires—vandalism, revenge, fraud, and quarrels are common motives according to fire



Source: NFIRS

Figure 23. Causes of Residential Fires and Fire Losses (2001)

officials. Because of advances in criminal forensics, the use of arson to conceal crimes is yet another motive.[4] Part of the reason for the increase in the rank order of arson fires is the success in reducing accidental and careless fires, or detecting them early enough so that they are not reported to NFIRS.

There is little change in 2001 property losses from 1998. Arson and electrical distribution continued as the first and second leading causes, respectively.

Heating, the second leading cause of residential fires, includes those fires where the equipment involved in ignition is central heating, fireplaces, portable space heaters, fixed room heaters, wood stoves, and water heating. The central heating and water heater portions of the problem have remained relatively steady, while the portable space heater and wood burning stove portion of the problem, along with chimney fires, rose very sharply from the late 1970s to the early 1980s but has since abated.

As in all previous years, smoking is the leading cause of residential fire deaths (and fire deaths overall), accounting for one-quarter of all fatalities. The percentage of smoking deaths increased slightly since 1998. Smoking is fourth in injuries and seventh in fires and dollar loss. Smoking deaths may be higher than the other measures because the careless smoker has fallen asleep or is incapacitated and unable to escape the ensuing fire.

It is important to note that the leading causes are different depending on what measure is used, as can be seen from Figure 23. Table 12 displays the top three causes of each measure for 2001 and compares this ranking with those of 1996 and 1998. Two causes are included for the first time in the top three groupings. Open flame fire injuries jumped from fifth in 1998 to second place and its property loss moved to third place.

Table 12. Leading Causes of Residential Fires and Fire Losses (2001)

[Numbers in parentheses reflect the 1996/1998 rankings]

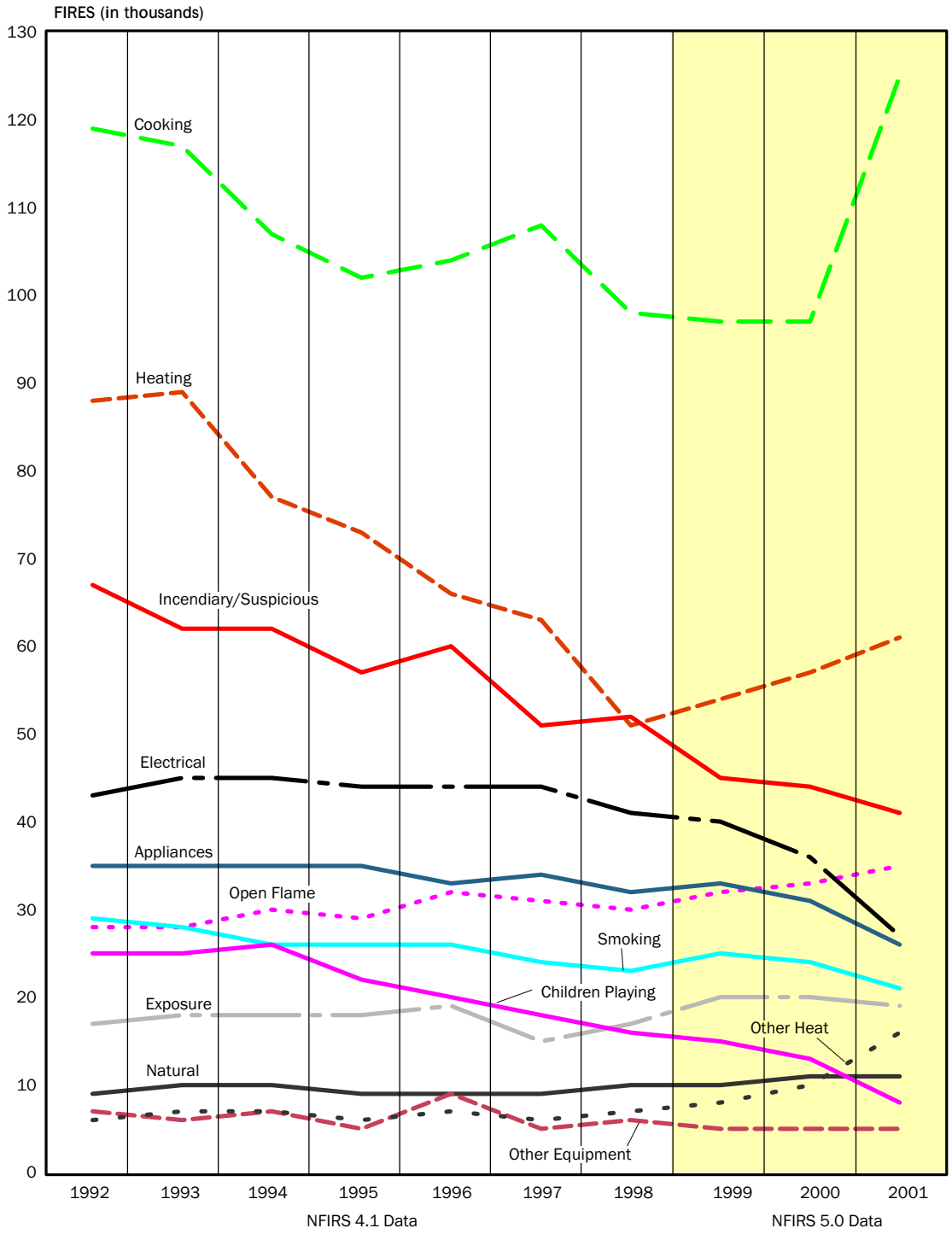
Rank	Fires	Deaths	Injuries	Dollar Loss
1	Cooking (1/1)	Smoking (1/1)	Cooking (1/1)	Arson (1/1)
2	Heating (2/3)	Arson (3/2)	Open Flame (6/5)	Electrical (3/2)
3	Arson (3/2)	Cooking (5/3)	Arson (3/2)	Open Flame (5/5)

Sources: NFIRS and 11th and 12th Editions, *Fire in the United States*

Cause Trends

Figure 24 (four pages) shows the trends in the causes of residential fires and fire losses over the years 1992–2001. Table 13 shows the 10-year trend increase or decrease for each cause.

[4] Motives were not reported in NFIRS 4.1, but are included in NFIRS 5.0. However, this report does not examine the NFIRS 5.0 data on arson motives.



Note: Data provided in Appendix B, Table B-3.

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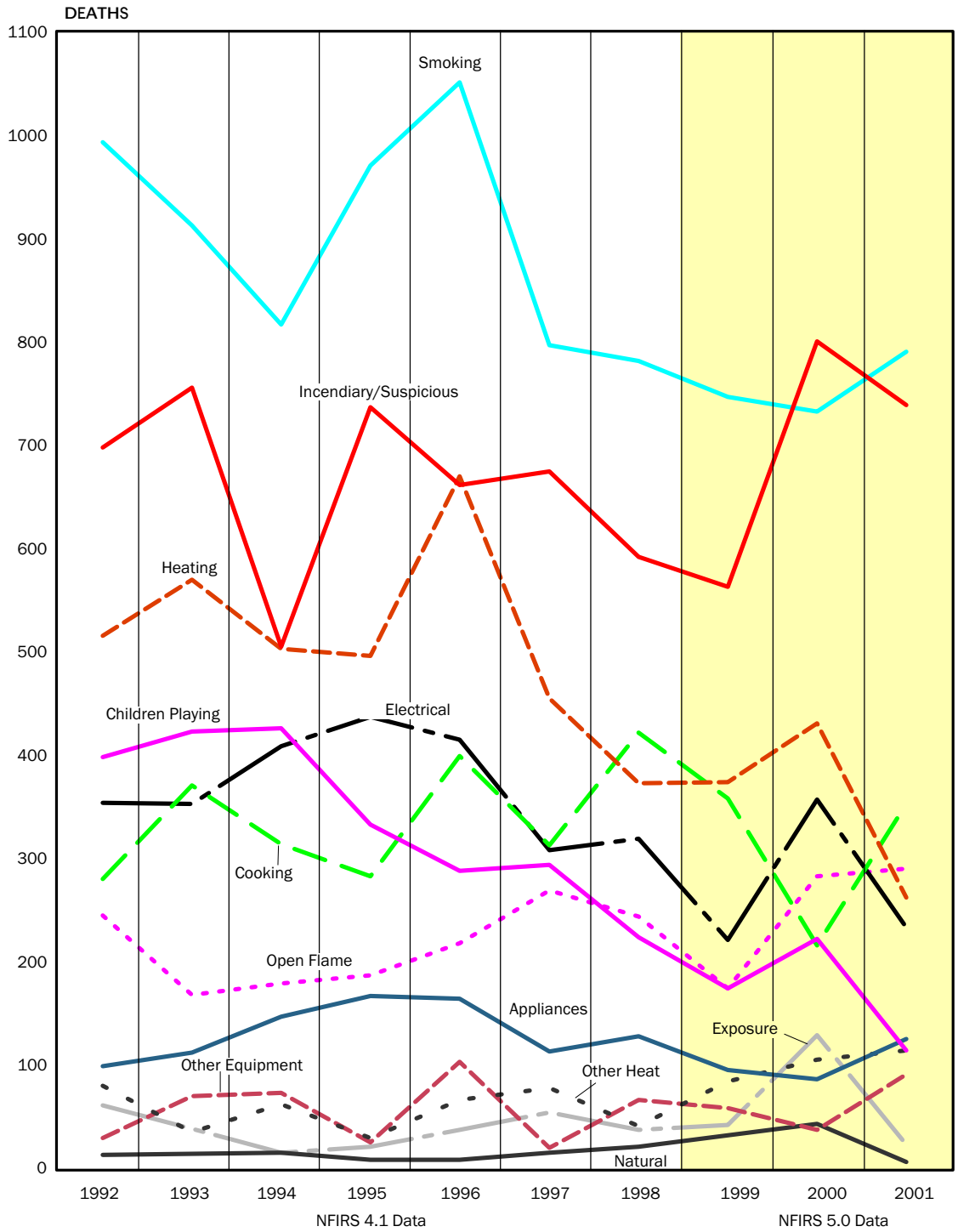
Figure 24. Trends in Causes of Residential Fires and Fire Losses



Note: Data provided in Appendix B, Table B-3.

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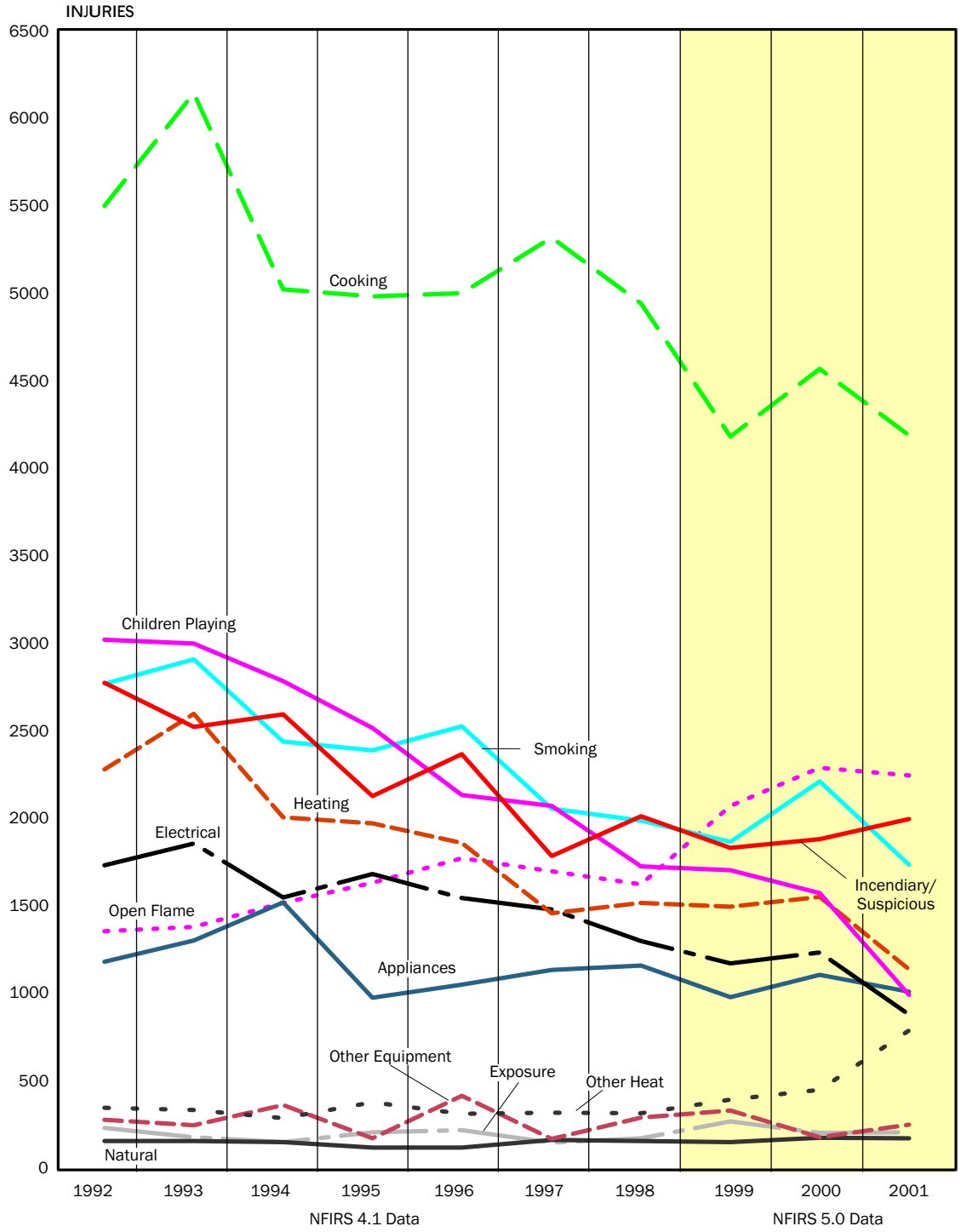
Figure 24. Trends in Causes of Residential Fires and Fire Losses (cont'd)



Note: Data provided in Appendix B, Table B-3.

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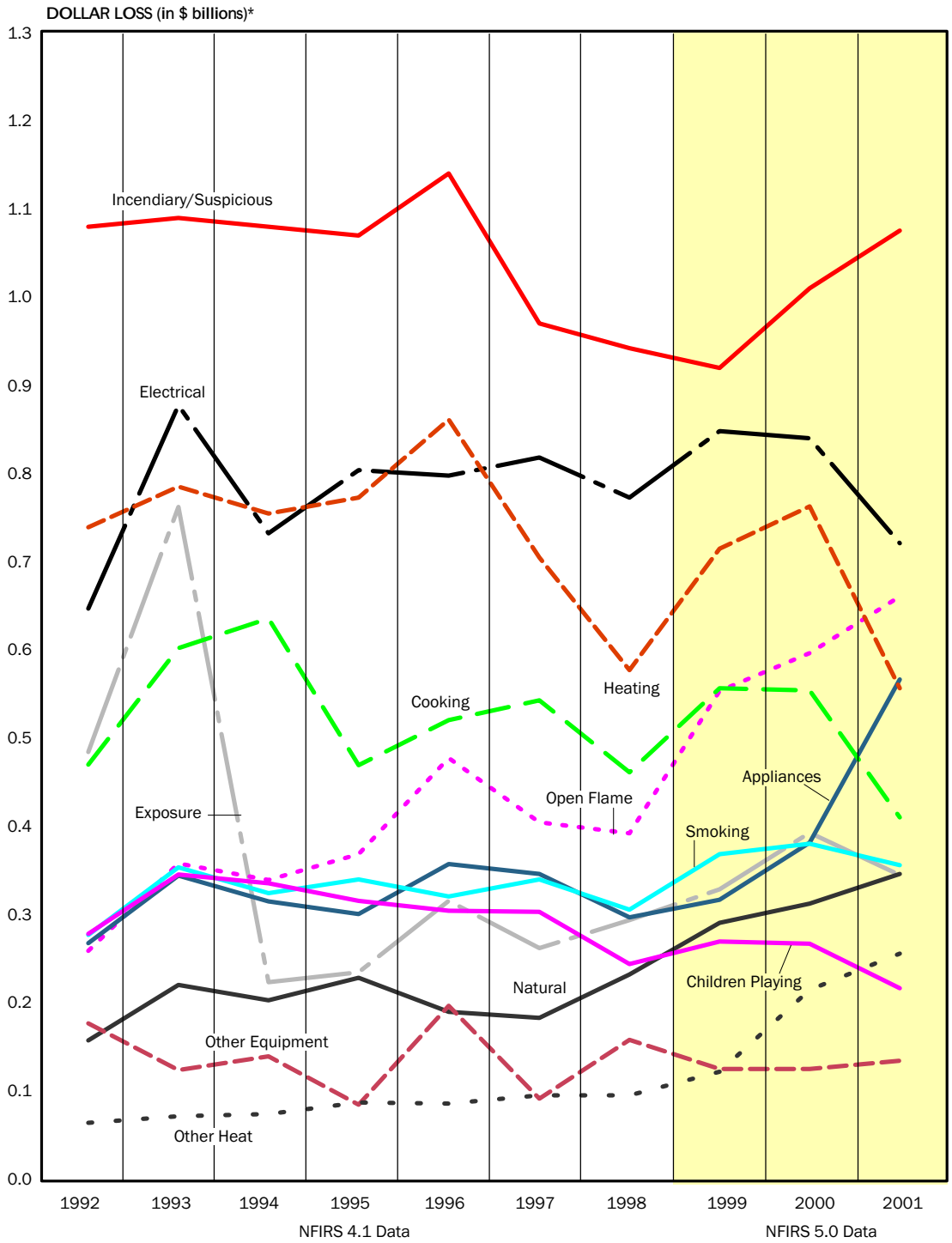
Figure 24. Trends in Causes of Residential Fires and Fire Losses (cont'd)



Note: Data provided in Appendix B, Table B-3.

*Adjusted to 2001 dollars

Sources: NFIRS, NFPA, and Consumer Price Index

Figure 24. Trends in Causes of Residential Fires and Fire Losses (cont'd)

Table 13. Trends in Causes of Residential Fires and Losses (1992–2001) (percent)

Cause	Fires	Deaths	Injuries	Dollar Loss
Incendiary/Suspicious	–38.3	+4.6	–33.7	–9.8
Children Playing	–62.8	–68.6	–62.8	–27.1
Smoking	–21.8	–23.8	–36.5	+18.4
Heating	–41.2	–41.7	–50.2	–18.8
Cooking	–7.0	+2.0	–25.6	–12.4
Electrical Distribution	–27.7	–32.9	–44.5	+6.5
Appliances	–18.7	–15.3	–15.2	+59.4
Open Flame	+21.1	+41.0	+72.1	+129.4
Other Heat	+132.1	+119.9	+112.4	+472.3
Other Equipment	–20.7	+32.3	–14.9	–12.5
Natural	+11.3	+146.2	+17.5	+94.6
Exposure	+8.8	+83.9	+11.4	–38.6

Sources: NFIRS, NFPA, and Consumer Price Index; data provided in Appendix B, Table B-3.

All of these trends would appear lower if presented as per capita rather than in the absolute because the population increased by an estimated 11 percent over the 10 years. Therefore, an upward trend that is less than the population increase or any downward trend reflects an improvement to the overall fire problem. One significant change is that, starting in 1994, the hotel/motel category began to be counted under other residences because the magnitude of the hotel/motel fire problem had dropped so much as to not merit a separate category. Therefore, certain trend data could not be reported for the hotel/motel category after 1994.

Cooking fires remain the leading cause by a widening margin. There was a modest downward trend in cooking fires until 2000, but they increased to their highest level in 2001. Heating fires decreased considerably from 1992 to 1998, but in the 3 years since they have steadily risen. Much of this increase is a result of the inclusion of confined cooking and heating fires. Heating, the second highest cause of fires in 9 of the past 10 years, trended down 41 percent. Arson fires have been in third place for 9 of the past 10 years, but the 10-year trend is down 38 percent; as will be seen, however, arson deaths are up and property losses due to arson are considerably higher than any other cause. An encouraging trend is children playing fires, which has trended down 63 percent and is more than three times less in 2001 than in 1992. Along with the reduction in children playing fires is the reduction in deaths from these fires—69 percent. As a reminder, however, the 1999 to 2001 cause data are derived from the new NFIRS 5.0 data. Subtle definitional changes may result in the data not being directly equivalent.

Smoking and arson are the number one and two causes of deaths by very wide margins over the next leading cause even though the number of fires for both have trended down over 10 years (22 and 38 percent, respectively). Deaths from heating and children playing causes reached their lowest levels in 2001—and decreased 42 and 69 percent, respectively.

Injuries from cooking fires are down 26 percent, but they still are nearly double those of the next leading cause. Open flame injuries catapulted from the seventh leading cause in 1992 to

the second leading cause in 2001, increasing 72 percent. Arson is the third leading cause of injuries in 2001. As with the number of fires, children playing injuries have fallen steeply (63 percent). Heating injuries continued falling over the 10 years, and they reached their lowest point in 2001, half the number reported in 1992.

Dollar losses from fires fluctuate widely.[5] Arson has always been the leading cause of dollar loss. Heating losses continue their decline (19 percent), dropping to its lowest level in 2001. Since 1998, losses from open flame fires have soared so that they are nearly tied with electrical distribution for the second leading cause; the trend is up 129 percent. In 2001, losses from appliance fires also increased substantially—more than double the losses reported in 1992.

Table 13 shows significant trend increases in several areas. Other heat fires, deaths, and injuries are up more than 100 percent and dollar losses are up more than 400 percent. Dollar losses due to open flame and natural causes are also up considerably. These increases may be the result of definitional changes in NFIRS 5.0 or increased attention to reporting property losses in wildland fires. This area needs to be investigated further.

Smoke Alarm Performance

The term *smoke alarm* encompasses a variety of devices intended to warn occupants of the presence of fire. Smoke alarms are thought to play a significant role in the decrease in reported fires and fire deaths since their installation and use began to increase in the mid 1970s. From national surveys, we know that more than 90 percent of U.S. households have at least one smoke alarm.[6] It appears, however, that only 39 percent of households that had fires were reported to have alarms (Figure 25).[7] Considering only the incidents where smoke alarm performance was

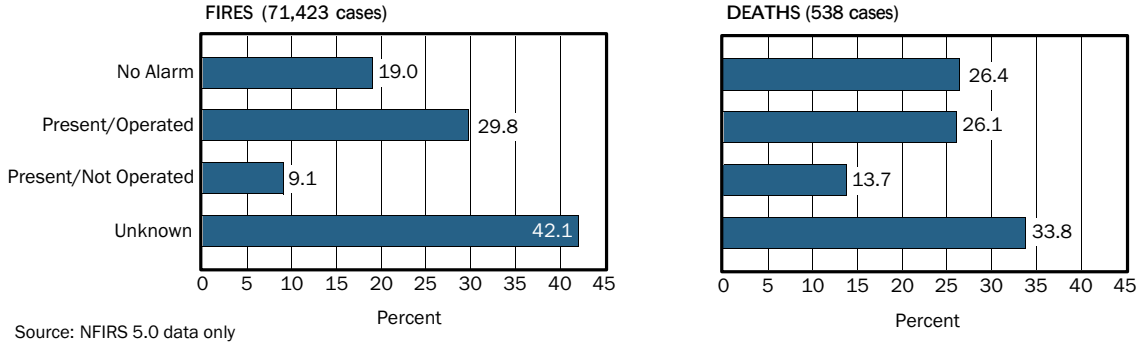


Figure 25. Smoke Alarm Performance in Residences (2001)

[5] When analyzing dollar loss trends, any precipitous increases must be checked to see if they might be due to errors in entering data for one or two fires. As noted earlier, two unconfirmed large loss fires are not included in these analyses.

[6] *The Smoke Detector Operability Survey Report on Findings*, Consumer Product Safety Commission, Revised 1999.

[7] The figure represents a much smaller subset of incidents than in previous editions of this report. The use of NFIRS 4.1 smoke alarm (and sprinklers) data was not easily compatible with NFIRS 5.0 data. Therefore, only NFIRS 5.0 records were considered in this analysis.

reported (adjusted for the unknowns), this percentage rises to 67 percent, still considerably less than the national average. That is, the 10 percent of households without smoke alarms have disproportionately high reported fires, deaths, injuries, and dollar loss. In other words, smoke alarms are less likely to have been installed in households with reported fires. Either people with alarms are more safety conscious or the alarms allow early detection and extinguishment so that fires are not reported. Also, anecdotal evidence suggests that reported fires are more prevalent in older, less well cared for homes, and these are less likely to be equipped with a smoke alarm.

In 2001, smoke alarms operated in 30 percent of fires. Looking at this percentage from the opposite perspective, there was no alarm, the alarm did not operate, or the presence of alarms was unknown in 70 percent of the reported household fires. When only incidents where smoke alarm performance was reported, the percent of operating smoke alarms rises to 51 percent.

When the "unknowns" of Figure 25 are apportioned to the other three categories, alarms were not present in 40 percent of the homes that had fire fatalities in 2001; an additional 21 percent of the deaths occurred in homes where smoke alarms were present but failed to operate. In 39 percent of fire deaths, an alarm did operate—10 percentage points higher than in 1998. This is somewhat disturbing since there is a widespread belief that an operating alarm will save lives. In some of these cases, the alarm may have gone off too late to help the victim, the victim may have been too inebriated or too feeble to react, or the fire may have been too close to the victim.

The presence or absence of alarms was not reported to NFIRS in 42 percent of residential fires. Figure 26 shows the operation of those smoke alarms when they were present. When the unknowns are apportioned, smoke alarms operated in 77 percent of the fires, failed to operate in 14 percent, and the fire was too small to activate the system in 9 percent.

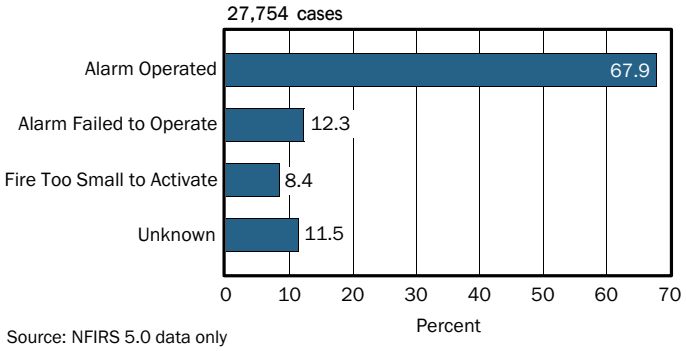


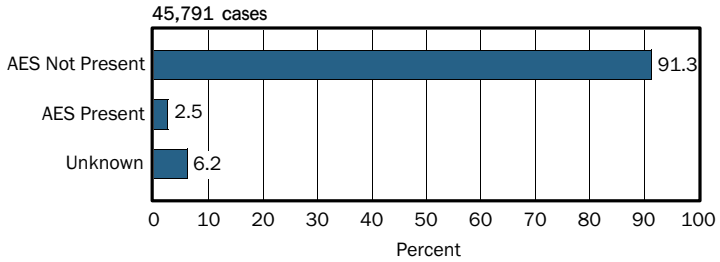
Figure 26. Operation of Smoke Alarms in Fires When Present (2001)

Widespread public education programs that focus on the proper maintenance of alarms are needed to increase both the number of installed smoke alarms and to ensure that they operate properly. A number of initiatives are focused directly on this problem. For example, a message is broadcast nationally when daylight savings time goes into effect reminding the public to check

and maintain their alarms. Some local fire departments in urban areas distribute free smoke alarms to households that are unprotected. These initiatives have all helped, but there are still many non-working alarms in residences that have reported fires.

Presence of Automatic Extinguishing Systems

Other protection types fall in the category of automatic extinguishment systems (AESs). AESs encompass sprinkler, dry chemical, foam, halogen, and carbon dioxide systems. When found in residences, sprinkler systems are the most common type of AESs. Residential sprinklers are found in only a small fraction of residences other than hotels, newer apartment buildings, and newer high-value custom homes today. It is no surprise that they are reported to be present in only a small percentage of residential fires nationally (Figure 27), though they represent a great potential in the future.[8] In residences, sprinklers are widely thought to be the most effective type of system, not only alerting residents of the presence of fire, but helping to extinguish it. If a fire is extinguished by a sprinkler, it may never be reported.



Note: Fires reported as confined are excluded.

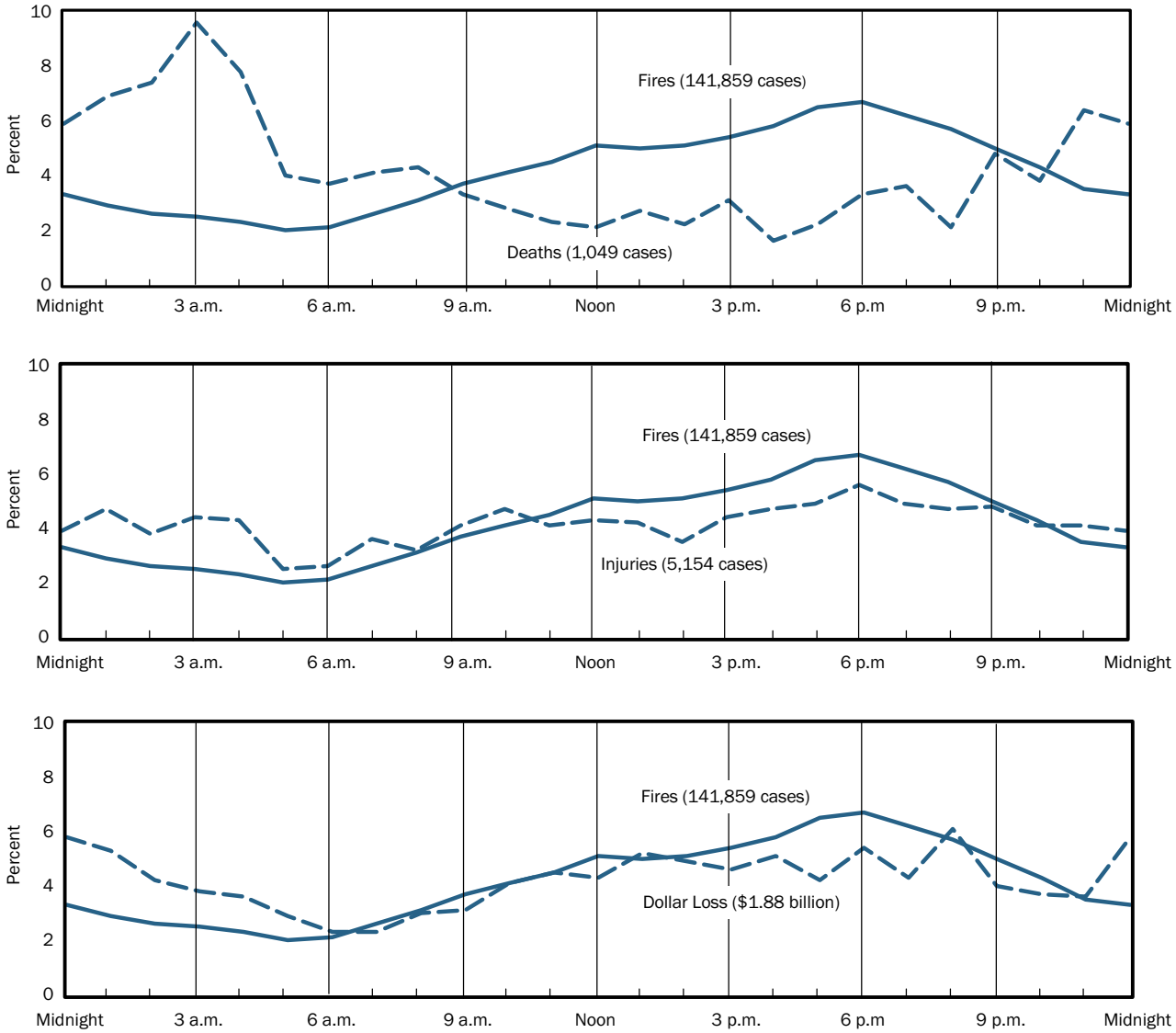
Source: NFIRS 5.0 data only

Figure 27. Presence of Automatic Extinguishing Systems in Residential Structures (2001)

When Fires Occur

TIME OF DAY. Fires do not occur uniformly throughout the day, as shown in Figure 28. Residential fire incidents peak from 5:00 to 7:00 p.m., during dinner preparation. Although fire incidents drop when people sleep, deaths are at their highest late at night and in the early morning. More than half of residential fire deaths occur in fires that start from 10:00 p.m. to 6:00 a.m. The peak night hours are from 2:00 to 5:00 a.m. when most people are in deep sleep. A large portion of these early morning deaths are attributed to arson or smoking. Fire injuries occur more uniformly throughout the day, peak slightly during dinner hours when people cook, and again in the early morning hours. Property losses track closely with the number of fires except in the early morning hours from midnight to 6 a.m. when there is a notable separation

[8] The performance of AESs (i.e., whether they operated or not) could not be determined from the NFIRS 5.0 data in time for inclusion in this report. Also, confined fires are excluded from AES analyses as no AES information is collected for these incidents.

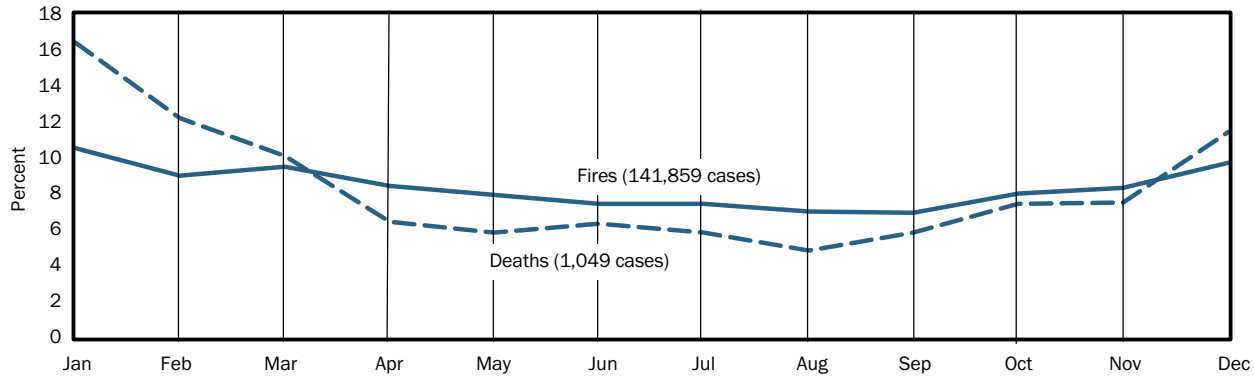


Source: NFIRS

Figure 28. Time of Day of Residential Fires and Fire Losses (2001)

between the two measures. This is partially because residents are asleep so the fire spreads more widely before the fire service is notified. The patterns for fires and losses are largely unchanged from previous years.

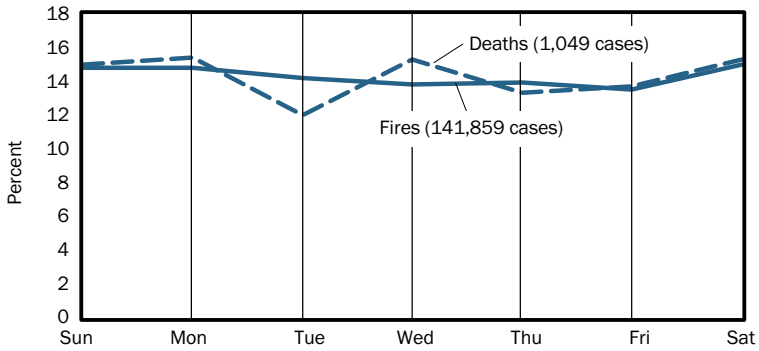
MONTH OF YEAR. Residential fires are relatively uniform throughout the year, rising slightly in the winter months. Fire deaths are most frequent during winter months when heating systems add to other causes. Forty percent of all deaths occur in the quarter of the year from December through February (Figure 29). This is essentially the same pattern as in 1998.



Source: NFIRS

Figure 29. Month of Year of Residential Fires and Fire Deaths (2001)

DAY OF WEEK. There is little discernable difference in the incidence of residential fires by day of the week (Figure 30). Deaths reached their nadir on Tuesdays, but no assumption should be drawn from this fact. Deaths increased marginally over the weekend, a reversal from 1998 deaths.



Source: NFIRS

Figure 30. Day of Week of Residential Fires and Fire Deaths (2001)

ONE- AND TWO-FAMILY HOMES

One- and two-family homes are where nearly three-quarters of the people in the United States reside.[9] The residential fire profile is therefore dominated by this category. Manufactured housing (mobile homes used as fixed residences) is included here in the profiles for one- and

[9] The U.S. Census Bureau shows that 70 percent of households (81.178 million) are in one-unit attached and detached structures (http://www.census.gov/hhes/www/housing/ahs/01dtchrt/tab2-1.html and http://www.census.gov/hhes/www/housing/ahs/ahs01_2000wts/tab1a1.htm). Household size is estimated at 2.59 (http://factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=D&-qr_name=DEC_2000_SF2_U_QTP10&-ds_name=D&-_lang=en&-redoLog=false). Thus, 81.178 million households x 2.59 people per household = 210.251 million. With the U.S. population given as 285,092,813, 73.4 percent of the population lives in one- and two-family housing.

two-family homes. A separate examination of mobile homes used as fixed residences fires is included at the end of this section.[10]

Overview of Trends

As with the residential trends, one- and two-family fires, deaths, and injuries declined during the 10-year period, and property loss increased (Figure 31). Because the number of fires dropped faster than deaths or dollar losses, the statistics per fire worsened. The increased use of smoke alarms has been a major factor in the reduction in the number of reported fires. Fires that are detected early are often extinguished before they are reported to the fire department, so the number of reported fires decreases. When smoke alarms are not present, the fire burns longer before detection and does more damage.

When Fires Occur

TIME OF DAY. Figure 32 mirrors Figure 28 (all residences). Fires and injuries in one- and two-family structures are highest between 5:00 and 7:00 p.m., when cooking fires sharply increase. Fire deaths, on the other hand, peak in the early morning hours, from midnight to 5:00 a.m. The early morning hours are when most people are in deep sleep and do not awaken in time to escape. Deaths during this period are often caused by smoking fires that smolder for several hours and then rapidly increase in smoke production and open flames. Smoke and flames have a greater opportunity to grow larger while people are asleep and unable to respond quickly to warning signs. Arson is also a major cause of these deaths. Dollar loss is relatively consistent with the number of fires throughout the day except between 1:00 and 6:00 a.m.

MONTH OF YEAR. Fires and fire deaths in one- and two-family homes peak in mid winter, when heating fires add to the other types of year-round fires (Figure 33). Deaths are at their lowest in the summer months.

Causes

One-quarter of all fires and injuries in one- and two-family structures are caused by cooking incidents (Figure 34). The most common cooking fires result from unattended cooking, when oil or grease catches fire, and from the ignition of loose clothing.

Heating at 19 percent and arson at 10 percent are the second and third leading causes of fires. Since 1994, the difference between heating and cooking fires has widened, possibly because the use of wood stoves and kerosene heaters has continued to diminish and because of the addition of confined fires (confined cooking fires outnumber confined heating fires by two to one).

The leading cause of death in 2001 is smoking, as in all NFIRS years, at 22 percent. Most of the smoking deaths come from cigarettes dropped on upholstered furniture or bedding.

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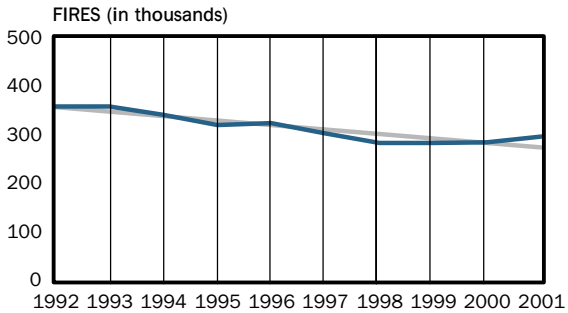
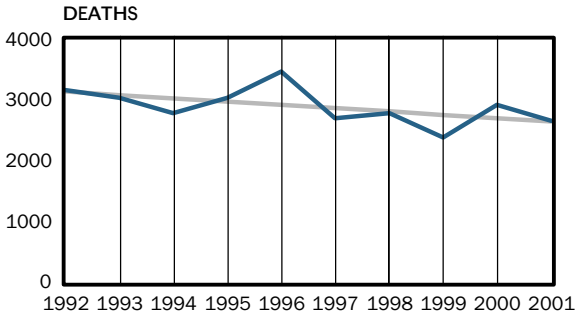
[10] Detached garages are considered non-residential properties and are discussed in Chapter 4.



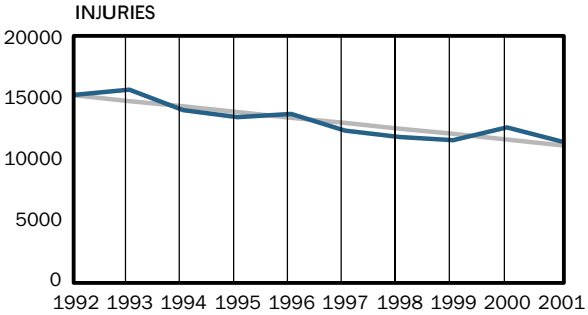
1992	358.0	1997	302.5
1993	358.0	1998	283.0
1994	341.0	1999	282.5
1995	320.0	2000	283.5
1996	324.0	2001	295.5

10-Year Trend = –23.1%



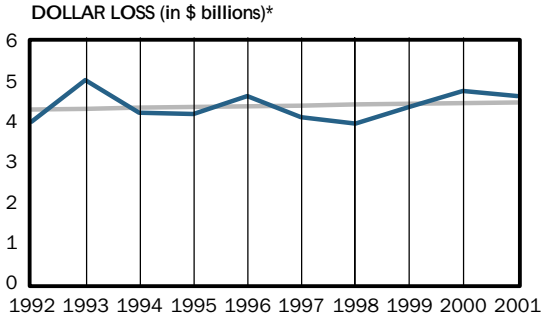
1992	3,160	1997	2,700
1993	3,035	1998	2,776
1994	2,785	1999	2,375
1995	3,035	2000	2,920
1996	3,470	2001	2,650

10-Year Trend = –15.6%



1992	15,275	1997	12,300
1993	15,700	1998	11,800
1994	14,000	1999	11,550
1995	13,450	2000	12,575
1996	13,700	2001	11,400

10-Year Trend = –27.0%



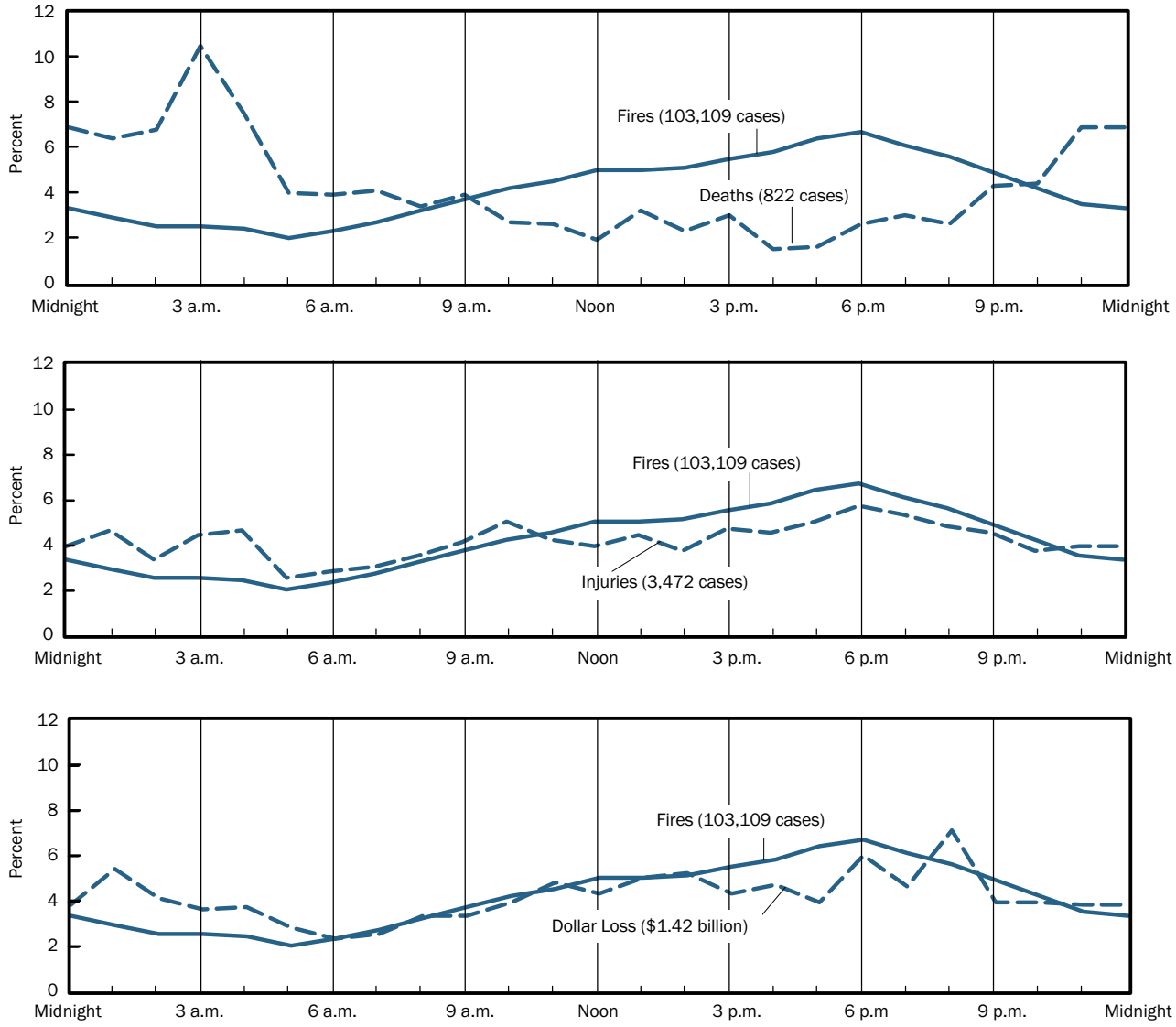
1992	$4.01	1997	$4.12
1993	5.04	1998	3.96
1994	4.23	1999	4.38
1995	4.20	2000	4.77
1996	4.65	2001	4.65

10-Year Trend = +4.3%

*Adjusted to 2001 dollars

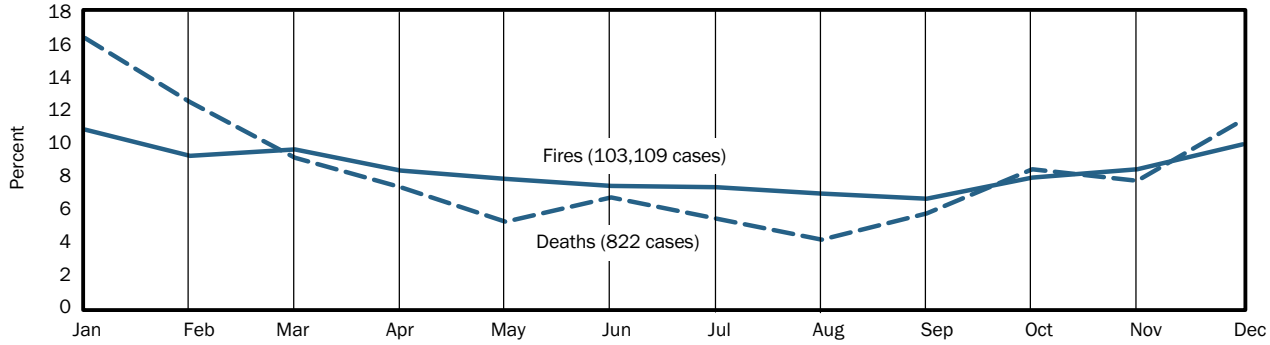
Sources: NFPA and Consumer Price Index

Figure 31. Trends in One- and Two-Family Dwelling Fires and Fire Losses



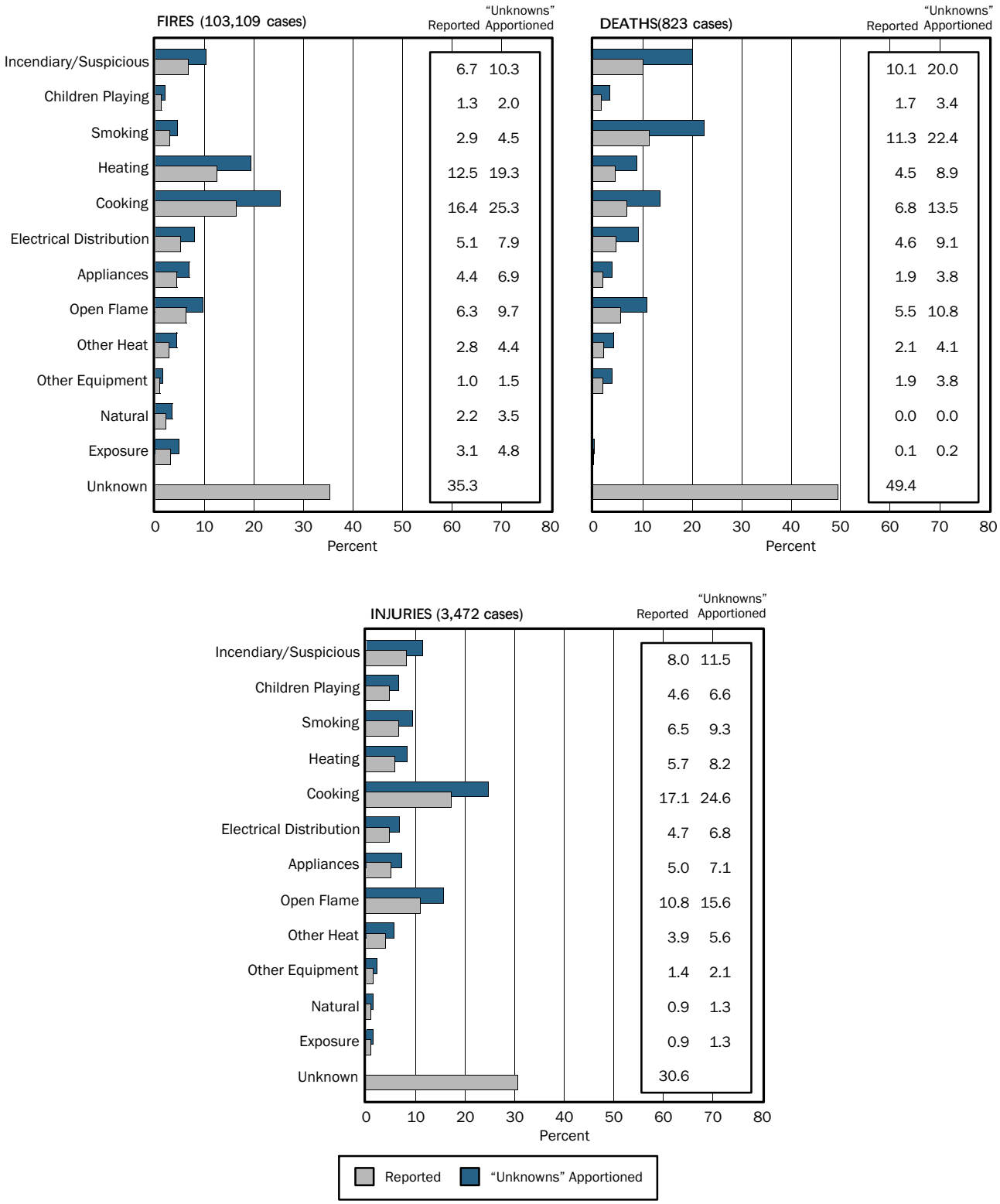
Source: NFIRS

Figure 32. Time of Day of One- and Two-Family Dwelling Fires and Fire Losses (2001)



Source: NFIRS

Figure 33. Month of Year of One- and Two-Family Dwelling Fires and Fire Deaths (2001)



Source: NFIRS

Figure 34. Causes of One- and Two-Family Dwelling Fires and Fire Casualties (2001)

Studies and anecdotal evidence suggest that alcohol consumption may have a role in these fires.[11] Arson is the second leading cause of death at 20 percent and cooking is third at 14 percent. These three causes account for more than half of the total 2001 deaths. In 1998, heating was the third leading cause, but it dropped to sixth in 2001.

Open flame fire injuries jumped from the fourth leading cause in 1998 to the second leading cause in 2001, at 16 percent.

Cause Trends

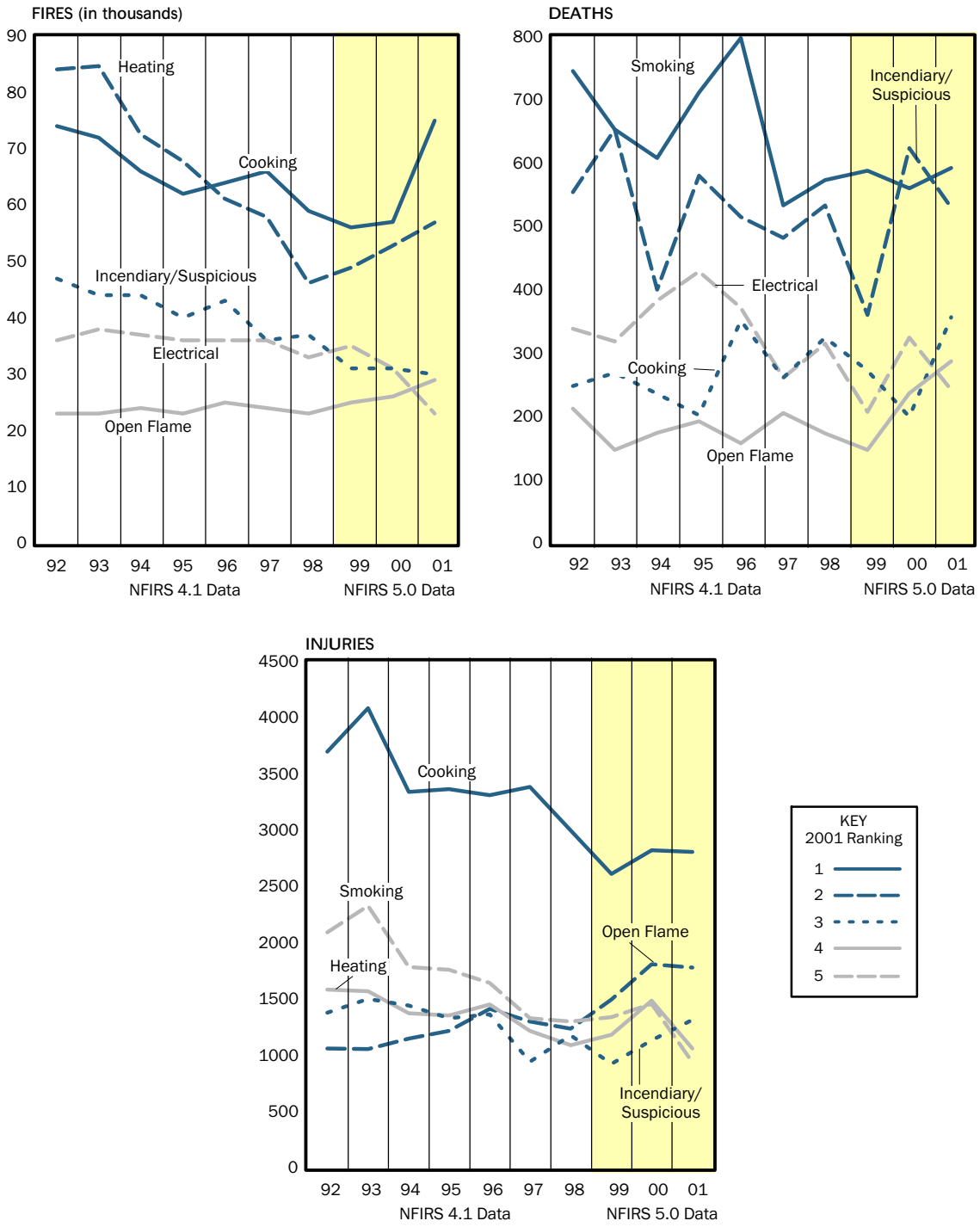
Figure 35 shows the trends for the top five causes of one- and two-family residential fires and casualties in 2001. Table 14 shows the 10-year percentage increases and decreases for each cause. With the introduction of the NFIRS 5.0 system and the resulting changes in cause definitions, some notable changes occurred. The leading cause of fires since 1996—replacing heating—was cooking, which reached its highest level in 2001. Even so, cooking fires decreased 12 percent over 10 years. Deaths from cooking, in third place, also reached a new high, and they increased by 19 percent. Cooking injuries, by far the leading cause of injuries in all years, increased slightly since its low point in 1999. Nevertheless, cooking injuries have declined 30 percent over the past 10 years.

Heating fires, which have sharply declined since the mid 1980s, reached its low point in 1998. In 1999, they began to rise. Nevertheless, heating fires, deaths, and injuries have trended down markedly over 10 years. Open flame fires replaced appliance fires in the top five list.

Although the curves for the leading causes of deaths in one- and two-family homes are erratic, the top five causes have not changed noticeably over 10 years with the exception of heating deaths, which has been replaced with open flame deaths among the top five. Smoking deaths dropped sharply in 1997 and have leveled off since then. It continues as the leading cause of fire deaths, though its trend declined by 21 percent. Arson fire deaths were the second leading cause and one of considerable concern to fire officials.

Injuries attributed to smoking declined 26 percent. Children playing trends have declined greatly on all fronts: fires and deaths, 61 percent each; injuries, 58 percent. These fires no longer are among the the top five in injuries.

[11] Several of the published studies of the effect of alcohol abuse on U.S. fires are cited in the "Resources" section at the end of Chapter 2.



Sources: NFIRS and NFPA; data for all 12 causes are provided in Appendix B, Table B-4.

Figure 35. Trends in Leading Causes of One- and Two-Family Dwelling Fires and Fire Casualties

Table 14. Trends in Causes of One- and Two-Family Dwelling Fires and Casualties (1992–2001) (percent)

Cause	Fires	Deaths	Injuries
Incendiary/Suspicious	–36.7	–7.9	–24.9
Children Playing	–60.7	–60.8	–58.0
Smoking	–19.1	–20.5	–25.7
Heating	–44.0	–38.2	–52.0
Cooking	–12.2	+19.4	–30.4
Electrical Distribution	–24.8	–31.2	–44.4
Appliances	–22.3	–7.1	–14.7
Open Flame	+18.7	+38.8	+74.4
Other Heat	+135.7	+207.0	+112.2
Other Equipment	–11.0	+77.7	–11.8
Natural	+8.6	+35.4	+14.4
Exposure	+8.3	+90.2	+50.4

Sources: NFIRS and NFPA; data provided in Appendix B, Table B-4.

Area of Fire Origin

To help visualize the fire problem more personally, it is useful to describe it in terms of where different types of fires occur in the home and what types of fires occur in each room. Figure 36 shows the leading rooms where fires originate in one- and two-family homes in 2001. The rankings of the top three rooms for all three measures have remained unchanged since 1996. Kitchens, bedrooms, and lounge areas (e.g., living rooms, family rooms) are the rooms where most fires originate—50 percent of fires, 70 percent of deaths, and 66 percent of injuries ("unknowns" apportioned).

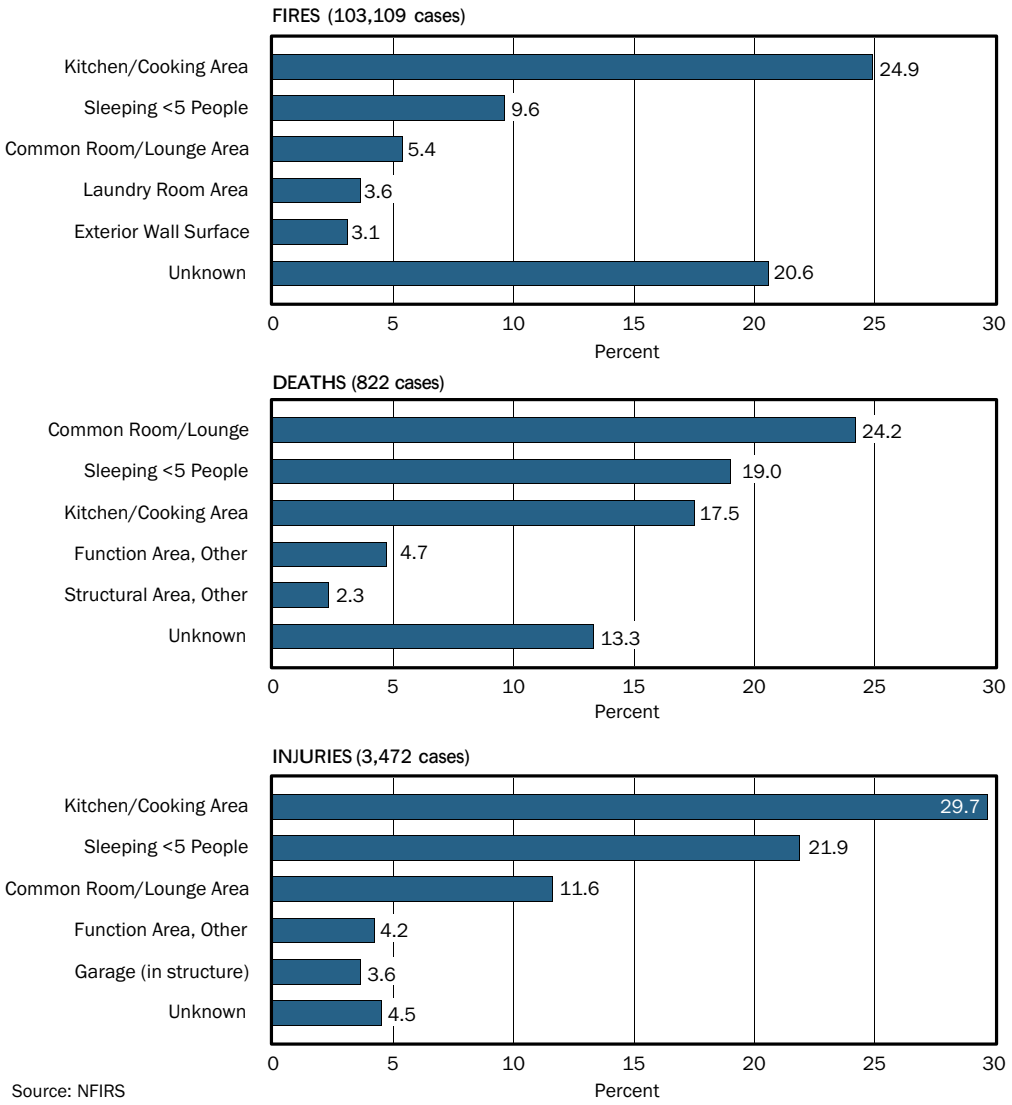
Two and one-half times as many fires occur in the kitchen as in any other area, obviously those caused by cooking. Half of all deaths occur in lounge areas and bedrooms, possibly because people fall asleep smoking in bed or on upholstered furniture, and 54 percent of injuries occur in the kitchen and bedroom.

Smoke Alarm Performance

In 2001, amoke alarms were present in 62 percent ("unknowns" apportioned) of homes that had reported fires (Figure 37); this is eight percentage points higher than in 1998. Alarms also were present in 54 percent of homes that had a fatality. In one-third of all fire death cases, the alarm operated, a troublesome statistic since alarms are purported to save lives. This may require further investigation.[12]

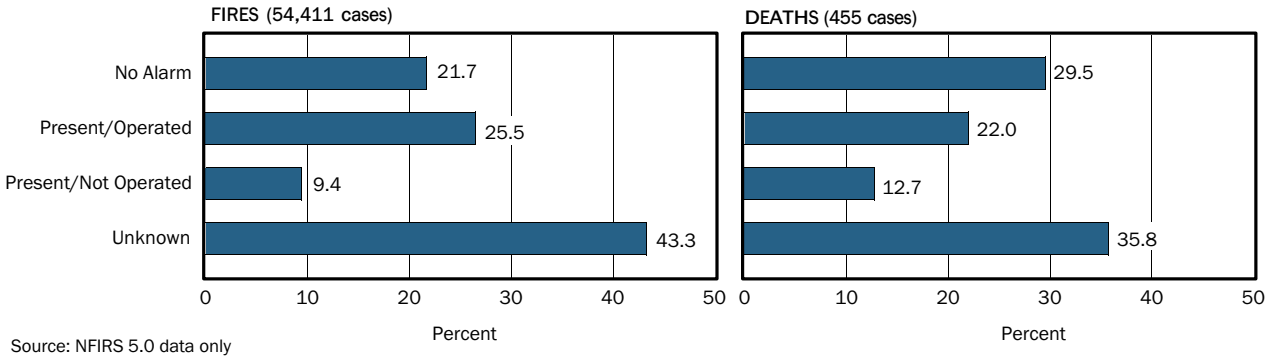
One- and two-family homes in which fires occur have, proportionally, fewer alarms installed than in apartments that experience fires. This may be because apartment smoke alarms are often provided by landlords and more often required by law than in single-family homes. (See page 87 for more on apartments.) Thirty-eight percent of all one- and two-family homes

[12] For example, were the victims physically unable to escape the blaze or were they simply not awakened by the sound of the alarm? Recent studies indicate that certain population segments (e.g., children) do not respond to alarms while in deep sleep.



Source: NFIRS

Figure 36. Leading Locations of Fire Origin in One- and Two-Family Structures (2001)



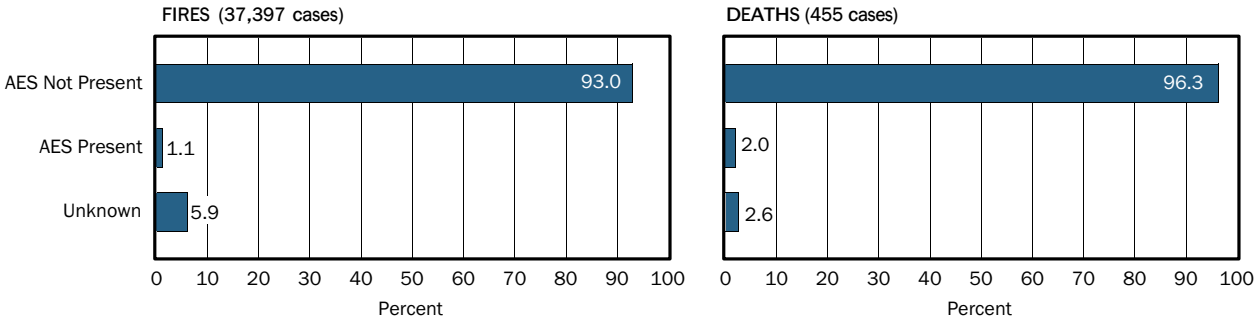
Source: NFIRS 5.0 data only

Figure 37. Smoke Alarm Performance in One- and Two-Family Structures (2001)

that had a reported fire had no smoke alarm installed in 2001, which is nearly three times greater than in apartments without alarms.

Presence of Automatic Extinguishing Systems

AESs were present in only 1 percent of fires and 2 percent of fatal fires in one- and two-family homes in 2001 (Figure 38). Although this is an insignificant amount from which to draw conclusions, the proportion of homes with AESs, such as sprinklers, nearly doubled over 1998 data ("unknowns" apportioned). Unlike the 1998 data in which only one death out of 1,010 was reported where an AES was installed, 9 deaths out of 455 were reported in the 2001 data. Further investigation into the 2001 results should be conducted.



Note: Fires reported as confined are excluded.

Source: NFIRS 5.0 data only

Figure 38. Presence of Automatic Extinguishing Systems in One- and Two-Family Structures (2001)

Mobile Homes Used as Fixed Residences

Today, the term *manufacturedhousing* includes many types of structures that are built and assembled under the controlled conditions of a factory. These structures are built to much higher standards than the mobile units of the early 1970s. Many of the noticeable distinctions between manufactured housing and standard (or "site-built") housing are disappearing, as most manufactured housing is no longer single units in trailer parks, but double units placed on permanent foundations on private land.[13] Retirement communities are springing up throughout the United States using manufactured homes as a way to keep costs to retirees at a minimum.

Prior to 1976, the most common type of factory-built housing was the mobile home. *Mobile* connotes what these homes were—a unit on a steel chassis that could be hooked to a tractor unit and moved. Historically, these units were placed on concrete blocks, many with the wheels still attached. This section deals only with mobile homes situated on semipermanent sites and used as fixed residences; this is a subcategory of one- and two-family structures. Although only 7

[13] "A Few Facts About Manufactured Housing," Federal Reserve Bank of Richmond, http://www.rich.frb.org/cao/reports/housing.html.

percent of the U.S. population lives in manufactured housing,[14] it has represented a severe fatality problem over the past 10 years—more than double the fatality rate per fire compared to other homes. This caused the U.S. Department of Housing and Urban Development (HUD) in 1976 to establish strict standards for improving the fire safety of such homes.

The HUD standard clearly made an impact. Although the fire problem in mobile homes used as fixed residences is still significant, Figure 39 shows large downward trends in fires (48 percent), deaths (57 percent), injuries (51 percent), and property loss (50 percent) even as the mobile housing stock has increased by 25 percent or more over the 10 years.[15] These decreases are much sharper than the fire and casualty trend decreases in other single-family dwellings.

All of the reasons for these sharp declines are speculative. The 1976 HUD fire safety standards have played a part, causing manufacturers to incorporate more fire-resistant materials in these structures. More smoke alarms may be in use in mobile property housing. The decline might also have been affected by a change in behavior of the residents of mobile homes. This topic should be investigated more closely to determine whether lessons from improvements in the manufacture of mobile properties could be applied to other types of residences and to reinforce whatever is working.

Figure 40 shows the rate of deaths and injuries in mobile homes used as fixed residences. Deaths per 1,000 fires reached a low in 1998 with 13 deaths per 1,000 fires and highs in 1995 and 1996 with 27 deaths per 1,000 fires; the 10-year trend in deaths per fire decreased 15 percent. Injuries per 1,000 fires and dollar loss per fire also decreased modestly.

The 2001 cause profiles for mobile home fires and deaths are shown in Figure 41. Arson is the leading cause of fires, with heating, electrical distribution, open flame, and cooking close behind.

Other equipment (24 percent) and smoking (18 percent) are the leading causes of fire deaths in mobile structures. (Smoking is the leading cause of deaths in one-and two-family residences.) Smoking deaths in mobile properties used as fixed residences dropped from first in 1996 to sixth in 1998 and back to second in 2001. The reasons for the extreme shifts in year-to-year rank ordering of causes of deaths are because of the relatively few deaths reported (84) and the large number of unknowns (61 percent).

Figure 42 presents smoke alarm performance in mobile homes used as fixed residences. Overall, smoke alarms were present in six percentage points fewer than in one- and two-family residences (56 vs. 62 percent, apportioned) and their operation was in a similar proportion (38 vs. 45 percent). When present, smoke alarms operated in 68 percent of fires, somewhat higher than the 64 percent reported in 1998. Alarms were not installed in 44 percent of fires.

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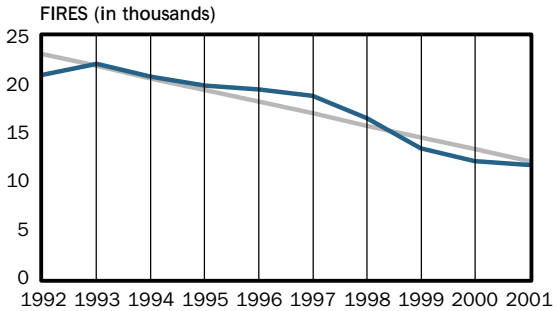
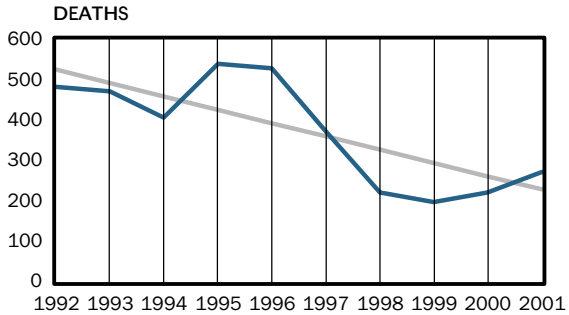
[14] American Housing Survey, U.S. Census Bureau and Department of Housing and Urban Development, http://www.census.gov/hhes/www/housing/ahs/ahs01-80/tab1a3.html.

[15] Idem, http://www.census.gov/prod/1/constr/h150/h150-93m.pdf; http://www2.census.gov/prod2/ahsscan/h150-91.pdf; and http://www.census.gov/hhes/www/housing/ahs/ahs01-80/tab1a3.html.



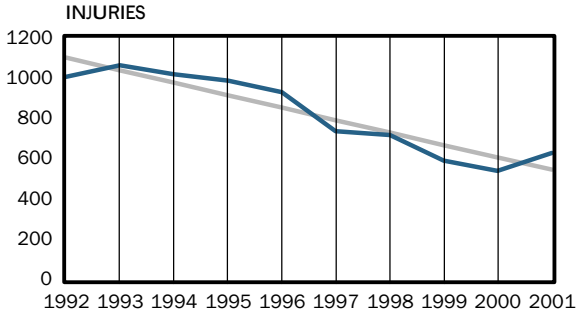
1992	21.0	1997	18.8
1993	22.1	1998	16.5
1994	20.8	1999	13.5
1995	19.9	2000	12.1
1996	19.5	2001	11.7

10-Year Trend = –47.6%



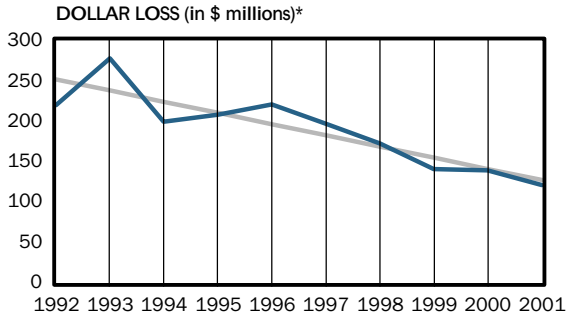
1992	481	1997	372
1993	471	1998	220
1994	405	1999	196
1995	539	2000	270
1996	528	2001	271

10-Year Trend = –56.8%



1992	1,004	1997	736
1993	1,061	1998	717
1994	1,018	1999	590
1995	986	2000	538
1996	930	2001	627

10-Year Trend = –50.6%



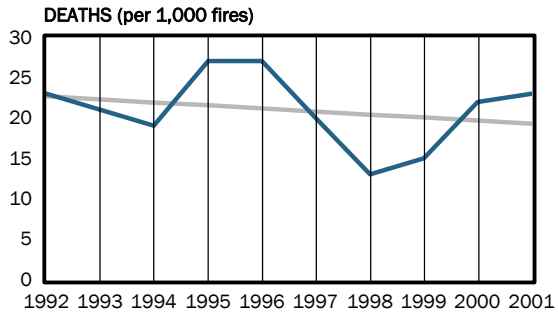
1992	$219.6	1997	$196.1
1993	277.1	1998	171.7
1994	198.6	1999	140.1
1995	207.5	2000	138.2
1996	220.3	2001	119.9

10-Year Trend = –49.8%

*Adjusted to 2001 dollars

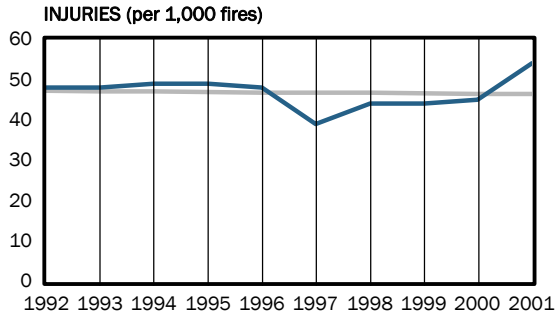
Sources: NFIRS, NFPA, and Consumer Price Index

Figure 39. Trends in Fires and Fire Losses in Mobile Homes Used as Fixed Residences



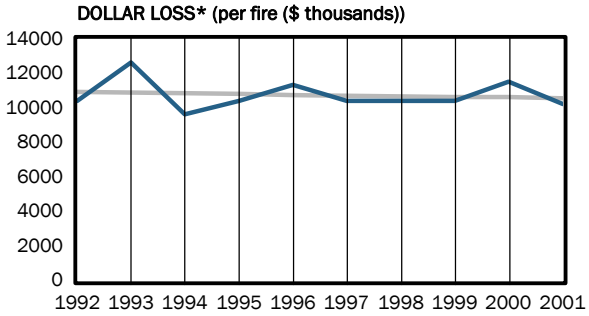
1992	23	1997	20
1993	21	1998	13
1994	19	1999	15
1995	27	2000	22
1996	27	2001	23

10-Year Trend = –14.9%



1992	48	1997	39
1993	48	1998	44
1994	49	1999	44
1995	49	2000	45
1996	48	2001	54

10-Year Trend = –1.8%



1992	$10,400	1997	$10,400
1993	12,600	1998	10,400
1994	9,600	1999	10,400
1995	10,400	2000	11,500
1996	11,300	2001	10,200

10-Year Trend = –3.2%

*Adjusted to 2001 dollars

Sources: NFIRS and Consumer Price Index

Figure 40. Trends in Casualty and Loss Rates in Mobile Homes Used as Fixed Residences

Moreover, in 62 percent of mobile structure fires, there were no operating alarms. No deaths were reported in 2001 where an alarm operated in the mobile property.

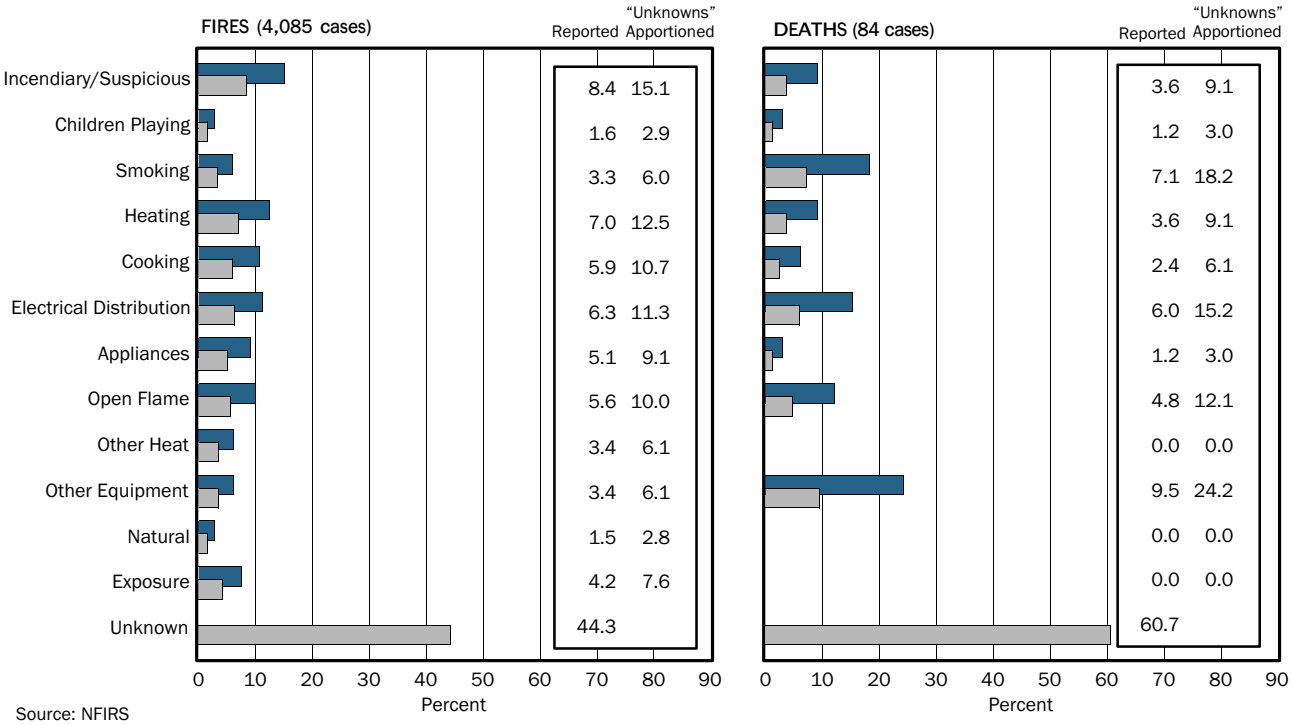


Figure 41. Causes of Fires and Fire Deaths in Mobile Homes Used as Fixed Residences (2001)

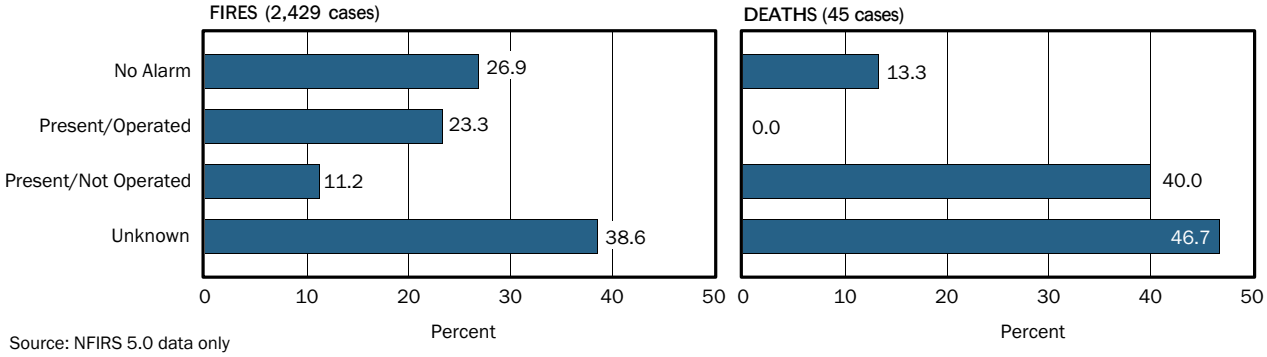


Figure 42. Smoke Alarm Performance in Mobile Homes Used as Fixed Residences (2001)

APARTMENTS

Multifamily dwellings, referred to as apartments in this report, tend to be more regulated by building codes than one- and two-family structures. Most apartments are rental properties, often falling under more stringent fire prevention statutes. In many communities, apartments also have a different socio-economic mix of residents compared to single-family dwellings. They may have more low-income families in housing projects or more high-income families in luxury highrises, or they may be centers of living for the elderly. In large cities, all of these groups are represented in apartments.

Because apartment buildings have large clusters of similar people, prevention programs can be specially tailored to the cause profiles of apartment buildings in different areas of the community.

Trends

Figure 43 shows the 10-year trends in apartment fires and losses. The number of apartment fires dropped 16 percent, whereas one- and two-family dwelling fires dropped at about one and one-half times this rate. The opposite was true of the death trend in apartments, which was down 26 percent, more than one and one-half times the trend in one- and two-family structures. The trend for injuries was down 33 percent, slightly higher than that of one- and two-family dwellings. Apartment fire injuries reached their lowest level in 2001. Adjusted dollar losses were up 14 percent in apartments, compared with a 4 percent increase in one- and two-family dwellings. Property losses in both types of structures reversed the downward trends shown in the previous 10-year period (1989–1998).

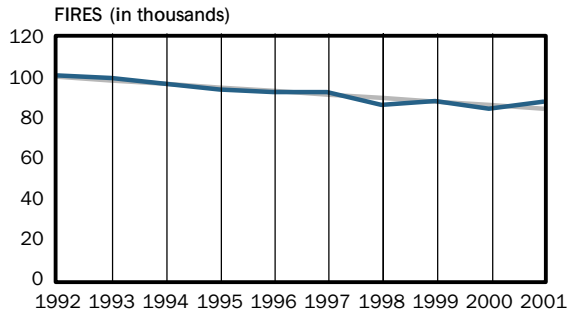
The steep declines in apartment deaths and injuries may be due to compliance with stricter building codes, the required presence of smoke alarms, and the increase in the number of sprinkler systems. More detailed study of socio-economic and demographic changes over time might reveal some of the factors involved in fire incidence.

Causes

The fire problem in apartments is generally similar to that of one- and two-family structures with the exception of one major category: heating-related fires. Because apartments generally have central heating systems that are professionally maintained, heating-related fires from misuse and poor maintenance are less in apartments than in single-family dwellings. This changes the proportions of the causes for apartments, with heating becoming less significant and the other causes moving up in importance.

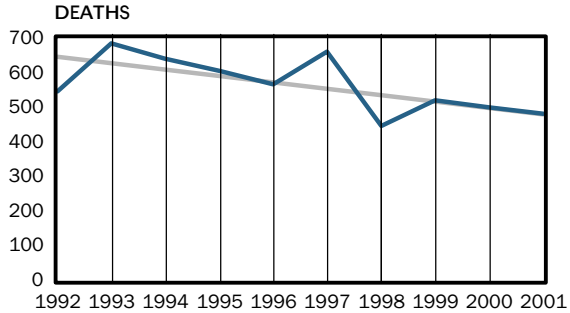
In terms of numbers of reported fires in 2001, cooking in apartments leads by a factor of nearly five over the second leading cause (Figure 44). Cooking accounts for almost half of all apartment fires (but only one-quarter of one- and two-family residential fires). Cooking fires reached a 10-year high in 2001. As noted in previous discussions of cooking fires, this increase is largely the result of the addition of confined cooking fires. Arson is a distant second at 10 percent, and smoking third at 8 percent. The ranking of the top five leading causes of apartment fires has remained unchanged since 1994.

The leading cause of deaths in apartments is smoking, accounting for 35 percent of deaths. This is a higher proportion than in one- and two-family residences (22 percent). The second leading cause is arson (33 percent). These two causes account for two-thirds of all fire deaths in apartments; all other causes are relatively small.



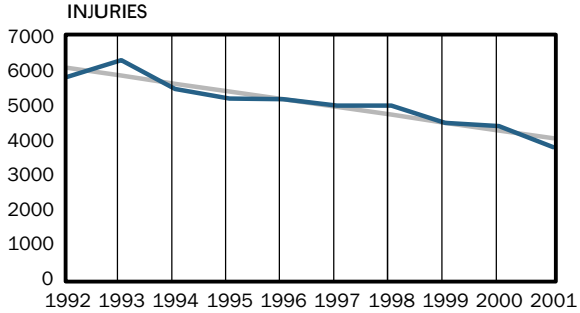
1992	101.0	1997	93.0
1993	100.0	1998	86.5
1994	97.0	1999	88.5
1995	94.0	2000	84.5
1996	93.0	2001	88.0

10-Year Trend = -15.8%



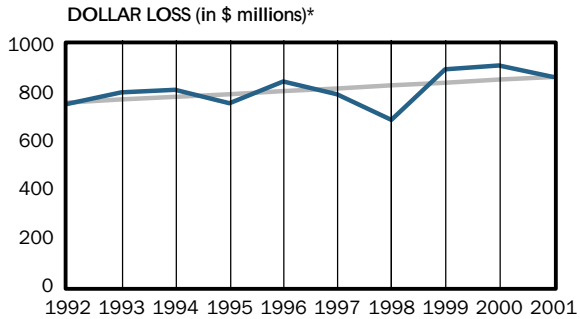
1992	545	1997	660
1993	685	1998	445
1994	640	1999	520
1995	605	2000	500
1996	565	2001	460

10-Year Trend = -25.7%



1992	5,825	1997	5,000
1993	6,300	1998	5,000
1994	5,475	1999	4,500
1995	5,200	2000	4,400
1996	5,175	2001	3,800

10-Year Trend = -33.3%



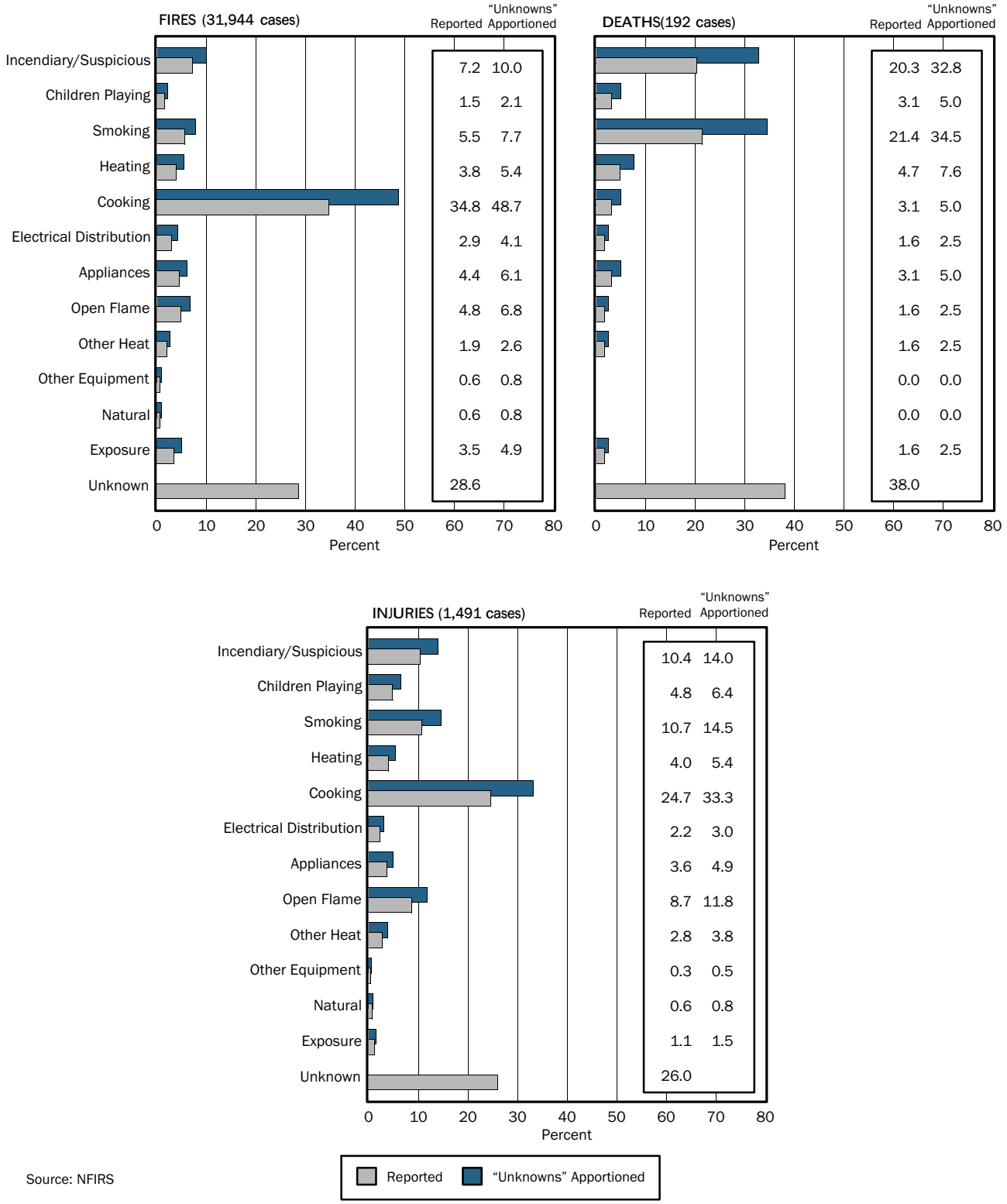
1992	$753.6	1997	$792.3
1993	800.3	1998	685.6
1994	810.2	1999	895.1
1995	754.2	2000	911.2
1996	844.3	2001	864.0

10-Year Trend = +13.9%

*Adjusted to 2001 dollars

Sources: NFPA and Consumer Price Index

Figure 43. Trends in Apartment Fires and Fire Losses



Source: NFIRS

Figure 44. Causes of Apartment Fires and Fire Casualties (2001)

For fire injuries, cooking was first at 33 percent, smoking second at 15 percent, and arson third at 14 percent. The rankings of these three causes of injuries are identical to those in one- and two-family properties.

Although cooking in apartments represents nearly half of all fires and one-third of all injuries, relatively few apartment dwellers (5 percent) die in these incidents. This follows the same pattern as in one- and two-family residences and may reflect the general circumstances of cooking fires. Cooking fires tend to occur during the day or evening hours during meal times when most people are awake and responsive. Deaths are less likely under these circumstances.

Cause Trends

Figure 45 shows the trends in the five leading causes (in 2001) of apartment fires and casualties from 1992 to 2001. Table 15 shows the 10-year trends increases and decreases for each cause. The leading causes of apartment fires have shifted very little over the past 10 years. Cooking is still the leading cause of apartment fires and injuries but by widening margins since the introduction of the NFIRS 5.0 code changes. Smoking continues as the leading cause of apartment deaths, but it has sharply dropped since 1997; in fact, there were more arson-related deaths in 1999 than smoking deaths. Deaths from arson dropped sharply in 1998, but rose to its highest level the next year. In terms of injuries, four of the top five causes hit 10-year lows.

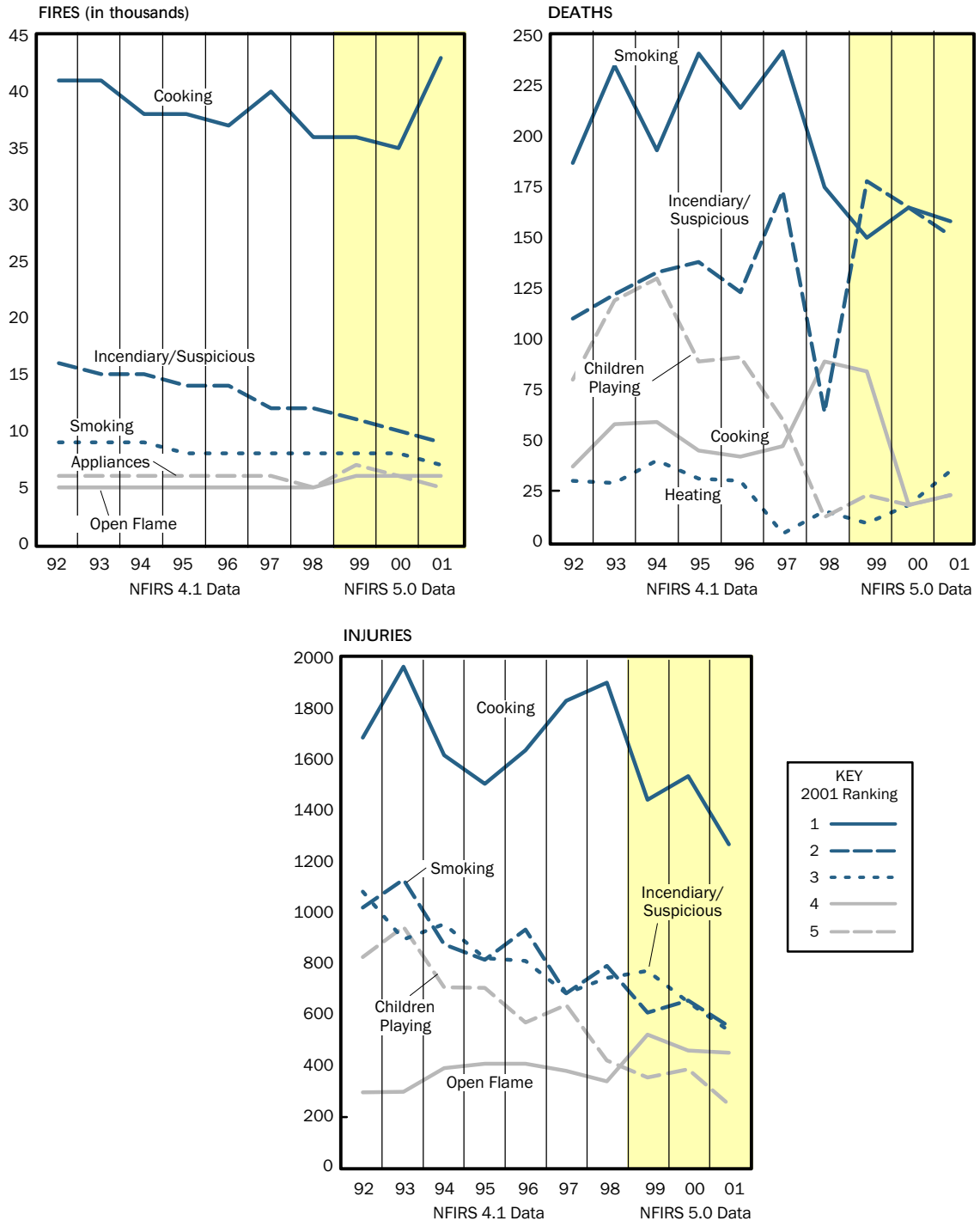
Except for arson deaths, all of the measures for the first six causes listed in Table 15 decreased, some sharply. Other heat and open flame fires and injuries increased substantially. The reason for the large decrease of natural fire deaths is because there were only 18 deaths over 10 years and no deaths were reported in 7 of those years.

The above data suggest that fire prevention programs aimed at apartment dwellers might emphasize the risks of fires associated with cooking and smoking. Further study on the arson problem in apartments would also be useful.

Smoke Alarm Performance

Smoke alarms were present in 86 percent ("unknowns" apportioned) of all apartment fires in 2001 (Figure 46). This is in contrast to one- and two-family dwelling where alarms were present in only 62 percent of fires. Smoke alarms are more likely to be installed in apartments, where they are provided by landlords, than in dwellings, where the occupants/owners provide and maintain them.

Smoke alarms were present and operating in 70 percent of fire deaths in apartments. Why alarms worked and people still died may be a subject for further study. In an apartment fire, more people will be at risk (e.g., 20 people in a hallway vs. 2.6 people in a one- or two-family dwelling). Another possibility is that hallway alarms or alarms in other apartments operated after the victims were overcome. Also, apartments have fewer ways to escape, especially apartments on higher floors. At night, escaping from an apartment can be particularly confusing when people



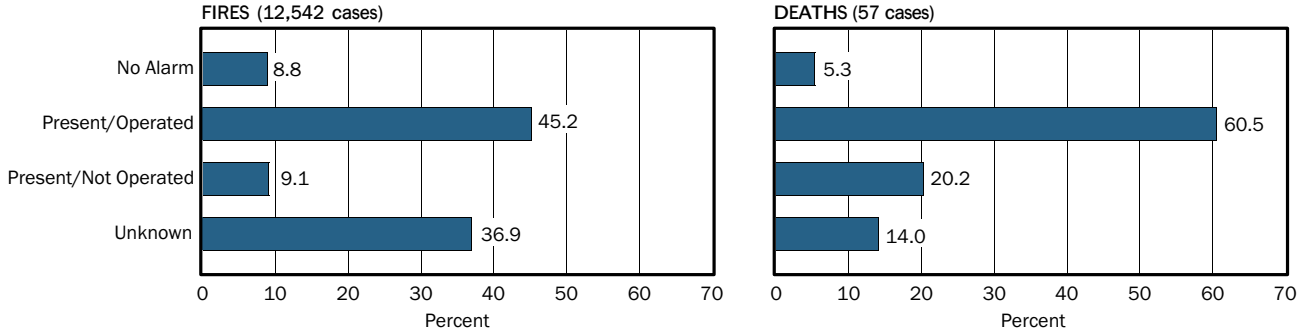
Sources: NFIRS and NFPA; data for all 12 causes are provided in Appendix B, Table B-5.

Figure 45. Trends in Leading Causes of Apartment Fires and Fire Casualties

Table 15. Trends in Causes of Apartment Fires and Casualties (1992–2001) (percent)

Cause	Fires	Deaths	Injuries
Incendiary/Suspicious	–41.4	+34.0	–42.9
Children Playing	–67.1	–92.6	–71.3
Smoking	–22.3	–27.3	–47.5
Heating	–22.9	–45.6	–30.9
Cooking	–5.4	–14.5	–18.9
Electrical Distribution	–25.9	–52.8	–42.1
Appliances	+3.9	+18.7	–23.0
Open Flame	+28.4	+31.7	+52.3
Other Heat	+75.0	–54.6	+72.0
Other Equipment	–50.3	–82.3	–54.6
Natural	+13.6	–750.0	+61.8
Exposure	+19.2	+7.2	–49.3

Sources: NFIRS and NFPA; data provided in Appendix B, Table B-5.



Source: NFIRS 5.0 data only

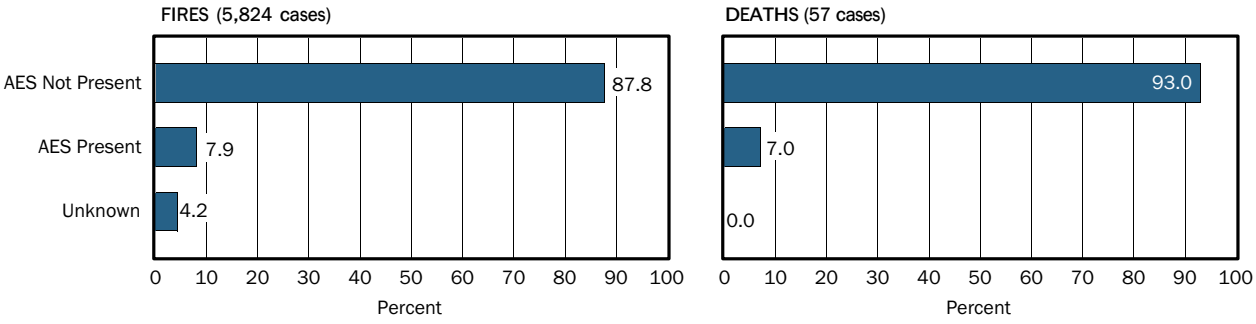
Figure 46. Smoke Alarm Performance in Apartments (2001)

are awakened suddenly. This situation suggests the need to emphasize fire prevention to apartment dwellers. Also, the installation of sprinkler systems could prove highly beneficial in apartments.

Smoke alarms were present but did not operate in 23 percent ("unknowns" apportioned) of apartments that had fire fatalities in 2001—a higher percentage than in one- and two-family dwellings having fatalities and alarms were nonoperative. This result is unexpected as apartment alarms are more likely to be hardwired into the electrical system and professionally maintained than alarms in dwellings.

Presence of Automatic Extinguishing Systems

Figure 47 shows the presence of AESs in apartments in 2001. As expected, a much higher percentage of apartments were equipped with sprinklers than in one- and two-family homes. The number of apartments that had reported fires and were equipped with sprinklers is virtually unchanged from 1998. This result is surprising since it is known that more newer apartments are



Note: Fires reported as confined are excluded.

Source: NFIRS 5.0 data only

Figure 47. Presence of Automatic Extinguishing Systems in Apartments (2001)

equipped with sprinkler systems during construction. Perhaps the decline is a result of definitional changes in NFIRS reporting; also, the number of reported fires in 2001 is only one-third of those in 1998. NFIRS data does not report whether sprinklers were in the apartment of fire origin or in common areas such as hallways.

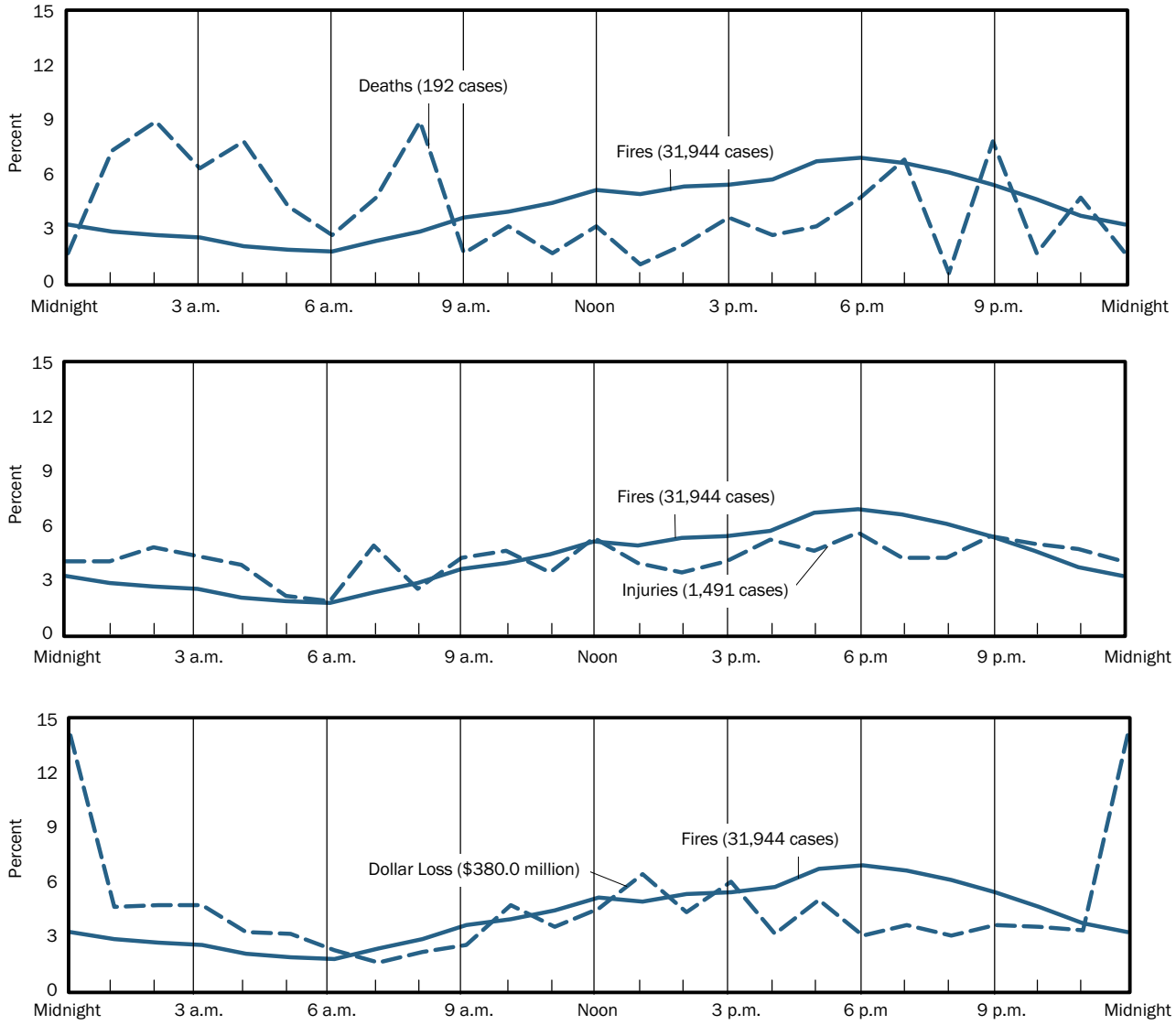
When Fires Occur

TIME OF DAY. Figure 48 shows the alarm times for fires, deaths, injuries, and dollar loss in apartment fires. The profiles are not as smooth as those for one- and two-family structures due to the smaller numbers of incidents involved.

As in one- and two-family residences, apartment fires peak during the evening cooking hours—here from 5:00 to 7:00 p.m.—and are at a lowest point from 4:00 to 6:00 a.m. The early morning hours from 1:00 to 4:00 a.m. are the most dangerous in terms of fire deaths, especially those associated with latent smoldering fires from smoking. The reason for the large spike in deaths at 8:00 a.m. is unknown.

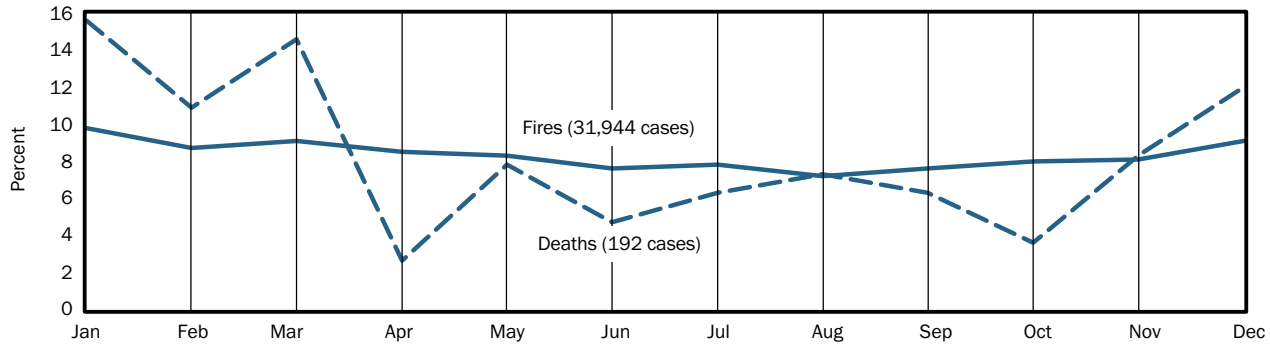
Injuries are spread somewhat evenly throughout the day, generally rising from 6 a.m. throughout the day and falling at night. Dollar loss is similar to the injuries curve, except for the enormous spike reported at midnight. This spike results from a $35 million fire in a New Hampshire motel that was being used as an apartment.

MONTH OF YEAR. Fires in apartments track closely with those in one- and two-family dwellings (Figure 49). They are somewhat more common in winter than in summer, perhaps because of heating fire problems in low-income apartments and increased indoor activity such as children playing. Other seasonal factors in addition to heating probably play a role in winter fires and deaths, such as the presence of dry Christmas trees, the use of holiday candles, or simply the greater propensity to stay indoors.



Source: NFIRS

Figure 48. Time of Day of Apartment Fires and Fire Losses (2001)



Source: NFIRS

Figure 49. Month of Year of Apartment Fires and Fire Deaths (2001)

Room of Fire Origin

Figure 50 shows the leading rooms where apartment fires originated in 2001. As in every year, the kitchen is the most common place for a fire and injury, with cooking as the cause; bedrooms and lounge areas are the most common rooms where a fatal fire starts because of smoking on upholstered furniture, mattresses, or bedding. Although the leading apartment locations of all three measures are the same as in one- and two-family dwellings, apartment kitchens have twice the percentage of fires and nearly one and one-half times the percentage of injuries.

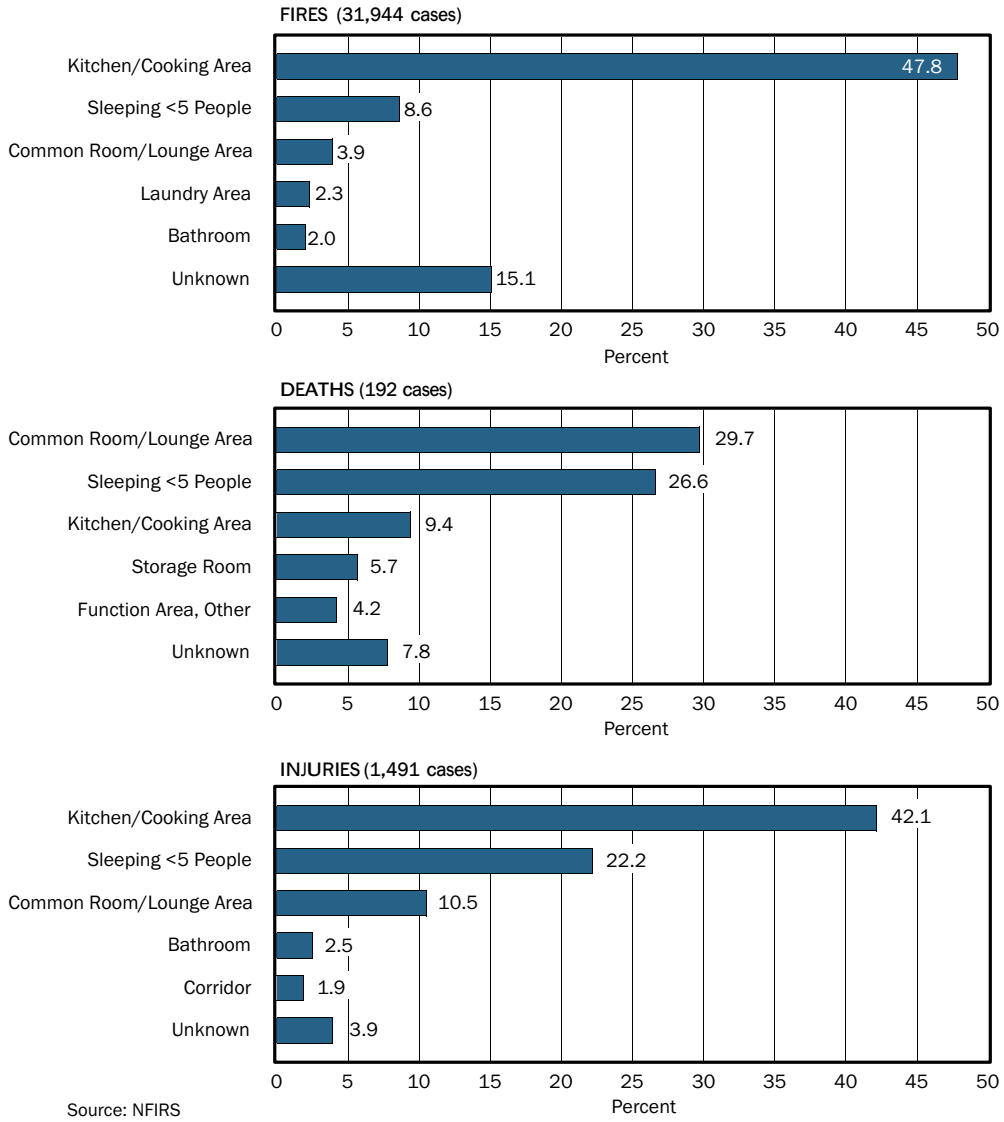


Figure 50. Leading Locations of Fire Origin of Apartment Fires and Fire Casualties (2001)

OTHER RESIDENTIAL PROPERTIES

Other residential properties include rooming houses, dormitories, home hotels, halfway houses, hotels and motels, and miscellaneous and unclassified properties reported as residences. Prior to 1994, the other residential properties category did not include hotels and motels in the yearly NFPA estimates of fires and fire losses; hotel/motel fires were reported separately. Since 1994, however, hotels and motels have been included as part of the other residential category. In this edition of *Fire in the United States*, other residential fires and fire losses have been recompiled to present a consistent series that includes hotels and motels. Therefore, the trends shown here are compatible only with the previous two editions of *Fire in the United States* (11th and 12th). The other residential properties category does not include homes for the elderly, prisons, orphanages, or other institutions; these have their own categories and are addressed in Chapter 4.

Trends

Figure 51 shows a slight 10-year decline (3 percent) in the number of other residential fires and large decreases in the number of deaths and injuries (76 and 34 percent, respectively). The 1993 spike in deaths is due to the Branch Davidian Compound fire in Waco, TX (47 deaths) and the Paxton "Hotel"[16] fire in Chicago (20 deaths). Fire deaths ranged from 25 to 105 a year; injuries ranged from 375 to 600. Adjusted dollar loss has trended up 28 percent over 10 years, with lows of $97 million in 1993 to a high of $153 million in 2000.

Property Types

Figure 52 shows that hotels and motels in 2001 accounted for far more fires, injuries, and dollar loss than other residential property in this category, and tied with boarding/rooming houses for most deaths.[17] The percentages for hotel/motel fires and losses are less than in 1998 for each of the four measures.

Causes

In 2001, cooking was the leading cause of fires, by a factor of three, in other residential properties (Figure 53). Arson was the leading cause of deaths and injuries, but because of the relatively small numbers of deaths and injuries, this cause does not stand out from the others. The cause of death was not reported in more than half of the cases.

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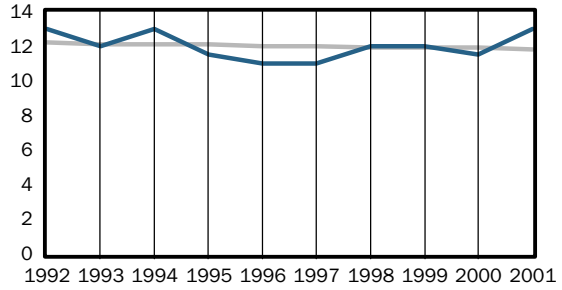
[16] This hotel was actually a permanent place of residence.

[17] The "other" category tends to be a catchall category for any residential property that does not neatly fit into the main residential categories. It is unusually high in 2001.

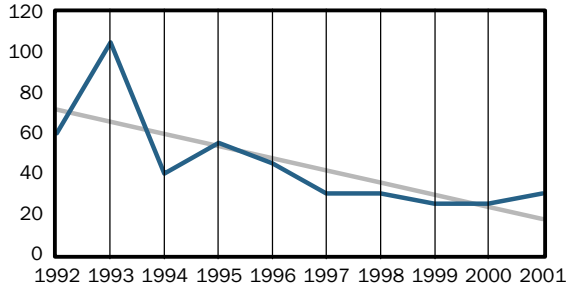
FIRES (in thousands)



1992	13.0	1997	11.0
1993	12.0	1998	12.0
1994	13.0	1999	12.0
1995	11.5	2000	11.5
1996	11.0	2001	13.0

10-Year Trend = -3.1%

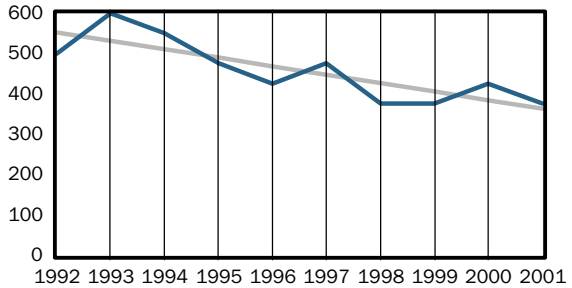
DEATHS



1992	60	1997	30
1993	105	1998	30
1994	40	1999	25
1995	55	2000	25
1996	45	2001	30

10-Year Trend = -75.8%

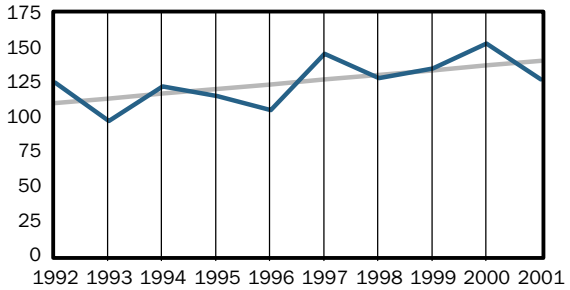
INJURIES



1992	500	1997	475
1993	600	1998	375
1994	550	1999	375
1995	475	2000	425
1996	425	2001	375

10-Year Trend = -34.3%

DOLLAR LOSS (in $ millions)*



1992	$125.0	1997	$145.7
1993	96.8	1998	128.2
1994	121.9	1999	135.0
1995	115.1	2000	153.2
1996	105.0	2001	127.0

10-Year Trend = +27.7%

*Adjusted to 2001 dollars

Sources: NFPA and Consumer Price Index

Figure 51. Trends in Other Residential Property Fires and Fire Losses

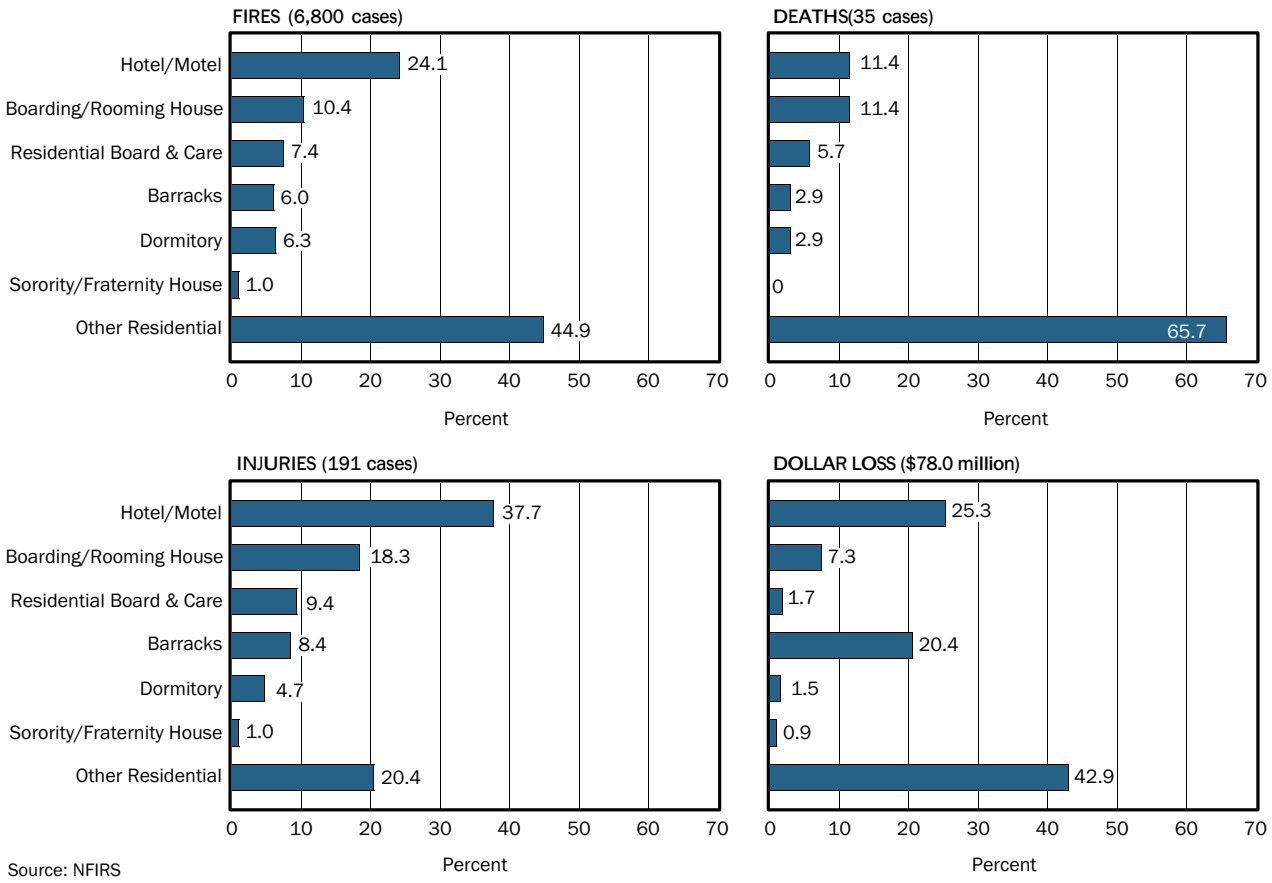


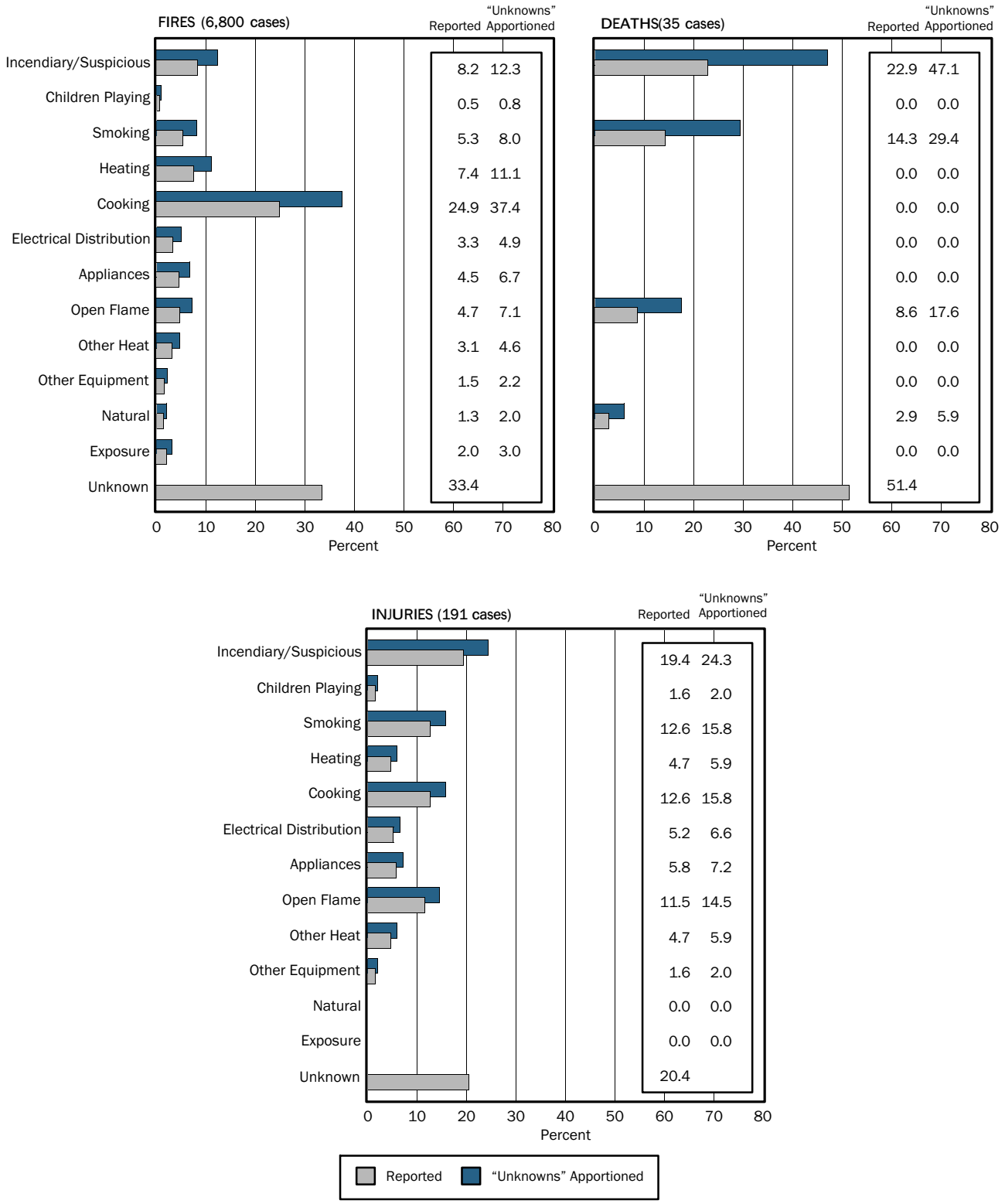
Figure 52. Other Residential Property Fires and Fire Losses by Property Type (2001)

Hotels and Motels

Because of the large reduction in the number of hotel and motel fires and fire losses, NFPA no longer tabulates this residential category separately. Although national numbers are no longer available for hotels and motels, NFIRS data are still tabulated separately and allow for the determination of the causes of hotel and motel fires, deaths, and injuries.

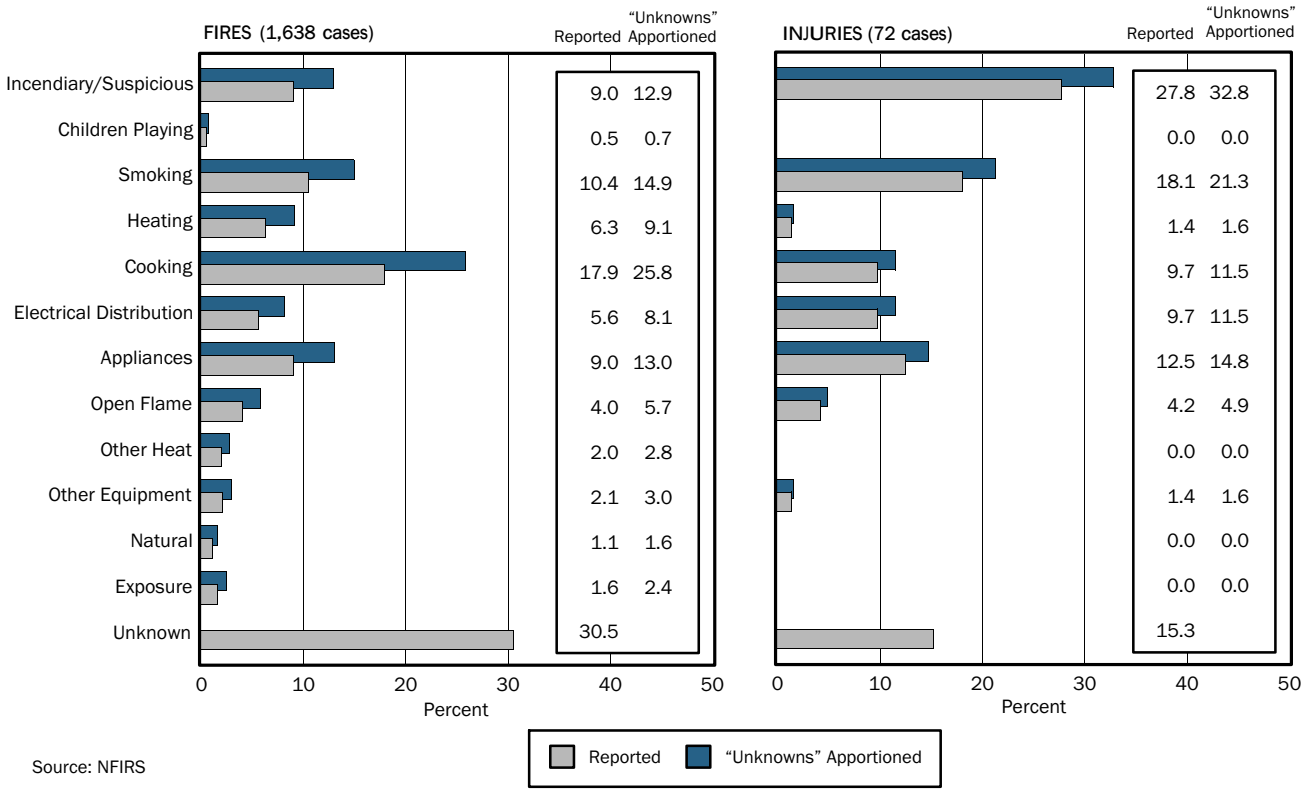
CAUSES. One-quarter of hotel/motel fires are from cooking, but these usually originate in the hotel's centralized restaurant, not in the guest rooms (Figure 54). Most other fires originate in guest rooms. Here, the leading causes tend to be careless acts that guests can commit in hotel rooms, such as smoking at 15 percent and appliance fires (e.g., hair dryers, irons, hot plates) at 13 percent. Some acts are intentional (arson at 13 percent) by employees or guests. Heating fires are less a cause in hotels than in other dwellings because heating systems are centralized and professionally maintained.

Only four hotel fire deaths were reported to NFIRS in 2001. One death was arson related, one was due to careless smoking, and the cause of two deaths was unknown.



Source: NFIRS

Figure 53. Causes of Other Residential Property Fires and Fire Casualties (2001)



Source: NFIRS

Figure 54. Causes of Hotel/Motel Fires and Fire Injuries (2001)

One-third of hotel/motel fire injuries were caused by arson. Smoking and appliance fires were the second and third leading causes of injuries.

TRENDS. Causes of hotel and motel fires, deaths, and injuries change from year to year because of the small numbers of fires, deaths, and injuries associated with this residential category. Table 16 compares the top three causes of fires, deaths, and injuries in 2001 with the three previous editions of *Fire in the United States*.

Although the causes shift from year to year, arson, smoking, cooking, and appliances are recurring causes in hotel and motel fires, deaths, and injuries. The hotel and motel industry has instituted major changes such as built-in fire protection systems and employee fire-awareness programs that have been instrumental in the overall decline of hotel and motel fire statistics.

Table 16. Leading Causes of Hotel and Motel Fires and Fire Casualties

Rank	1994	1996	1998	2001
FIRES				
1	Arson	Cooking	Cooking	Cooking
2	Cooking	Arson	Arson	Smoking
3	Appliances	Smoking	Appliances	Appliances
DEATHS				
1	Smoking	Smoking	Arson	Smoking/Arson
2	Cooking/ Electrical Distribution/ Other Heat	Arson	Electrical Distribution/ Other Heat	N/A
3	N/A	Other Equipment	N/A	N/A
INJURIES				
1	Smoking	Arson	Arson/Appliances	Arson
2	Arson	Smoking	Electrical Distribution	Smoking
3	Cooking	Appliances	N/A	Appliances

Source: NFIRS

USFA RESOURCES ON FIRES IN RESIDENCES

The vast majority of civilian fire deaths and injuries continue to occur in residences. Residential occupancies also account for the largest annual dollar loss, and more firefighter injuries occur fighting fires in residences than in any other property type. For these reasons, the USFA has a variety of initiatives that focus on reducing residential fires and the deaths and injuries that they cause.

Public fire education is a cornerstone of USFA's fire prevention programs. USFA continues to provide public fire education programs to the state and local levels by developing public education tools, public awareness campaigns, and technical materials. USFA also promotes school system acceptance of fire safety education in K–12 and encourages private sector commitment and support for community fire prevention.

Many of the following topics are addressed at USFA's Web site http://www.usfa.fema.gov.

Publications

To support and encourage public fire education, USFA has developed a series of public awareness campaign kits. Each campaign kit has a variety of high-quality, ready-to-use materials for use by educators, community organizations, fire departments, and the private sector. Most campaigns promote home fire safety, primarily in one- and two-family structures where 70–80 percent of residential fires, deaths, and dollar loss occur.

The USFA also produces a number of materials designed to improve the quantity and quality of public fire education efforts throughout the country. The *Directory of National Community Volun-*

teer Fire Prevention Programs (FA–92) is a catalog of local fire safety education programs addressing such issues as fire and burn prevention in the home, eliminating hazards, surviving and escaping fire, equipping the home with smoke alarms and fire extinguishers, and properly using home heating devices. *America Burning* and the updated version, *America Burning Revisited*, emphasize the importance of fire prevention and put it on the same level of importance as fire suppression. The *Juvenile Firesetter Intervention Handbook* (FA–210) offers concrete strategies on how to recognize a problem, interview children and their families, educate children not to set fires, and determine when a case calls for referral to a mental health professional. And finally, USFA offers the *Fire Safety Education Resource Directory* on line as a compendium of materials that may be useful in building and supplementing a public education program for fire safety: http://www.usfa.fema.gov/applications/fserd.

Many other valuable reports and books are produced and endorsed by USFA. The following list is by no means exhaustive, but it is intended to highlight some of the USFA literature not cited in other chapters:

After the Fire! Returning to Normal (English) (FA–46)
After the Fire! Returning to Normal (Spanish) (FA–46S)
Beyond Solutions 2000
Children and Fire–A Growing Concern (FA–244)
Escape From Fire—Once You're Out Stay Out! (FA–246)
Fire Safety Checklist for Older Adults (FA–221)
Fire Safety Checklist for Older Adults–Spanish (FA–221S)
Get Out and Stay Alive
Get Out and Stay Alive Fire Safety Brochure for College Students (L–234)
Is Your Home Fire Safe? Door Knob Hanger (L–227)
Protecting Your Family from Fire (English) (FA–130)
Protecting Your Family from Fire (Spanish) (FA–129)
Rural Arson Control (FA–87)
Rural Fire Problem in the United States (FA–180)
Safety and Your Tree Holiday Hang Tag (FEMA 024)
Security (Burglar) Bars: Special Report (USFA–TR–138)
Solutions 2000

The following children's publications pertaining to fire safety are:

Let's Have Fun With Fire Safety: Exty and Hydro's Activity Book (FA–189)
Sesame Street Fire Safety Station (FA–165)
Sesame Street Fire Safety Station (Spanish) (FA–165S)
Sesame Street Fire Safety Station Color and Learn (FA–176)
Sesame Street Fire Safety Station Color and Learn (Spanish) (FA–176S)

In addition to ordering through the online catalog, publications may be ordered by calling the Publications Center at (800) 561–3356 between 7:30 a.m. and 5:00 p.m. EST/EDT. To order publications by mail, write to:

Publications Center
United States Fire Administration
16825 South Seton Avenue
Emmitsburg, MD 21727

Please include your name, mailing address, daytime telephone number, date required, title(s) of the publication, and the quantity you need when ordering by phone or mail. Also, publications may be ordered online at http://www.usfa.fema.gov/applications/publications. Please include the parenthetical publication number, if given, in your request.

The *Topical Fire Research* series for the residential fires problem can be downloaded from http://www.usfa.fema.gov/inside-usfa/nfdc/pubs/tfrs.shtm, including:

Candle Fires in Residential Structures
Christmas/Christmas Tree Fires
Dormitory Fires
Fatal Fires
Fraternity and Sorority House Fires
Heating Fires in Residential Structures
Highrise Fires
Mattress and Bedding Fires in Residential Structures
Multiple-Fatality Fires
Portable Heating Fires in Residential Structures
Residential Air Conditioning Fires
Residential Structure Fires During the Winter Holiday Season
Residential Structure Fires in 2000
Residential Structure Fires on Agricultural Properties
Smoke Alarm Performance in Residential Structure Fires
Thanksgiving Day–Residential Structure Fires
Winter Fires

Campaign Materials

The USFA has developed a series of public awareness campaign kits containing high-quality materials for use by educators, community organizations, fire departments, and the private sector. A public education initiative, *Fire Stops With You: USFA Fire Safety and Prevention Information* (K–84), is a compilation of 5 years' worth of research that targets fire safety through empowerment: the individual's behavior is what must be addressed to prevent fire. It includes radio and print public service announcements (PSAs), factsheets, and technical reports.

Most campaigns promote home fire safety, primarily in one- and two-family houses. A recent campaign, *Spanish/English Home Fire Safety: Act On It*, was developed in cooperation with the

Sleep Products Safety Council, the National Association of Broadcasters, the National Board of Realtors, and the "Just Say No" campaign. It contains materials on general home fire safety themes, and includes radio and print PSAs, sample letters to the editor, a fill-in-the-blank press release, factsheets, and a resource guide. The factsheets and other fire safety information can be downloaded from http://www.usfa.fema.gov/public/factsheets/safety.shtm.

Major Fires Investigations

The USFA also conducts special studies to address specific problems and current issues facing the nation's fire and rescue service. The technical reports produced under the Major Fires Investigations series analyze major or unusual fires with emphasis on sharing lessons learned. They are directed primarily at chief officers, training officers, fire marshals, and investigators as a resource for training and prevention.

ONE- AND TWO-FAMILY STRUCTURES:

Children Left Home Alone: Eleven Die in Two Fires, Detroit, MI, February 1993 (USFA–TR–070)

Eight Children and Two Adults Die in Rural House Fire, Remer, MN, January 1989 (USFA–TR–028)

Eight-Fatality Row House Fire: Lessons Learned from Residential Fires With Five or More Fatalities, Chester, PA, December 1992 (USFA–TR–067)

Four House Fires That Killed 28 Children, September–December 1987 (USFA–TR–020)

Multiple-Fatality Single Dwelling Fire (St. Cloud, FL) (USFA–TR–142)

Nine-Fatality Mobile Home Fire, Maxton, NC, November 1989 (USFA–TR–037)

Power Off to Hard-Wired Detector in Nine-Fatality House Fire, Peoria, IL, April 1989 (USFA–TR–031)

Seven-Fatality Christmas Tree Fire, Canton, MI, December 1990 (USFA–TR–046)

Seven-Fatality Fire at Remote Wilderness Lodge, Grand Marais, MN, July 1991 (USFA–TR–055)

APARTMENTS:

A Comparison of Two Fires: The Westview Towers (NJ) and the Council Towers Apartments (MO), (USFA–TR–119)

Apartment Building Fire–East 50th Street, New York City, January 1988 (USFA–TR–019)

Apartment Complex Fire, 66 Units Destroyed, Seattle, WA, September 1991 (USFA–TR–059)

Fire, Police, and EMS Coordination at Apartment Building Explosion, New York City, November 1992 (USFA–TR–068)

Kona Village Apartments Fire, Bremerton, WA, November 13, 1997 (USFA–TR–121)

Multiple High-Rise Condominium Fire, Clearwater, FL, June 2002 (USFA–TR–148)

Operational Considerations for Highrise Firefighting: Special Report (USFA–TR–082)

Nine-Fatality Apartment House Fire, Ludington, MI, February 1993 (USFA–TR–072)

Old Buckingham Station, Chesterfield, VA, May 1995 (USFA–TR–105)

Schomberg Plaza Fire, New York City, Harlem, March 1987 (USFA–TR–004)

HOTELS AND MOTELS:

Doubletree Hotel Fire, New Orleans, LA, July 1987 (USFA–TR–008)

Five-Fatality Residential Motel Fire, Thornton, CO, January 1997 (USFA–TR–104)

LaPosada Hotel Fire, McAllen, TX, February 1987 (USFA–TR–001)

National Guard Plane Crash at Hotel Site, Evansville, IN, February 1992 (USFA–TR–064)
Nine Elderly Fire Victims in Residential Hotel, Miami Beach, FL, April 1990 (USFA–TR–041)
Ramada Inn Air Crash and Fire, Wayne Township, IN, October 1987 (USFA–TR–014)
St. George Hotel Complex 16 Alarm Fire, Brooklyn, NY, August 26, 1995 (USFA–TR–108)

The USFA has worked diligently in the implementation of PL101–391, The Hotel/Motel Fire Safety Act of 1990. By working closely with the American Hotel and Motel Association and the National Association of State Fire Marshals, USFA provided a range of support services to states to help them identify facilities that meet the fire safety requirements of the Act. Links to these associations are at the USFA Web site (http://www.usfa.fema.gov/applications/hotel).

OTHER RESIDENTIAL PROPERTIES:

Class A Foam for Structural Firefighting (USFA–TR–083)
College Dormitory Fires in Dover, Delaware, and Farmville, Virginia, April 1987 (USFA–TR–006)
Compressed Air Foam Use for Structural Fire Fighting: A Field Test, Boston Fire Department, June 1993 (USFA–TR–074)
Fire Safe Student Housing: A Guide for Campus Housing Administrators (FA–228)
Get Out and Stay Alive Fire Safety Brochure for College Students (L–234)
Hospital Fire Kills Four Patients, Southside Regional Medical Center, Petersburg, VA, December 1994 (USFA–TR–080)
Shenandoah Retirement Home Fire, Roanoke County, VA, December 1989 (USFA–TR–038)
Sixteen-Fatality Fire in Highrise Residence for the Elderly, Johnson City, TN, December 1989 (USFA–TR–039)
Success Story at Retirement Home Fire, Sterling, VA, December 1989 (USFA–TR–040)
Ten Elderly Victims From Intermediate Care Facility Fire, Colorado Springs, CO, March 1991 (USFA–TR–050)
Ten-Fatality Board and Care Facility Fire, Detroit, MI, June 1992 (USFA–TR–066)
Twelve-Fatality Nursing Home Fire, Norfolk, VA, October 1989 (USFA–TR–034)
Two-Fatality Board and Care Facility Fire, Salvation Army Rehabilitation Center, Miami, FL, November 1995 (USFA–TR–090)
Winter Fires—Safety Tips for the Home (FA–249)

Residential Sprinklers

The USFA has done extensive research to develop installation and application standards for quick-acting residential sprinklers and has conducted a variety of demonstrations of the quick-response sprinkler technology to demonstrate the practicality of these systems. The USFA also worked with the National Institute of Standards and Technology to design and test new limited-water-supply fire sprinkler systems for residential housing.

Home Fire Protection—Residential Fire Sprinkler Systems (FA–43) is a pamphlet for the general public explaining the merits of home sprinklers and the financial and insurance benefits. The brochure *New Home Construction and Life Safety Sprinklers* (FA–258) also provides useful information on the benefits of home sprinkler systems.

Other USFA reports on residential sprinklers include:

Backflow Protection for Residential Sprinkler Systems
Evaluating Small Board and Care Homes: Sprinklered vs. Nonsprinklered Fire Protection
Residential Sprinkler Retro Demo Case Study (FA–90)
Review of Residential Sprinkler Systems: Research and Standards (FA–265)

chapter four

Non-Residential Properties

This chapter addresses non-residential properties over the 10-year period from 1992 to 2001, with specific focus on 2001. Major variations from the last published statistics on non-residential properties—the 12th Edition, 1989–1998—are noted. Non-residential properties are discussed in three sections: structures, vehicles, and outside/other fires.

The non-residential property category includes industrial and commercial properties, institutions (such as hospitals, nursing homes, prisons), educational establishments (from preschool through university), mobile properties, and storage properties. Each category corresponds to one of the major divisions of property types. Each is quite different, and their cause profiles and magnitudes need to be examined separately.

Several changes in non-residential structure property types are reflected in this edition. Detached residential garages, a subset of non-residential storage properties, are included in this chapter. Vacant and under construction properties are no longer considered as a separate property type. Fires that occur on non-residential properties that are vacant or under construction are included in a separate discussion.

NON-RESIDENTIAL STRUCTURES

The terrorists' attacks on the World Trade Center and the Pentagon on September 11, 2001, killed 2,451 civilians (i.e., non-firefighters), injured 800, and caused $33.4 billion in property loss.[1] In large part, these losses are excluded from the following analysis of non-residential structures. The magnitude of such losses from a single event must be considered an outlier when studying fire events across an entire year and even 10 years. The omission of the September 11 losses from this report, however, is in no way meant to diminish the enormity of the event.

Magnitude and Trends

Significant public and private fire prevention efforts have focused on protecting non-residential structures. The results have proven effective in the main, especially relative to the residential fire problem. Non-residential structures annually account for only 7 percent of fires,

[1] NFPA's annual survey, 2001.

2 percent of deaths, and 8 percent of injuries. These properties, however, account for a disproportionately large annual dollar loss, 31 percent.[2]

The 10-year trends for fires, deaths, and injuries decreased from the 1989–1998 period, while property losses increased. Figure 55 shows that the trend for each of these measures is downward (fires, 22 percent; deaths, 48 percent; injuries, 46 percent; and dollar loss, 15 percent). In absolute numbers, fires, deaths, and injuries reached 10-year lows in 2001.

There were an estimated 80 deaths in non-residential structure fires in 2001. The 1995 peak (290 deaths) is attributed to the 168 people killed in the bombing of the Federal Building in Oklahoma City in 1995. The peak in injuries (3,950) in 1993 includes 1,024 injuries that occurred at the World Trade Center explosion and fire in New York City. Although difficult to discern from the chart, the $3.8 billion peak in property losses in 1995 includes $135 million for the Oklahoma City building, $200 million at a Georgia manufacturing plant fire, and $500 million at a Massachusetts industrial complex fire (values in 1995 dollars).

Figure 56 shows the relative magnitude of the fire problem in non-residential structures by each of ten property categories.[3] The eating/drinking property types are actually a subset of public assembly, and detached residential garages are a subset of storage properties, but it is useful to highlight these properties separately.

Fires in other/outside structures lead the property categories in 2001 at 23 percent, replacing stores and office fires, which led in 1994, 1996, and 1998. Stores/offices and storage facilities were the next highest property types for fires. Together, these three groupings represent 59 percent of all non-residential fires.

Fatalities were greatest at storage facilities in 2001 at 23 percent, notably higher than the 13 percent reported in 1998. Such a change, however, is not as drastic as might be first imagined because the total number of non-residential structure deaths reported in NFIRS in 2001 was quite small (47).

Stores/offices was the leading property type for both injuries (22 percent) and property loss (28 percent). Stores/offices, storage, and manufacturing properties accounted for over half of injuries (52 percent) and 65 percent of dollar loss in non-residential fires. Table 17 shows the per-fire property losses at each property type. The highest loss per fire was at manufacturing sites ($56,000). Industrial fires resulted in the second highest loss per fire ($45,000). Institutional fires had the smallest loss per fire at $5,000. The rankings (highest/lowest) of these three property types are unchanged from 1998. Only storage and outside/unknown structures had a lower loss per fire in 2001 than in 1998.

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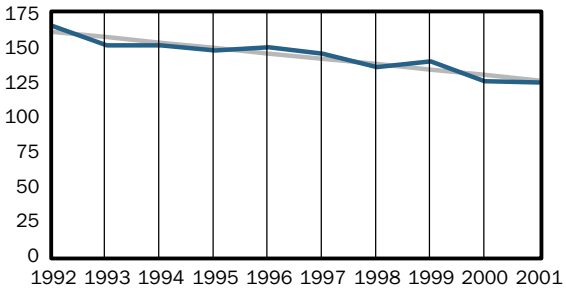
[2] These percentages are derived from summary data presented in NFPA's annual survey, 2001.

[3] In previous editions, vacant and under construction was a separate property category. In NFIRS 5.0, however, fires at under construction sites are allocated to the property category for which the building will be primarily used. Likewise, at vacant sites, the fire is allocated to the category for which it was once primarily used.

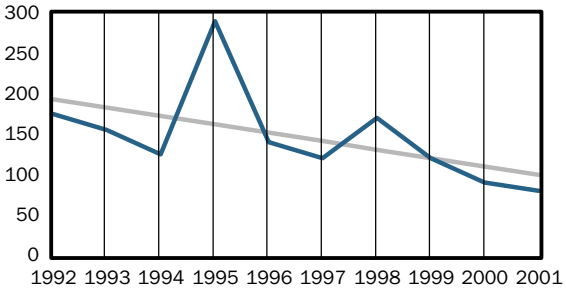
FIRES (in thousands)



1992	165.5	1997	145.5
1993	151.5	1998	136.0
1994	151.5	1999	140.0
1995	148.0	2000	126.0
1996	150.5	2001	125.0

10-Year Trend = –21.8%

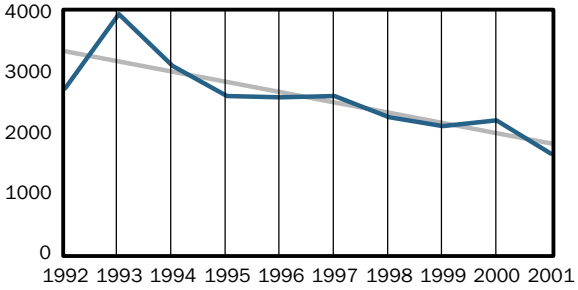
DEATHS



1992	175	1997	120
1993	155	1998	170
1994	125	1999	120
1995	290	2000	90
1996	140	2001	80
		2001 (incl. 9/11)	2,531

10-Year Trend = –48.4%

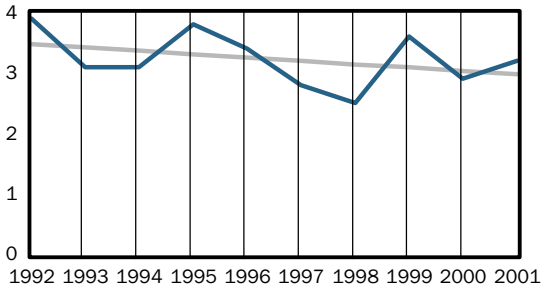
INJURIES



1992	2,725	1997	2,600
1993	3,950	1998	2,250
1994	3,100	1999	2,100
1995	2,600	2000	2,200
1996	2,575	2001	1,650
		2001 (incl. 9/11)	2,450

10-Year Trend = –45.7%

DOLLAR LOSS (in $ billions)*



1992	$3.9	1997	$2.8
1993	3.1	1998	2.5
1994	3.1	1999	3.6
1995	3.8	2000	2.9
1996	3.4	2001	3.2
		2001 (incl. 9/11)	36.7

10-Year Trend = –15.3%

*Adjusted to 2001 dollars

Sources: NFPA and Consumer Price Index

Figure 55. Trends in Non-Residential Structure Fires and Fire Losses

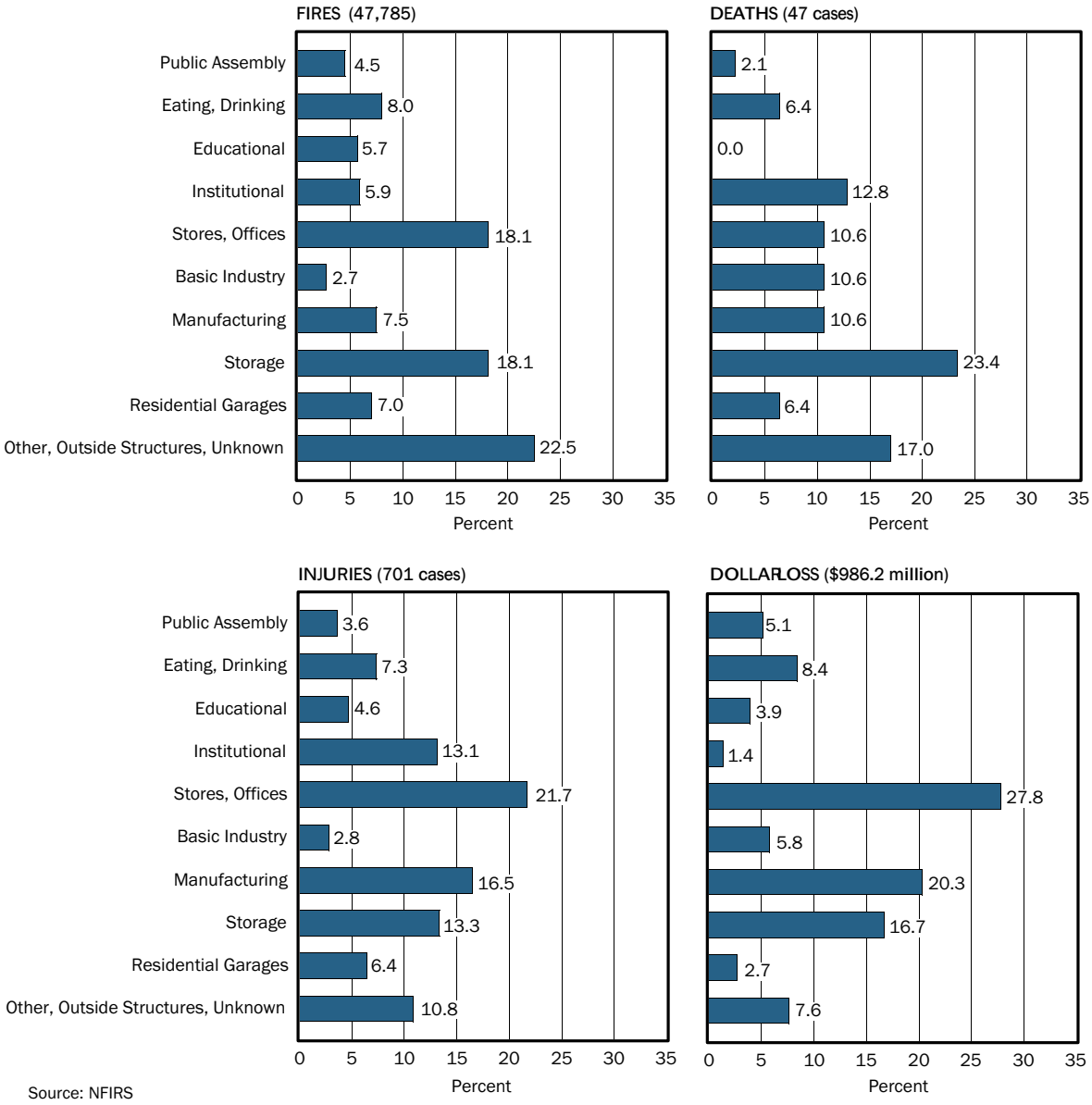


Figure 56. Non-Residential Structure Fires and Fire Losses by Property Type (2001)

The low rank ordering of some property categories should not obscure the fact that all of the categories have thousands of fires, multimillions of dollar loss, and hundreds of casualties. All parts of the fire problem need to be addressed. The relative magnitudes might help suggest where the greatest effort is needed.

When Fires Occur

TIME OF DAY. Non-residential structure fires increase in the afternoon from noon to 6 p.m. (Figure 57). Perhaps this is when workers are tired and are more accident prone or careless. Non-residential structure fires are a heterogeneous category, and the time of day when each of its

Table 17. Non-Residential Structure Dollar Loss Per Fire (2001)

Property Type	$ Loss/Fire
Public Assembly	$23,293
Eating, Drinking	21,867
Educational	14,371
Institutional	4,958
Stores, Offices	31,738
Basic Industry*	45,072
Manufacturing	55,793
Storage	19,024
Residential Garages	8,019
Outside Structures/Unknown	7,013

*Includes utility, defense, agricultural, and mining.

Source: NFIRS

different component property types peak may not agree with the overall picture. The incidence of all fires has the smoothest curve because it is based on the largest sample.

Fire deaths fluctuate wildly by time of day because of the relatively small number of deaths in most 1-hour intervals. Thirteen percent of fatalities (or six deaths) were recorded at 2 a.m. in 2001. Three other spikes (at 9 percent each) were at 4 a.m., 11 a.m., and 6 p.m., the latter at the heart of the dinner cooking period. No deaths were reported at 4 p.m. and 7 p.m.

Injuries begin to rise at 8 a.m., peak at 10 a.m., then begin to fall, and are somewhat steady from 2 p.m. to 10 p.m. Injuries are at their lowest at night, from 11 p.m. to 7 a.m.

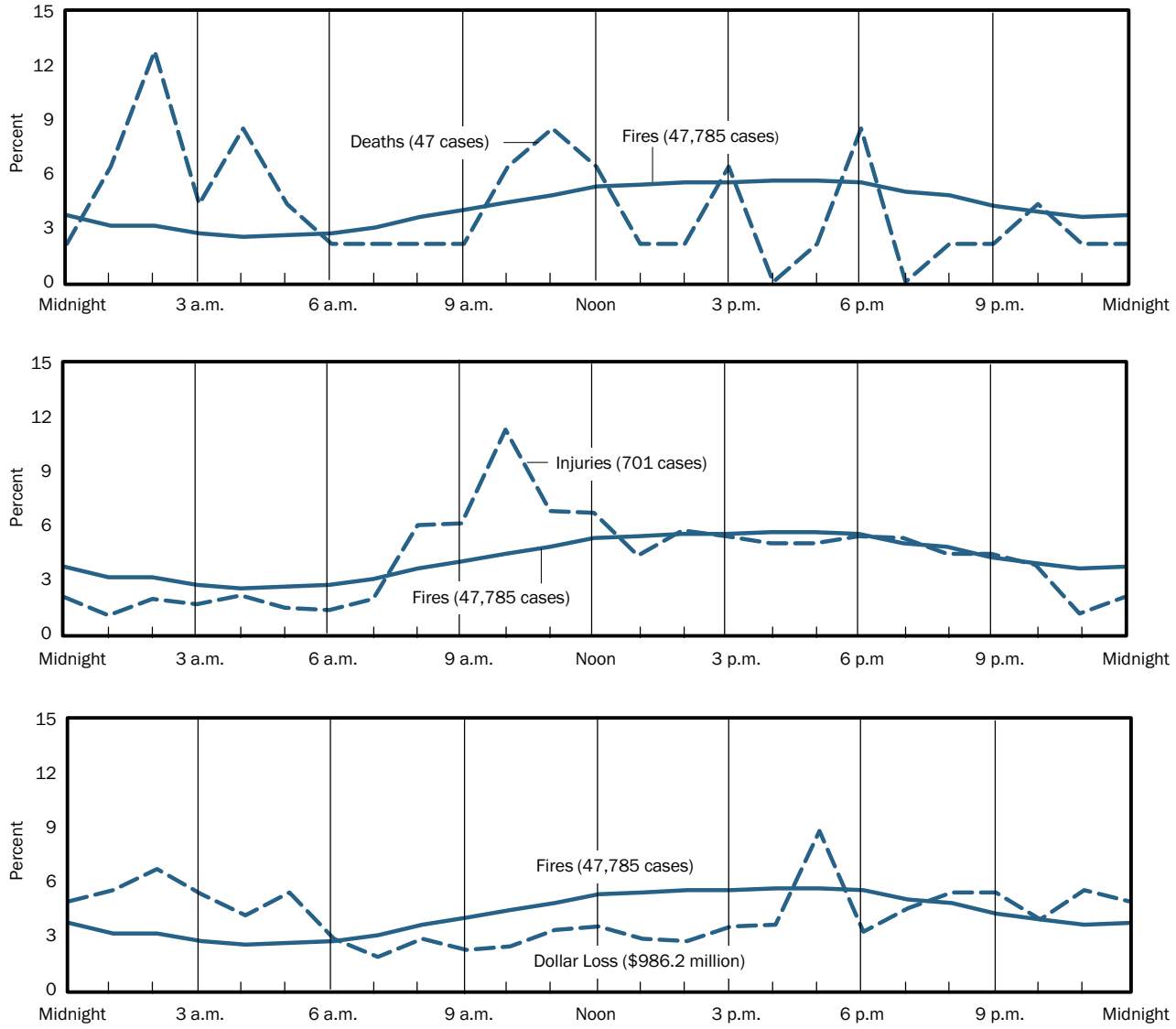
Peak dollar losses occur after hours, especially between 9 p.m. and 5 a.m. The leading cause, incendiary or suspicious, occurs mostly at night. These fires often cause significant damage before they are detected and reported to the fire department. Property losses are lowest from 6 a.m. to 4 p.m. with a spike at 5 p.m.

MONTH OF YEAR. Fires in non-residential properties continue to be relatively uniform throughout the year (Figure 58). The pattern for deaths is erratic because of their relatively small numbers.

DAY OF WEEK. Non-residential fires are nearly uniform from Monday through Friday; they drop off slightly on weekends when fewer people are at work. The patterns for fire in the different subcategories, such as restaurants, however, would probably be less steady. Deaths by day of week are too few and too erratic from which to draw any conclusions.

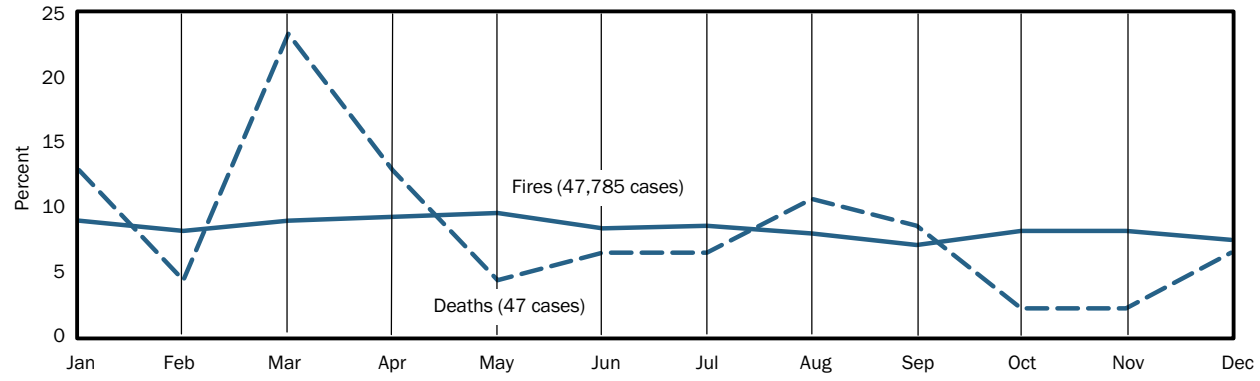
Causes

Changes in NFIRS and the subsequent effects on the cause schema have slightly changed the cause distributions. The inclusion of confined fires, mostly due to cooking, and the changes in how arson and children playing are defined, have generally resulted in decreases in arson and



Source: NFIRS

Figure 57. Time of Day of Non-Residential Structure Fires and Fire Losses (2001)



Source: NFIRS

Figure 58. Month of Year of Non-Residential Structure Fires and Deaths (2001)

children playing fires and increases in cooking fires. Nonetheless, since the inception of NFIRS, incendiary/suspicious has been by far the leading cause of non-residential structure fires and dollar loss. In fact, arson property losses are twice those of the next leading cause category, and represent 30 percent of all property losses (Figure 59). Smoking accounts for 28 percent of deaths, a ninefold increase over 1998. None of these smoking deaths occurred in eating or drinking establishments, which may reflect an additional benefit of smoking bans in many of these facilities. The incidents, injuries, and dollar loss associated with smoking remain nearly the same as in prior years despite increased smoking bans in the workplace.

The 10-year trends of the top five non-residential fires, deaths, injuries, and dollar loss by cause are shown in Figure 60; the actual values for all causes are presented in Table B-6. The percentage increase or decrease for all 12 causes is presented in Table 18.

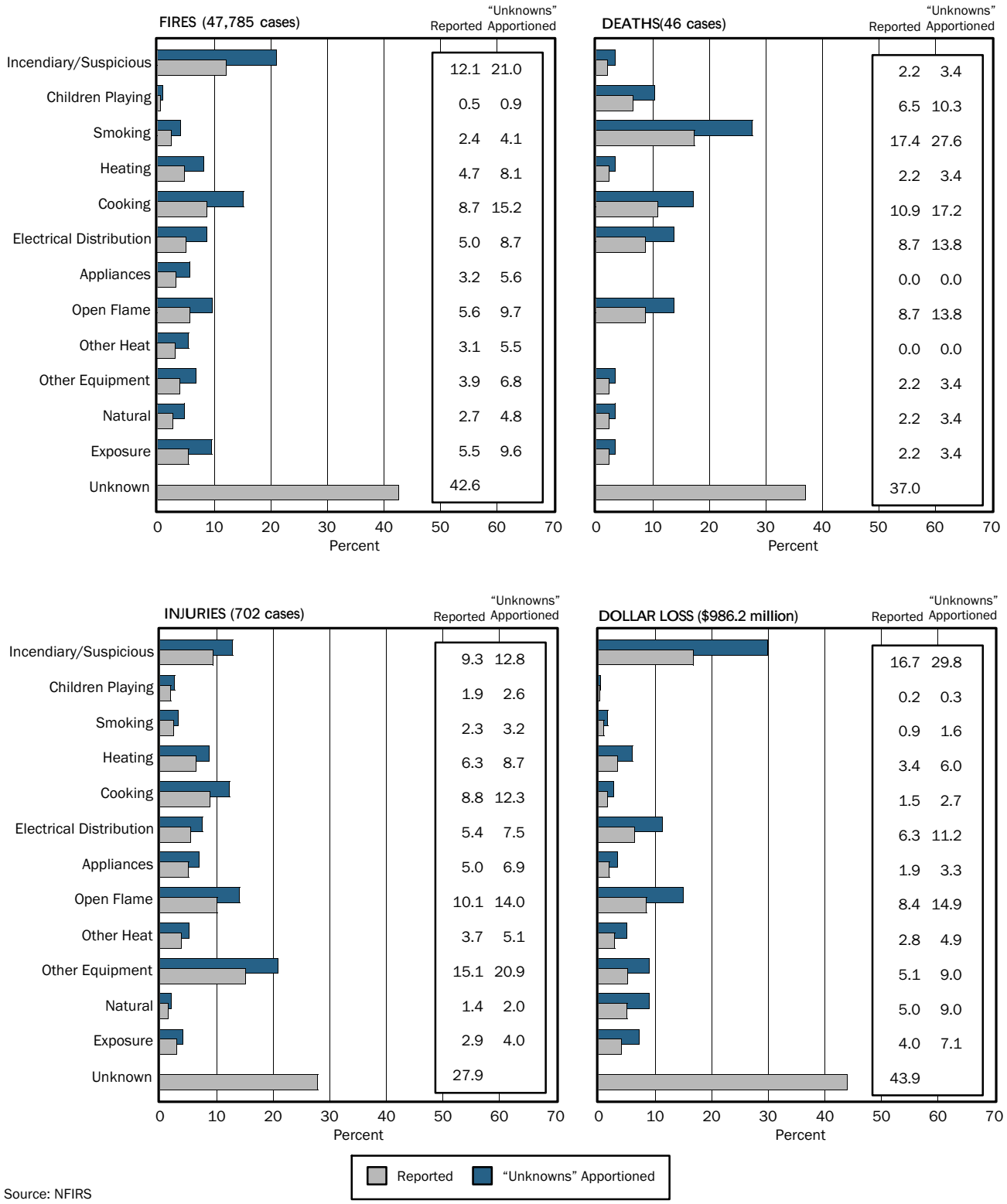
While arson has been the leading cause in the number of fires and the value of property losses, the gap between the number of arson fires and the second leading cause has narrowed considerably over the 1992–2001 period. Due to changes in NFIRS coding, definitions for arson fires changed slightly in the transition from NFIRS 4.1 to 5.0. Because suspicious fires are no longer captured directly and included in the arson totals, the proportion of arson fires have decreased. As shown in the table, arson trends decreased from 46 to 69 percent, depending on the measure. One final note regarding arson: In the 9 years before 2001, deaths from arson averaged 45; in 2001, only 3 deaths were attributed to arson.

The table also shows major increases and decreases in many of the cause trends. For example, the number of other heat fires has increased 136 percent and deaths 82 percent. Injuries from exposure fires have increased 134 percent. Fires, injuries, and dollar loss from children playing with fire have decreased sharply, but the definition of this cause has changed in NFIRS 5.0 so that an "apples-to-apples" comparison across the 10 years may not be valid.

Causes by Detailed Property Type

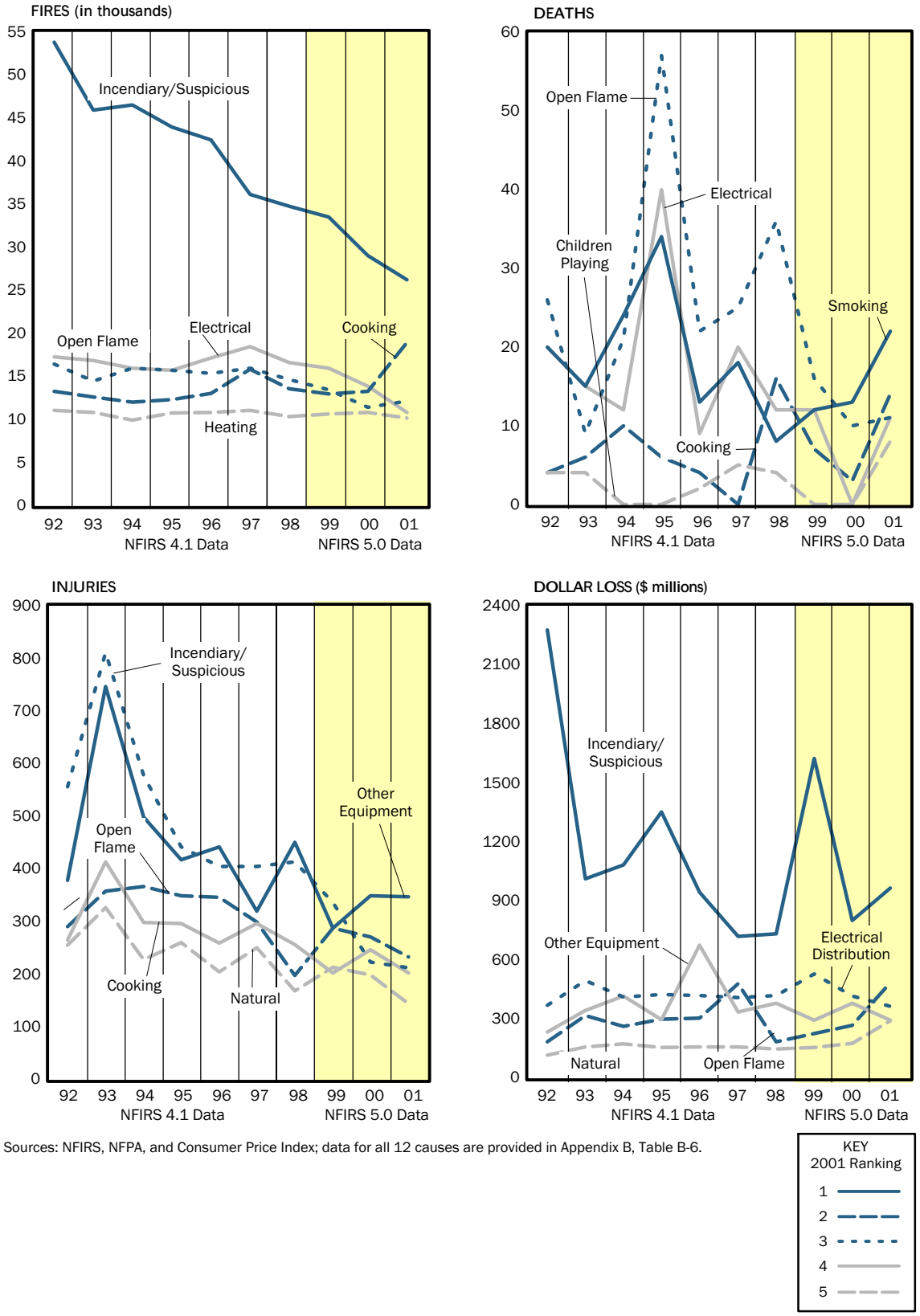
The number of fires and dollar loss in the non-residential occupancy categories are shown in Figures 61–71. (As with the other cause charts in this document, the gray bars represent the reported percentage and the solid bars represent the percentage when the unknowns are apportioned to the knowns.) Deaths and injuries are not presented because there are too few cases to draw meaningful conclusions. With minor variations, the data in 2001 are similar to 1998 data. Major changes in the 2001 profile from the 1998 profile are as follows:

- Institutional structures: The percentage of cooking fires nearly doubled in 2001 over 1998, and other equipment dollar loss is four times higher.
- Manufacturing structures: Heating fires went from 7 percent in 1998 to 13 percent in 2001. Dollar losses from open flame fires jumped from 7 to 34 percent and other equipment fire losses dropped from 42 to 11 percent.



Source: NFIRS

Figure 59. Causes of Non-Residential Structure Fires and Fire Losses (2001)



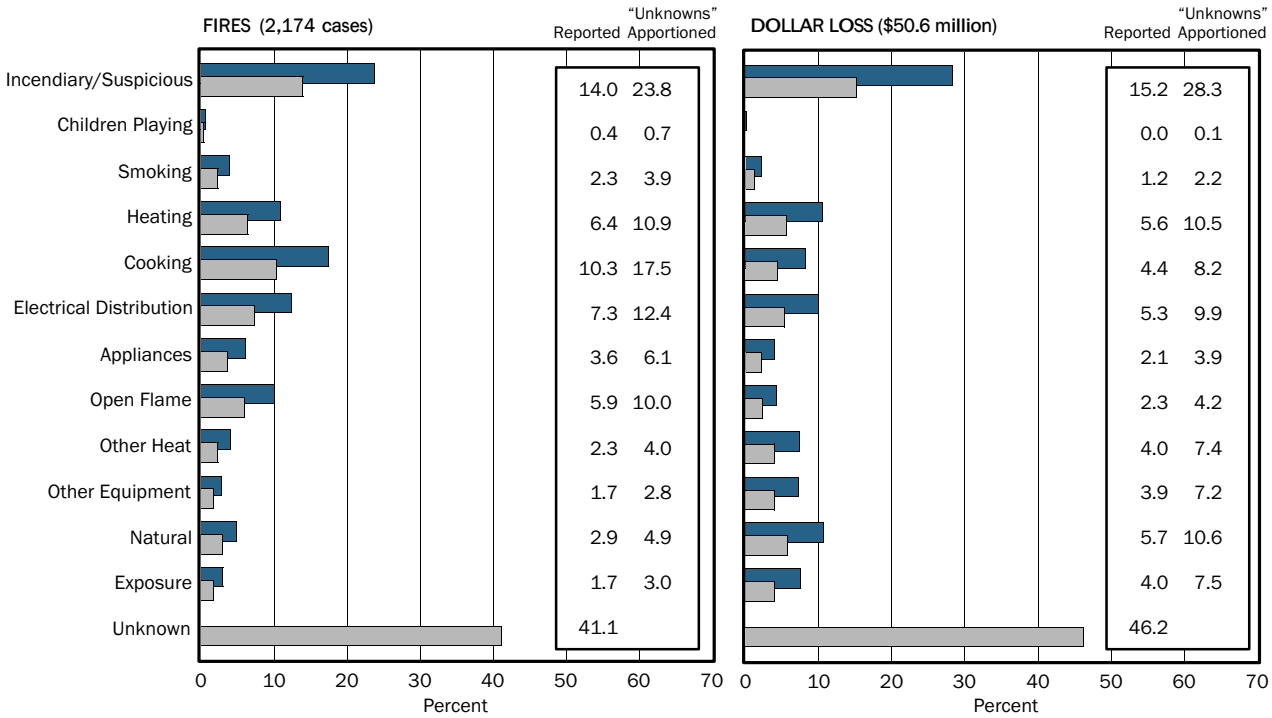
Sources: NFIRS, NFPA, and Consumer Price Index; data for all 12 causes are provided in Appendix B, Table B-6.

Figure 60. Trends in Leading Causes of Non-Residential Structure Fires and Fire Losses

Table 18. Trends in Causes of Non-Residential Structure Fires and Losses (1992–2001) (percent)

Cause	Fires	Deaths	Injuries	DollarLoss
Incendiary/Suspicious	–49.0	–56.6	–69.3	–46.2
Children Playing	–74.3	+60.5	–61.3	–52.9
Smoking	–24.8	–32.9	–67.2	+8.6
Heating	–2.9	–71.2	–42.2	–1.3
Cooking	+30.1	+90.6	–37.2	–15.5
Electrical Distribution	–22.7	–63.7	–46.5	–0.2
Appliances	–22.2	–126.7	–34.8	+1.3
Open Flame	–24.8	–39.9	–31.2	+44.9
Other Heat	+135.5	+82.3	+52.9	+37.1
Other Equipment	–22.3	–60.6	–42.2	+1.6
Natural	+17.2	–84.8	–53.8	+70.7
Exposure	+23.5	–16.7	+133.5	–8.2

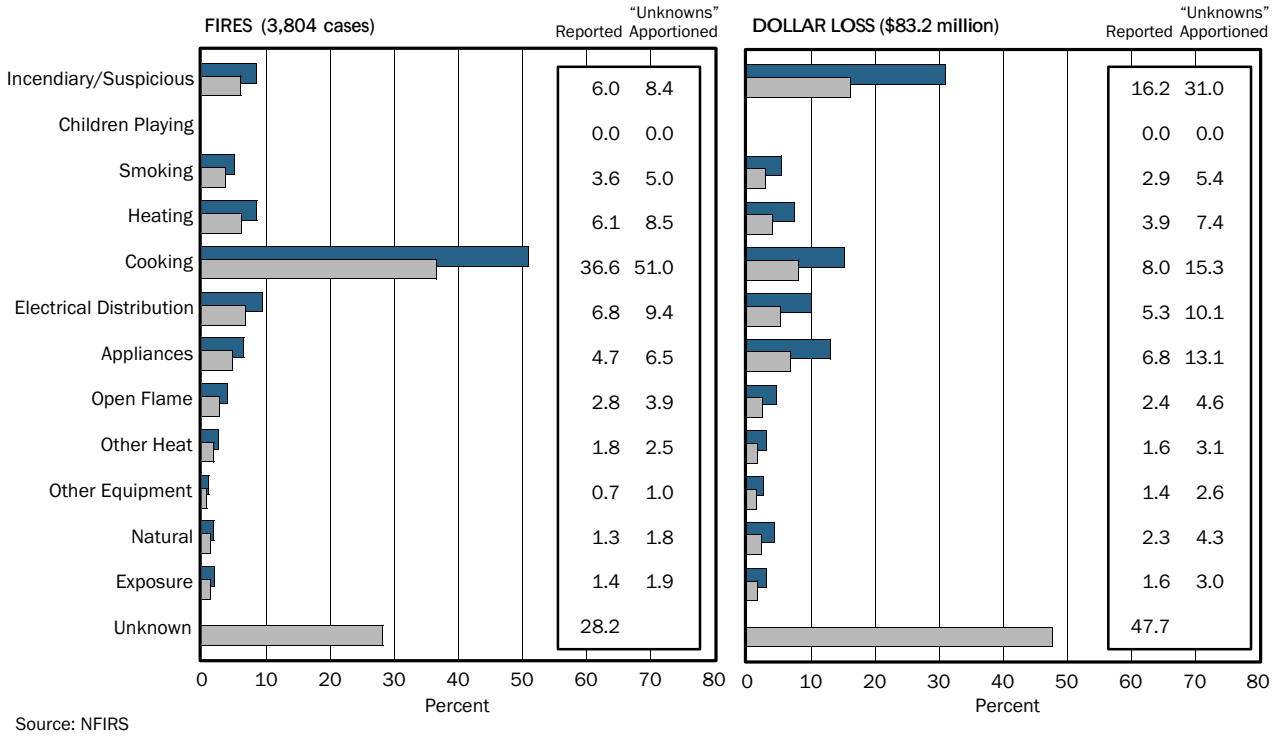
Sources: NFIRS, NFPA, and Consumer Price Index; data provided in Appendix B, Table B-6.



Note: Excludes eating and drinking establishments.

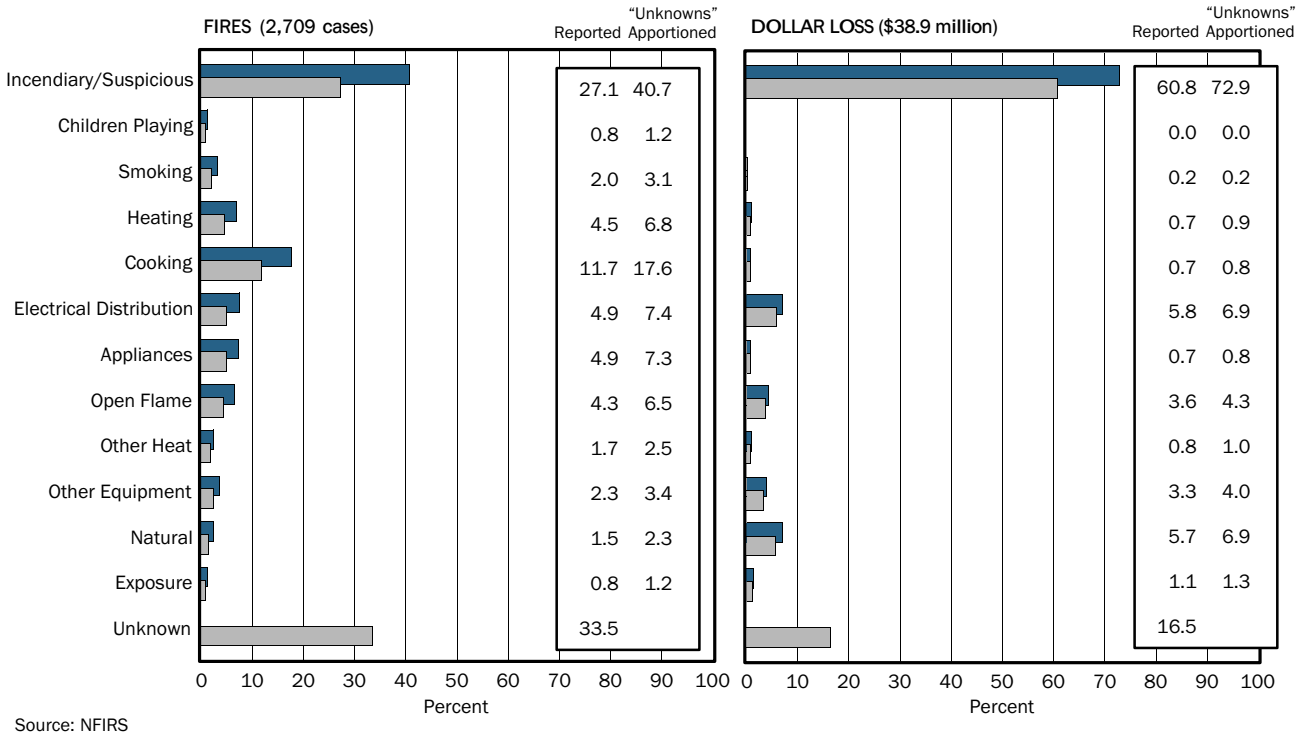
Source: NFIRS

Figure 61. Causes of Public Assembly Structure Fires and Dollar Loss (2001)



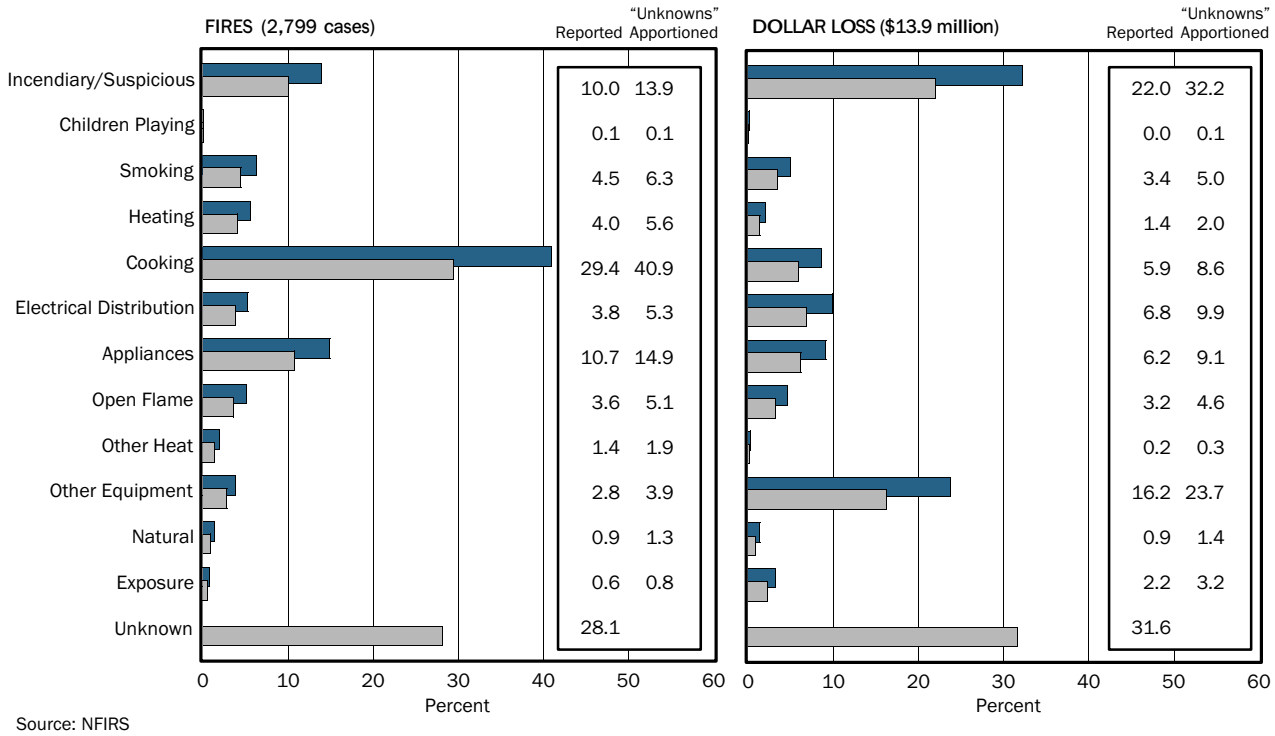
Source: NFIRS

Figure 62. Causes of Eating and Drinking Establishment Fires and Dollar Loss (2001)



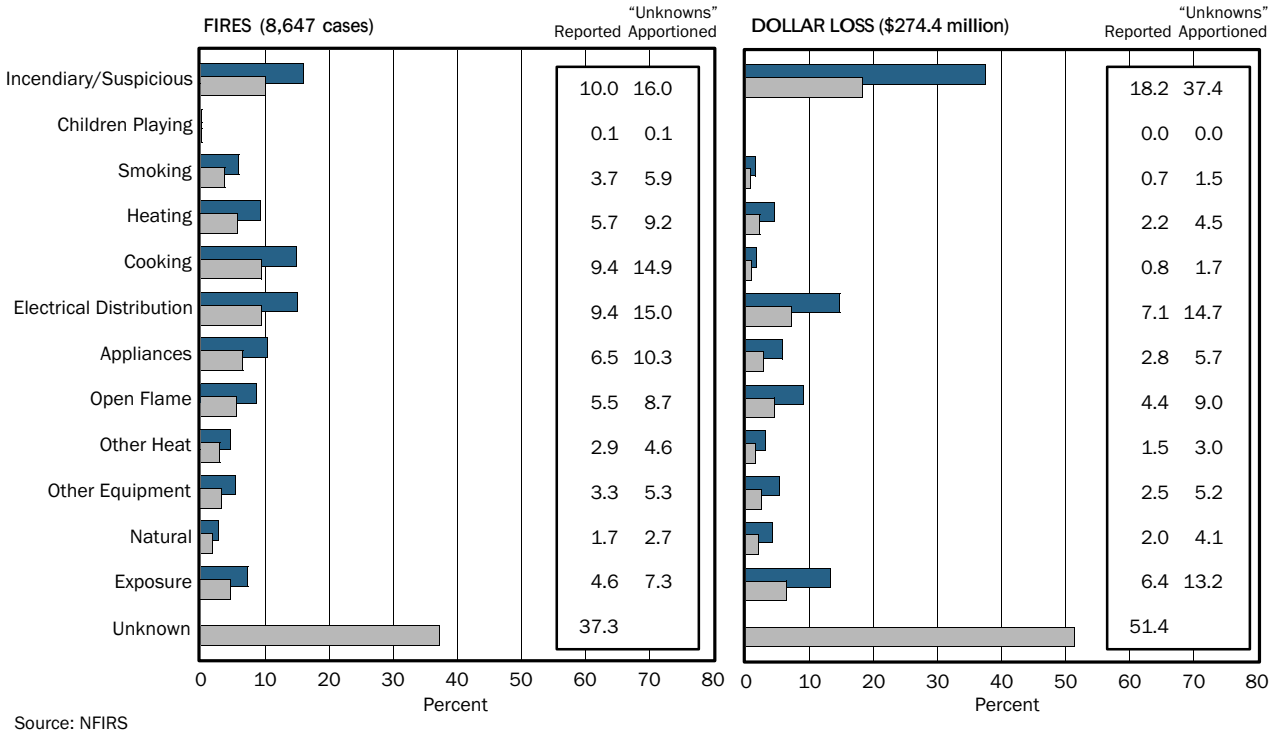
Source: NFIRS

Figure 63. Causes of Educational Structure Fires and Dollar Loss (2001)



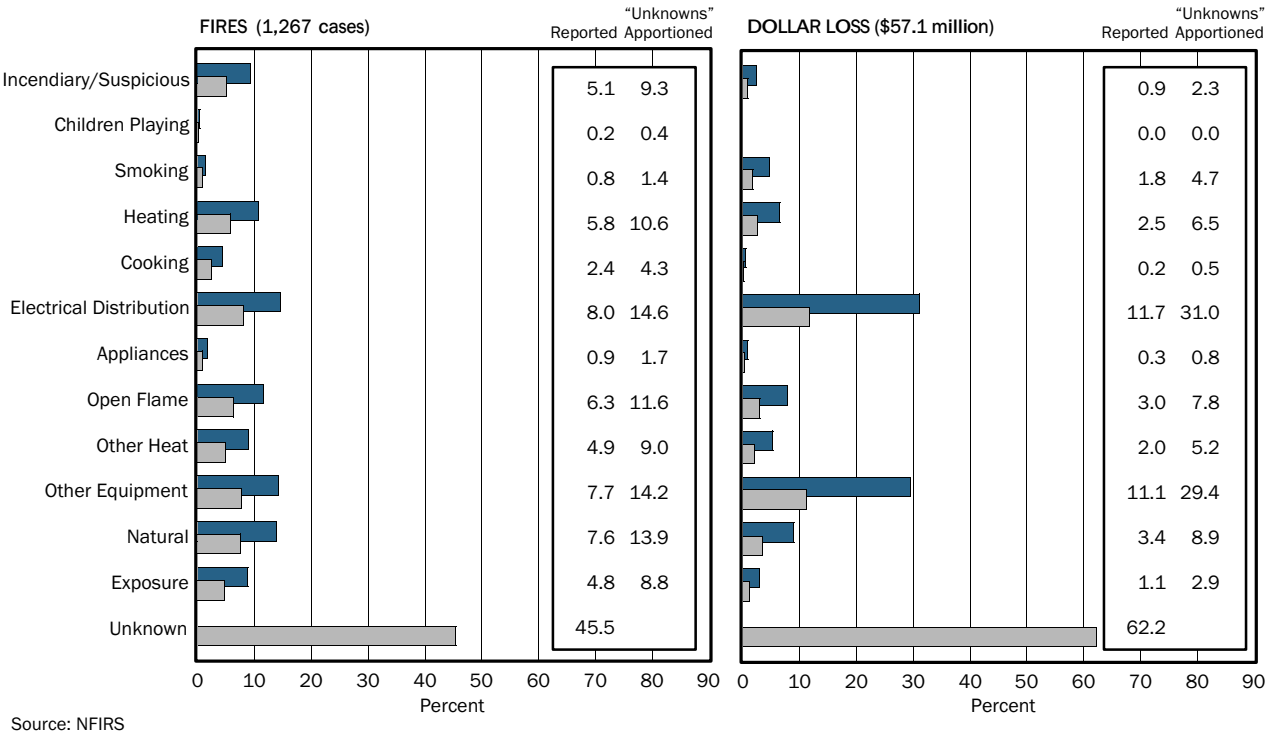
Source: NFIRS

Figure 64. Causes of Institutional Structure Fires and Dollar Loss (2001)



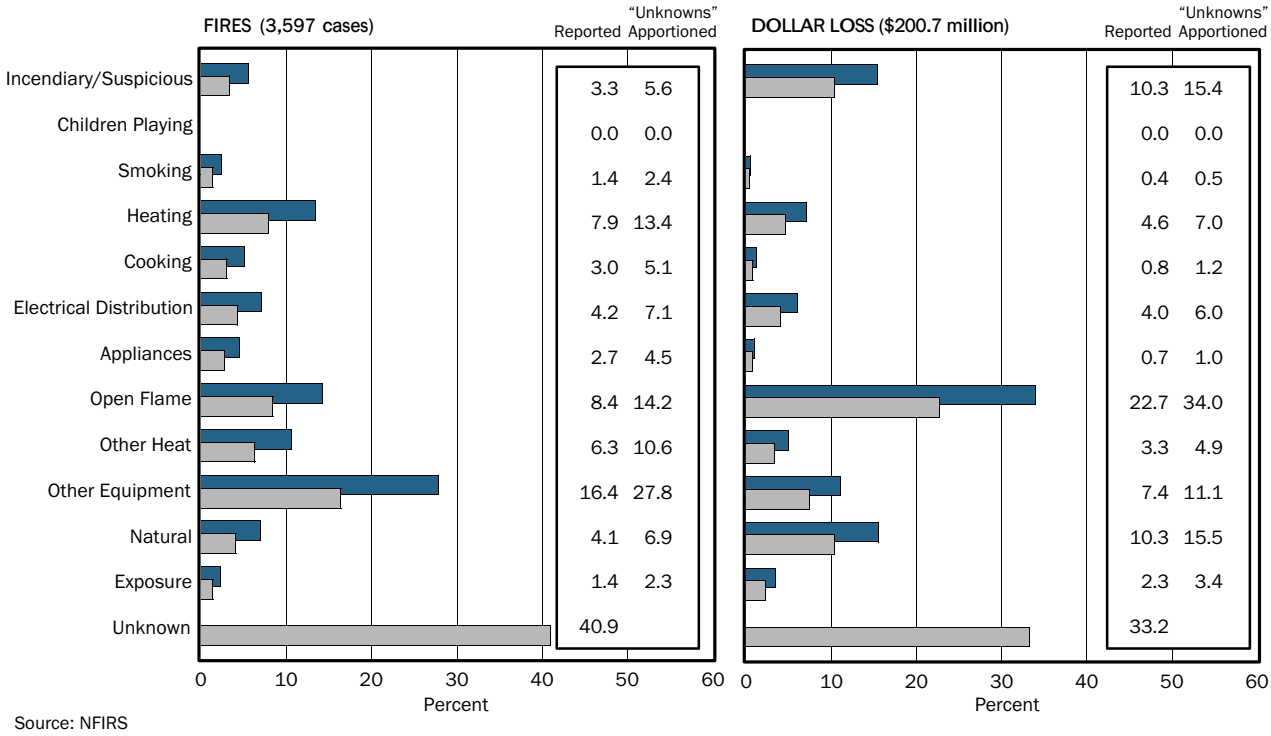
Source: NFIRS

Figure 65. Causes of Store and Office Fires and Dollar Loss (2001)



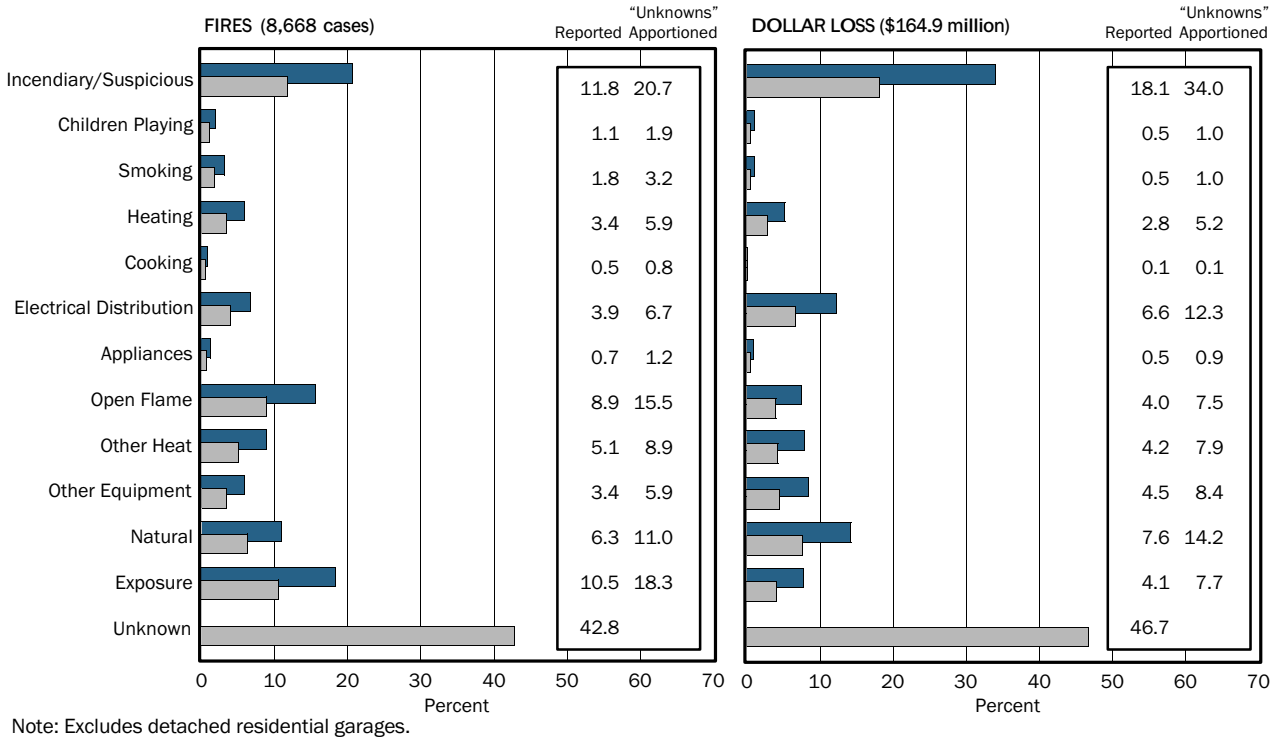
Source: NFIRS

Figure 66. Causes of Basic Industry Structure Fires and Dollar Loss (2001)



Source: NFIRS

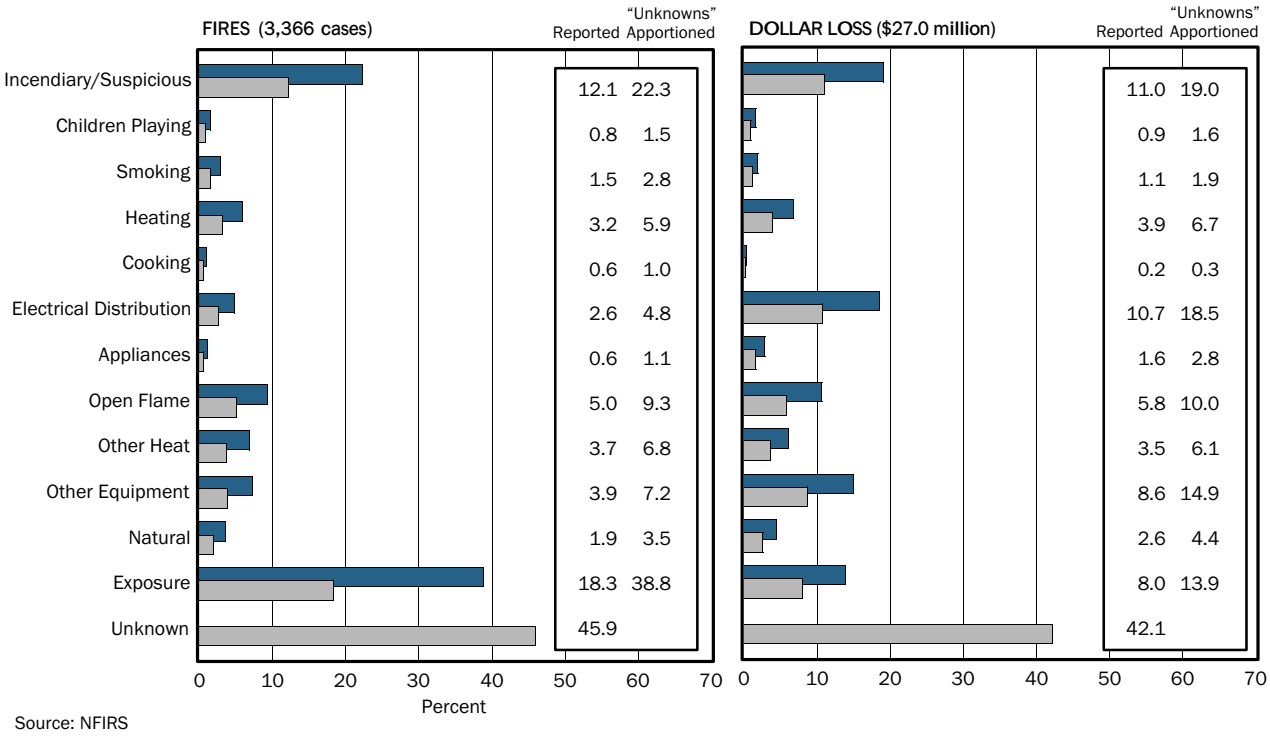
Figure 67. Causes of Manufacturing Structure Fires and Dollar Loss (2001)



Note: Excludes detached residential garages.

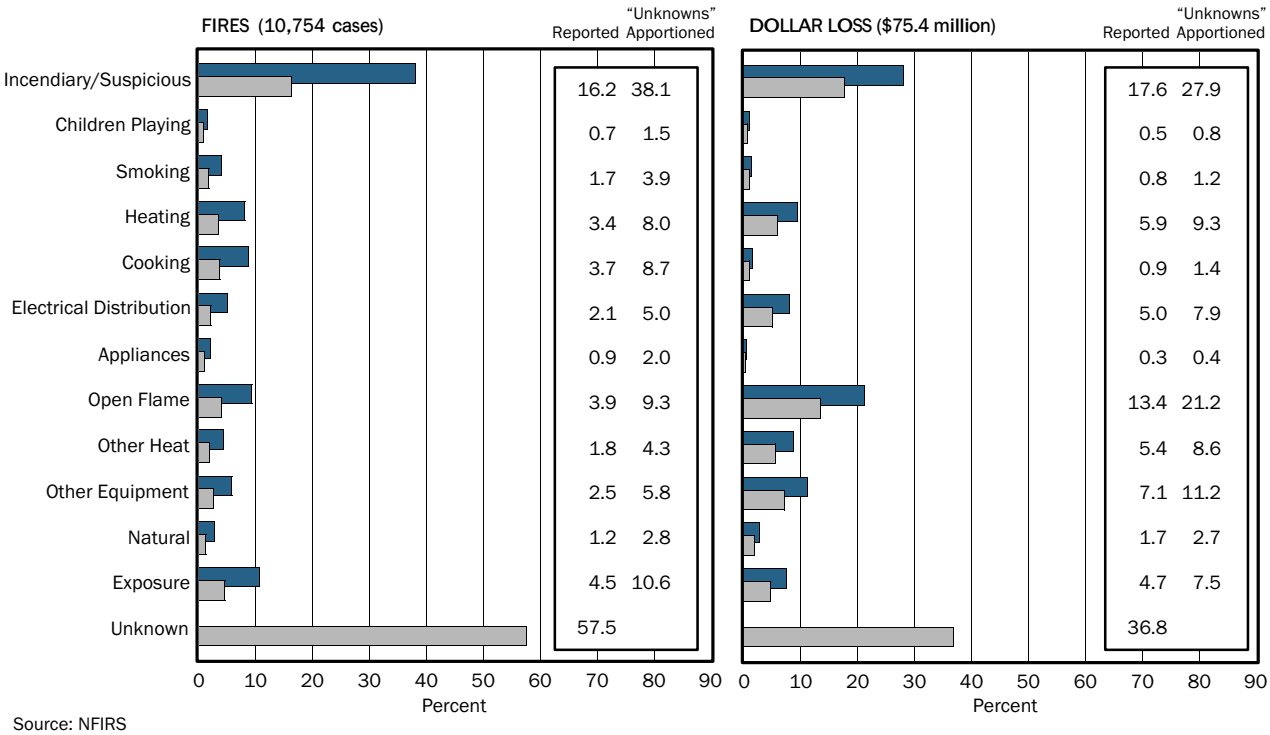
Source: NFIRS

Figure 68. Causes of Storage Structure Fires and Dollar Loss (2001)



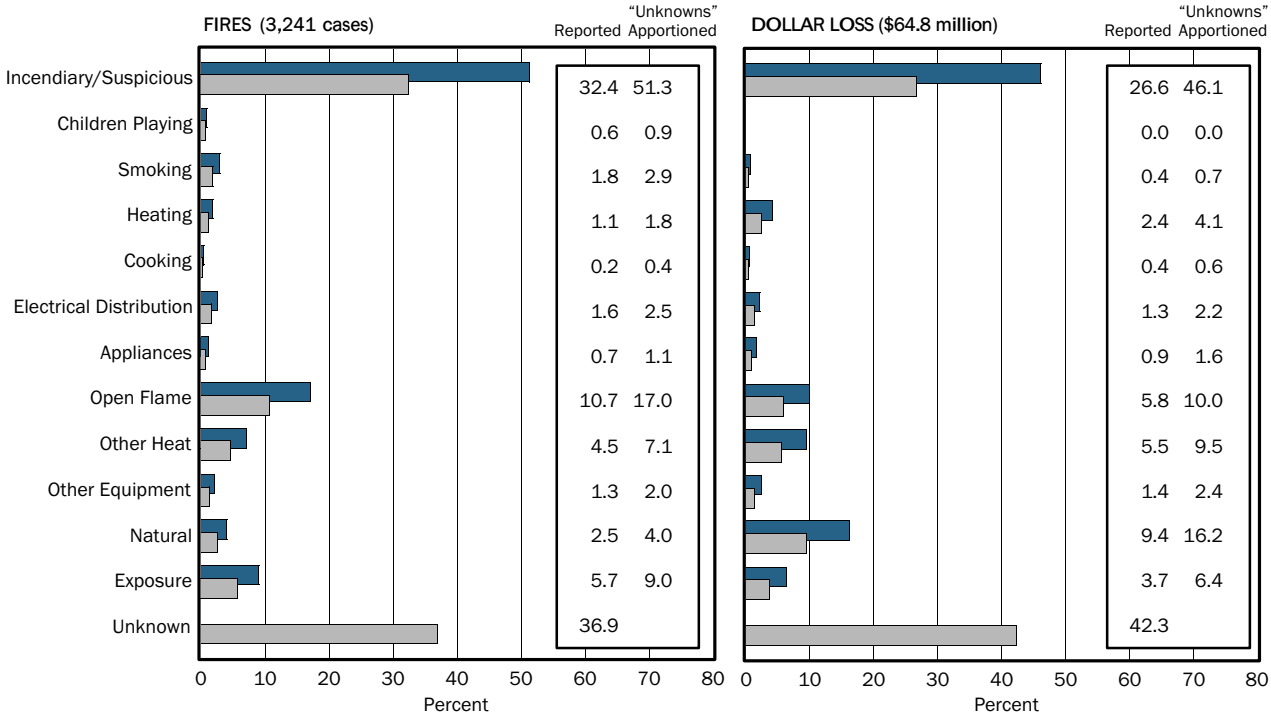
Source: NFIRS

Figure 69. Causes of Detached Residential Garage Fires and Dollar Loss (2001)



Source: NFIRS

Figure 70. Causes of Outside Structure and Unknown Fires and Dollar Loss (2001)



Note: NFIRS 5.0 assigns vacant fire incidents to a property use category based on the last primary use of that property; likewise, construction fire incidents are assigned to the primary use planned for that property.

Source: NFIRS

Figure 71. Causes of Vacant and Construction Fires and Dollar Loss (2001)

- Storage structures: Exposure fires increased from 10 percent in 1998 to 18 percent in 2001.
- Detached garages: Exposure fires increased from 20 percent in 1998 to 39 percent in 2001.
- Outside structure/unknown properties: Property loss from open flame fires quadrupled from 5 percent in 1998 to 21 percent in 2001.

Table 19 compares the leading cause of fires and dollar loss in 1996, 1998, and 2001 by each property type. Arson, the leading cause of fires and dollar loss in most property types, is clearly a major U.S. fire problem. Electrical distribution and open flame were also major contributors to fires and losses, and cooking was a factor in those non-residential structures that had kitchens.

Table 19. Comparison of Leading Causes of Non-Residential Structure Fires and Dollar Loss*

Property Type	Fires			Dollar Loss		
	1996	1998	2001	1996	1998	2001
Public Assembly	Arson	Arson	Arson	Arson	Arson	Arson
Eating, Drinking	Cooking	Cooking	Cooking	Cooking	Arson	Arson
Educational	Arson	Arson	Arson	Arson	Arson	Arson
Institutional	Arson	Arson	Cooking	Arson	Arson	Arson
Stores, Offices	Electrical Distribution	Electrical Distribution	Arson	Arson	Arson	Arson
Basic Industry	Electrical Distribution	Other Equipment	Electrical Distribution	Other Equipment	Appliances	Electrical Distribution
Manufacturing	Other Equipment	Other Equipment	Other Equipment	Other Equipment	Other Equipment	Open Flame
Storage	Arson	Arson	Arson	Other Equipment	Arson	Arson
Outside Structures, Unknown	Arson	Arson	Arson	Arson	Arson	Arson

*Detached residential garages and vacant/under construction properties not shown.

Source: NFIRS

Vacant and Under Construction

In previous editions, vacant and under construction properties were treated as a separate property type. Since 1999, fires at such sites have been categorized by their intended property use. Vacant and under construction is a property attribute that can now apply to properties of any use designation.

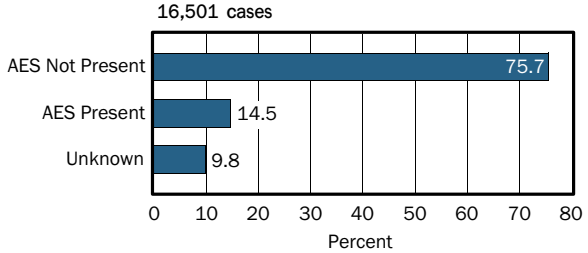
Vacant properties and properties under construction have long been a concern as the most dangerous fires often occur there. Many of these buildings are in areas that are not wholly secured. Fires are started when no one is around and the fire has the opportunity to grow

unchecked before the fire department is called. As shown in Figure 71, these fires are frequently arson-related as has been the case in previous years.

Presence of Automatic Extinguishing Systems

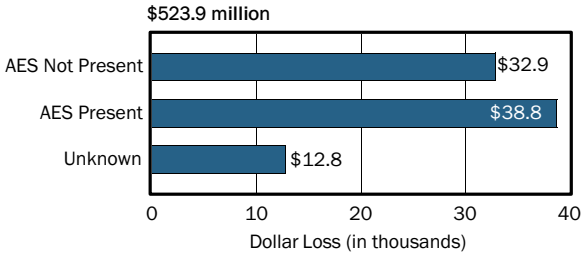
Figure 72 shows that automatic extinguishing systems (AESs) were present in 15 percent of reported fires in 2001 ("unknowns" apportioned). Although 15 percent is a relatively small number, it is considerably higher than what was found in one- and two-family dwellings (1 percent) and apartments (8 percent). This is not unexpected since commercial properties, institutions, and public assembly sites tend to occupy large structures that have been built to strict construction codes. Additionally, owners and proprietors of such sites have great incentive for protecting the structures' contents.

Figure 73 shows the property loss per fire when AESs are and are not present. When present, the property loss in 2001 was $38,800; when not present, the loss was valued at $32,900.



Note: Fires reported as confined are excluded.
Source: NFIRS 5.0 data only

Figure 72. Presence of Automatic Extinguishing Systems in Non-Residential Structure Fires (2001)



Note: Fires reported as confined are excluded.
Source: NFIRS 5.0 data only

Figure 73. Dollar Loss Per Non-Residential Structure Fire as a Function of AES Presence (2001)

How effective are AESs? Empirically, Figure 73 does not seem to support the conclusion that AESs are effective in limiting dollar losses. However, comparisons need to be made for similar properties with similar fire loads, with and without comparable AESs, but NFIRS data alone are insufficient for this comparison. Since NFIRS combines properties of different sizes and values in the same fixed property class, the data need to be viewed cautiously. AESs are more likely to be installed in large and highly valued properties than in small, inexpensive ones. A system in a large warehouse may do an excellent job of containing a fire and yet the loss for the fire may be larger than for a fire in a systemless small storage building.

VEHICLES AND OTHER MOBILE PROPERTIES

Transportation fires account for a larger portion of the fire problem than many people realize. In 2001, vehicles accounted for 13 percent of fire deaths overall, 9 percent of fire injuries, 14 percent of dollar losses, and 20 percent of all reported fires—nearly one in every five fires.[4]

The vast majority of fires, casualties, and property losses from mobile property involve cars and trucks, with cars clearly dominating this group. Fire departments respond to about as many fires involving vehicles as they do to fires involving residences.

Overview of Trends

The trends in mobile property fires, fire deaths, injuries, and dollar losses are shown in Figure 74. The number of fires continues to decrease (17 percent) according to NFPA estimates. Fire deaths and injuries have trended down sharply (32 and 42 percent, respectively). The downward trend of mobile property fire deaths would have been even greater, but in 1996 the aviation industry suffered two catastrophes: the ValueJet crash in May, killing 109 people, and the TWA crash in July, resulting in 230 deaths. These two disasters account for nearly 48 percent of the 710 mobile property fire-related deaths reported in the NFPA 1996 annual survey. The mobile property dollar loss trend increased 19 percent even as the other trends declined. Each year, the costs of new vehicles increase. If these costs exceed inflation, they may help explain the rise in the property loss trend.

Types of Vehicles

Figure 75 shows that the vast majority of mobile property fires and losses are from highway vehicles. The complexity and ambiguity in counting losses associated with accidents are described in a later section titled "Special Data Problems." Although the 10-year trend in highway vehicle fires, deaths, and injuries show substantial decreases (19, 26, and 44 percent, respectively), the dollar loss has trended up 17 percent.

Figure 76 gives more details on the relative proportions of the reported fire problem by type of vehicle in 2001. Automobiles and other passenger vehicles such as vans and buses dominate the mobile property picture. Automobiles are involved in 12 times as many fires as trucks (freight) and result in larger numbers of casualties and a larger dollar loss. On a per-incident basis, however, trucks have the more serious problem with 50 percent more deaths per fire and well over twice the injuries and property loss per fire (Table 20).

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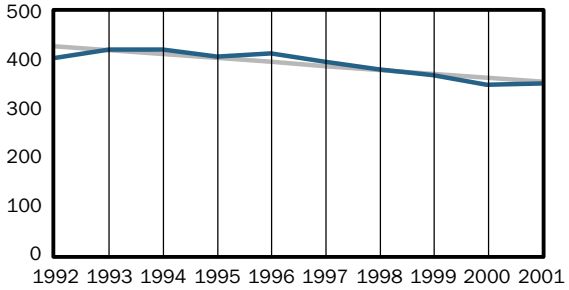
[4] Percentages are derived from summary data presented in NFPA's annual survey, 2001.

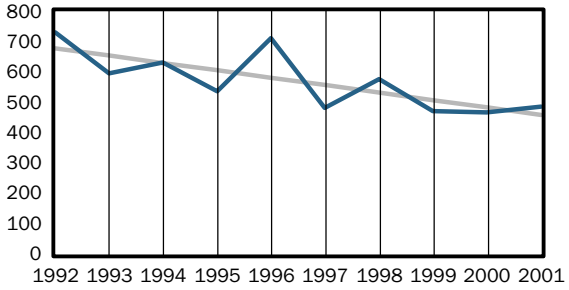
FIRES (in thousands)



1992	405.0	1997	397.0
1993	420.5	1998	381.0
1994	422.0	1999	368.5
1995	406.5	2000	348.5
1996	413.5	2001	351.5

10-Year Trend = –17.1%

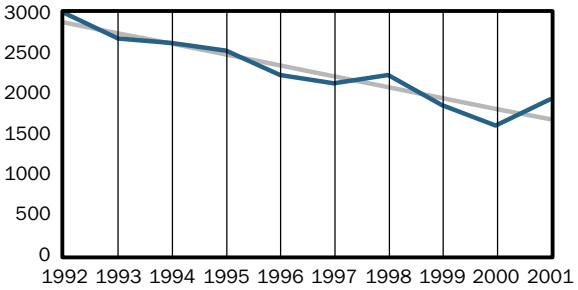
DEATHS



1992	730	1997	480
1993	595	1998	575
1994	630	1999	470
1995	535	2000	465
1996	710	2001	485

10-Year Trend = –32.4%

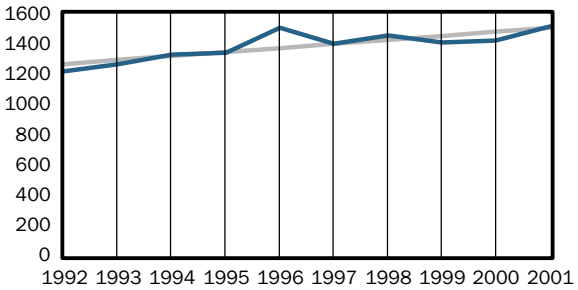
INJURIES



1992	3,000	1007	2,125
1993	2,675	1998	2,225
1994	2,625	1999	1,850
1995	2,525	2000	1,600
1996	2,225	2001	1,925

10-Year Trend = –41.8%

DOLLAR LOSS (in $ billions)*



1992	$1.22	1007	$1.40
1993	1.26	1998	1.45
1994	1.33	1999	1.41
1995	1.34	2000	1.42
1996	1.51	2001	1.51

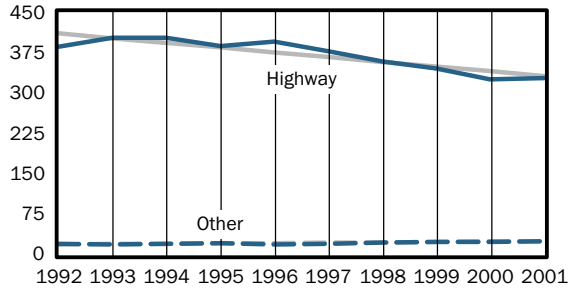
10-Year Trend = +18.9%

*Adjusted to 2001 dollars

Sources: NFPA and Consumer Price Index

Figure 74. Trends in Mobile Property Fires and Fire Losses

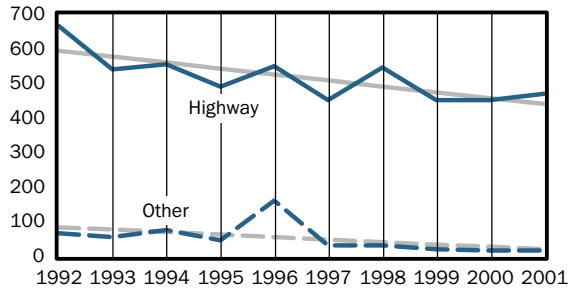
FIRES (in thousands)



	Highway	Other		Highway	Other
1992	385.5	19.5	1997	377.0	20.0
1993	402.0	18.5	1998	358.5	22.5
1994	402.0	20.0	1999	345.0	23.5
1995	386.0	20.5	2000	325.0	23.5
1996	395.0	18.5	2001	327.0	24.5

10-Year Highway Trend = –19.3%
10-Year Other Trend = +31.4%

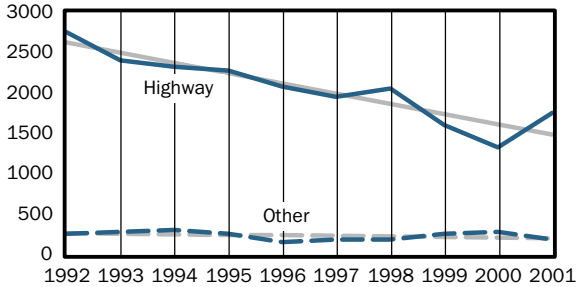
DEATHS



	Highway	Other		Highway	Other
1992	665	65	1997	450	30
1993	540	55	1998	545	30
1994	555	75	1999	450	20
1995	490	45	2000	450	15
1996	550	160	2001	470	15

10-Year Highway Trend = –26.1%
10-Year Other Trend = –77.4%

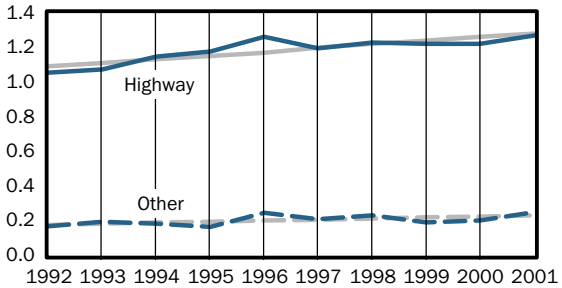
INJURIES



	Highway	Other		Highway	Other
1992	2,750	250	1997	1,950	175
1993	2,400	275	1998	2,050	175
1994	2,325	300	1999	1,600	250
1995	2,275	250	2000	1,325	275
1996	2,075	150	2001	1,750	175

10-Year Highway Trend = –43.6%
10-Year Other Trend = –23.8%

DOLLAR LOSS (in $ billions)*



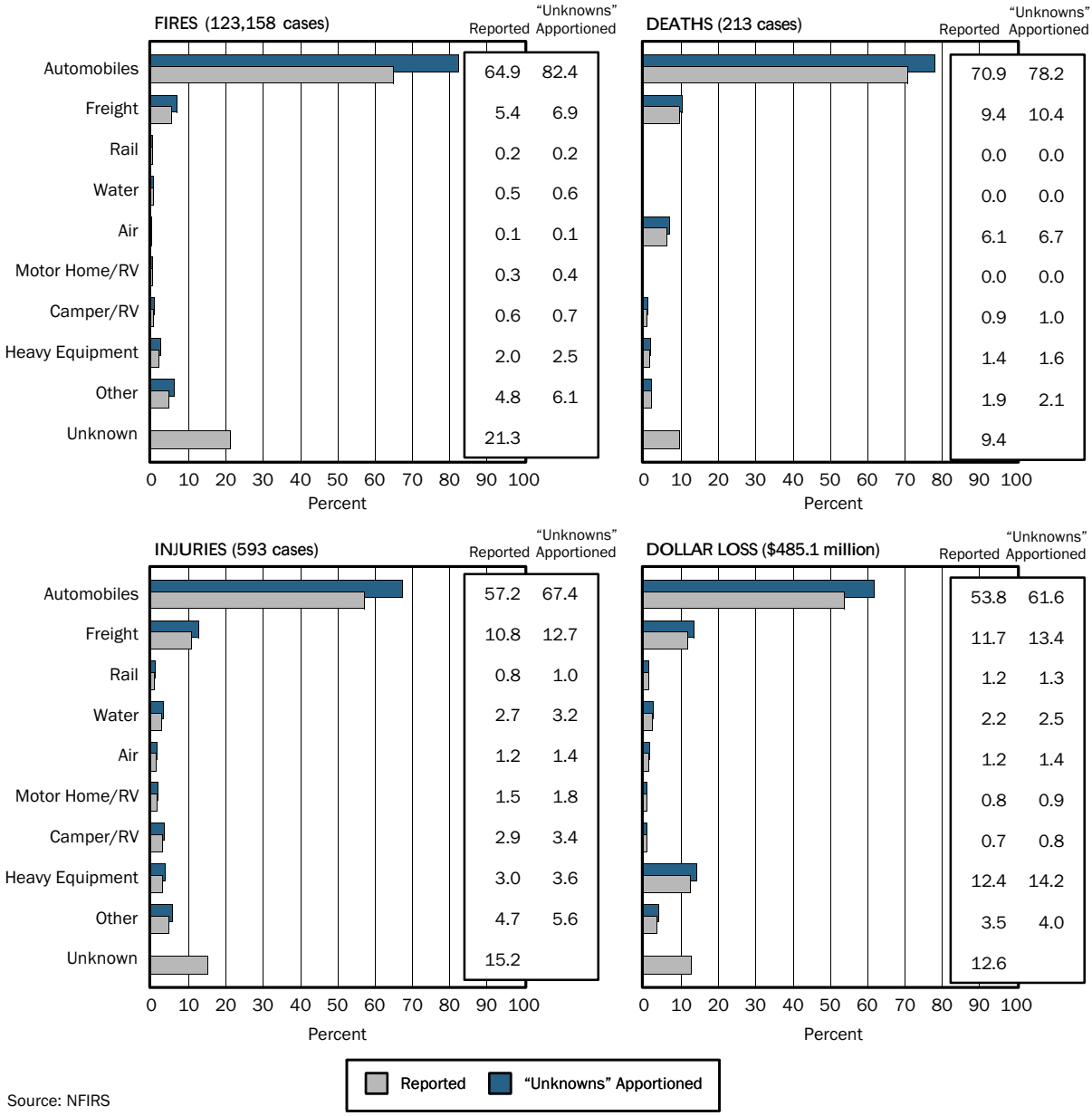
	Highway	Other		Highway	Other
1992	$1.05	$0.165	1997	$1.20	$0.204
1993	1.07	0.190	1998	1.23	0.226
1994	1.15	0.179	1999	1.22	0.186
1995	1.18	0.162	2000	1.22	0.200
1996	1.26	0.244	2001	1.27	0.245

10-Year Highway Trend = +17.4%
10-Year Other Trend = +30.7%

Sources: NFPA and Consumer Price Index

*Adjusted to 2001 dollars

Figure 75. Trends in Highway vs. Other Mobile Property Fires and Fire Losses



Source: NFIRS

Figure 76. Mobile Property Fires and Fire Losses by Vehicle Type (2001)

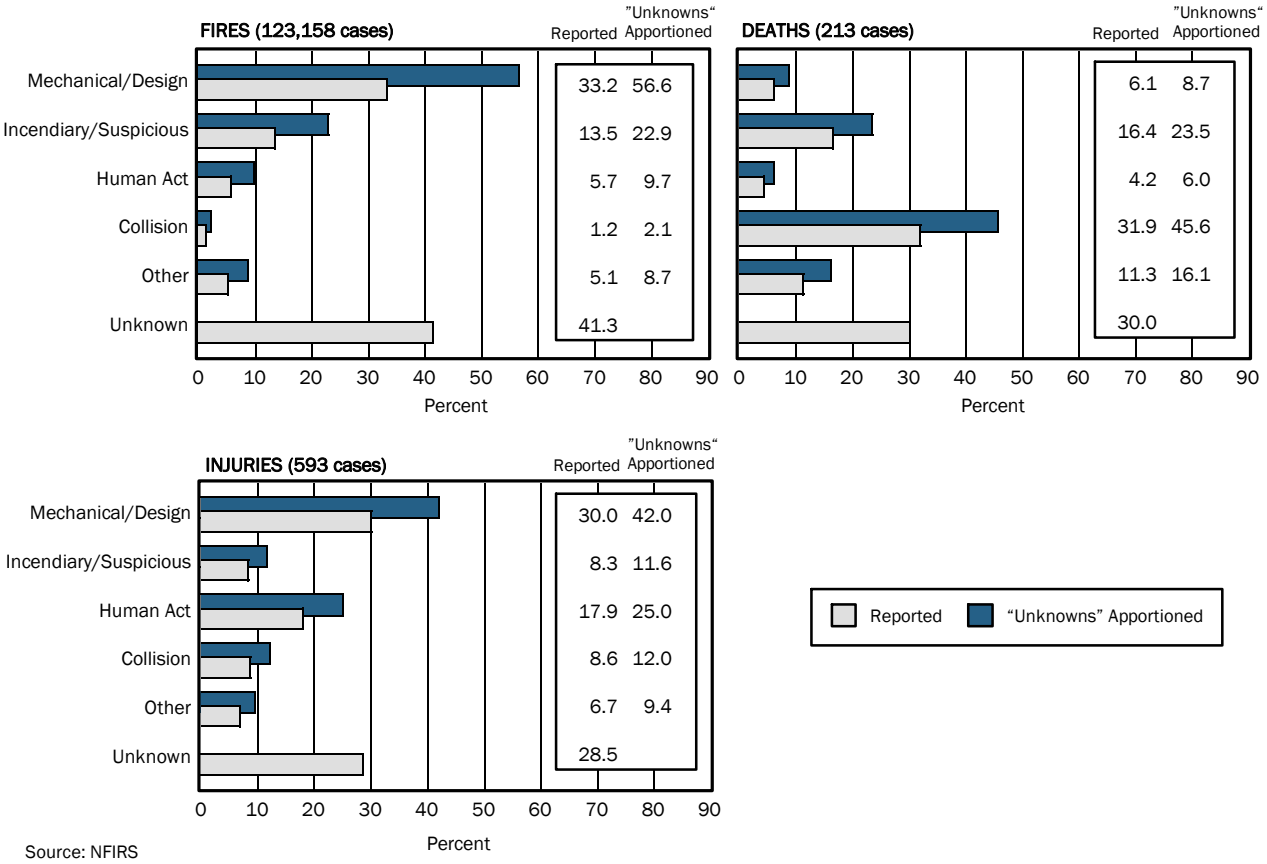
Table 20. Casualty and Dollar Loss Rates for Passenger and Freight Vehicles (2001)

VehicleType	Deaths Per 1,000 Fires	Injuries Per 1,000 Fires	Dollar Loss Per Fire
Passenger	1.9	4.2	$3,300
Road, freight, or transport	3.0	9.6	$8,500

Source: NFIRS

Causes

For the most part, vehicle fires have one of four origins: the aftermath of a collision, the result of a mechanical failure, the result of an act of carelessness, or the result of arson. Most vehicle deaths are from trauma following a collision; only 2 percent of collision deaths are the result of fire.[5] However, 46 percent of mobile property fire deaths occur in vehicle collisions (Figure 77). Preventing such fires is largely the purview of the U.S. Department of Transportation, state and local motor vehicle agencies, and the police, but fire departments are almost always called to the scene when there is a fire or the potential for a fire.



Source: NFIRS

Figure 77. Ignition Factors for Mobile Property Fires and Fire Casualties (2001)

Mechanical or design problems, such as broken fuel lines, faulty catalytic converters, blown tires, and overheating, are the ignition factor for 57 percent of all fires in vehicles and 42 percent of the associated injuries.

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[5] National Highway Traffic Safety Administration, Research and Development, B.01.17 Fire Safety Research, updated 06/00, http://www-nrd.nhtsa.dot.gov/departments/nrd-01/summaries/B0117.html. This 2000 research document notes that the National Highway Traffic Safety Administration (NHTSA) estimates that 310 deaths are caused by post-collision vehicle fires. This estimate is in the same order of magnitude of fire data estimates (46 percent of the 485 mobile property fire deaths or approximately 225 deaths).

Fires of incendiary or suspicious origin account for 23 percent of mobile property fires. Many vehicle fires are not investigated for arson, though some insurance companies are investigating the most suspicious or obviously incendiary fires before paying insurance claims. However, the arson problem may well be understated because of the limited effort available to spend on investigations of these incidents.

Carelessness (human act) includes causes such as cigarettes dropped on the upholstery, distractions such as eating or cell phone use, parking over dry leaves with a hot catalytic converter, and misuse of flammable liquids, especially gasoline, while servicing or maintaining the car. Carelessness in mobile properties accounts for 10 percent of fires, 6 percent of deaths, and 25 percent of injuries.

In each of the past 10 years, the top ignition factors for fires (mechanical/design), deaths (collision), and injuries (mechanical/design) have remained the same (Figure 78). Fire deaths and injuries from collisions fluctuate from year to year, but they reached 10-year lows in 2001 and their 10-year trends were down 49 and 57 percent, respectively (Table 21). Fires and deaths from mechanical or design factors dropped to their lowest levels in 2001. These encouraging results are partly because newer vehicles are equipped with improved safety features.

Table 21. Trends by Leading Causes of Ignition in Mobile Properties (1992–2001) (percent)

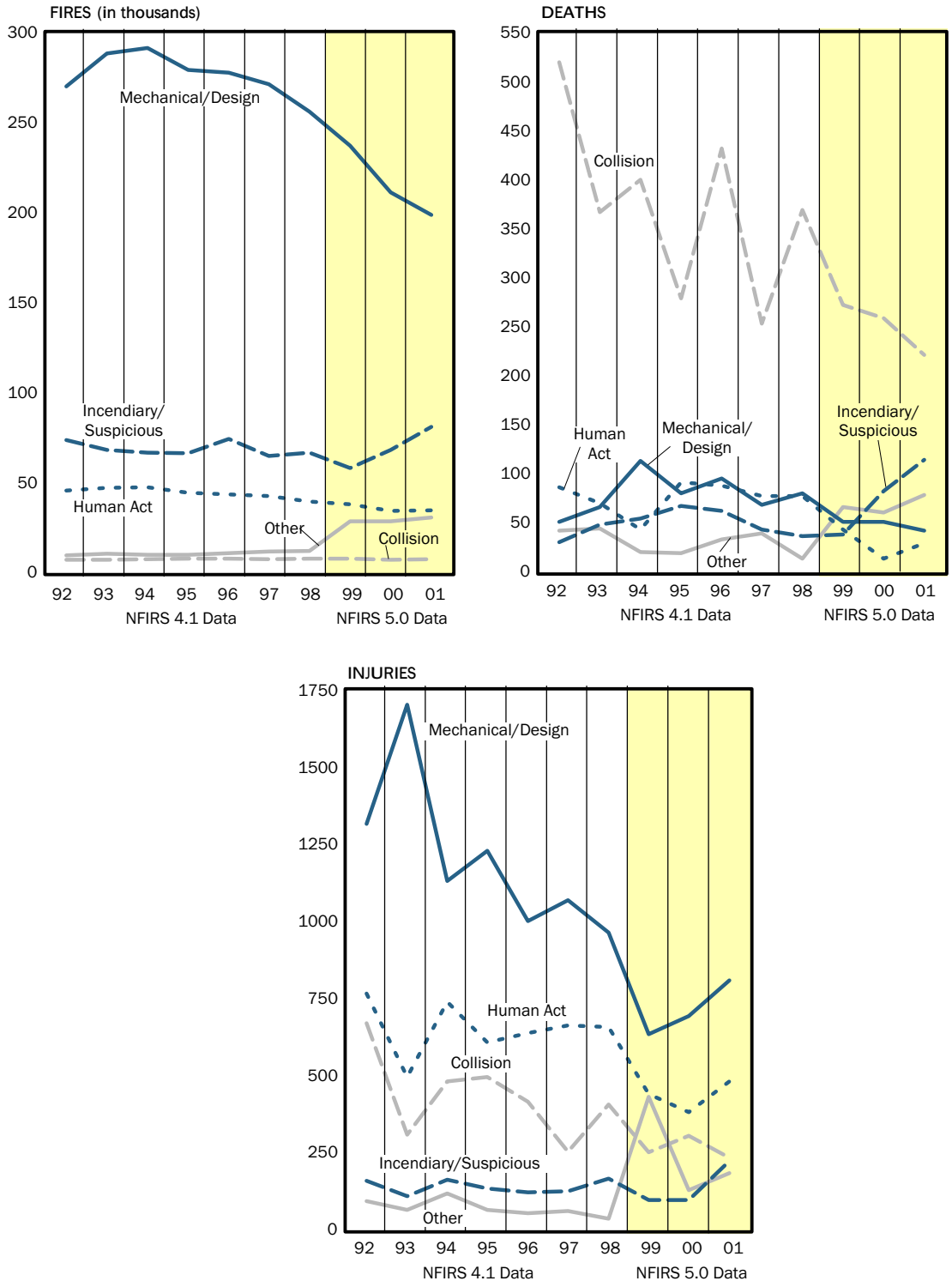
Ignition Factor	Fires	Deaths	Injuries
Incendiary/Suspicious	+1.0	+123.1	+10.9
Collision	+4.6	–48.8	–56.8
Human Act	–28.6	–59.8	–36.1
Mechanical/Design	–27.8	–34.0	–55.5

Sources: NFIRS and NFPA; data provided in Appendix B, Table B-7.

Because automobile fires are such a large part of the entire mobile property fire problem, the cause profiles for automobile fires in 2001 are very similar to those for mobile properties (Figure 79 compared to Figure 77).

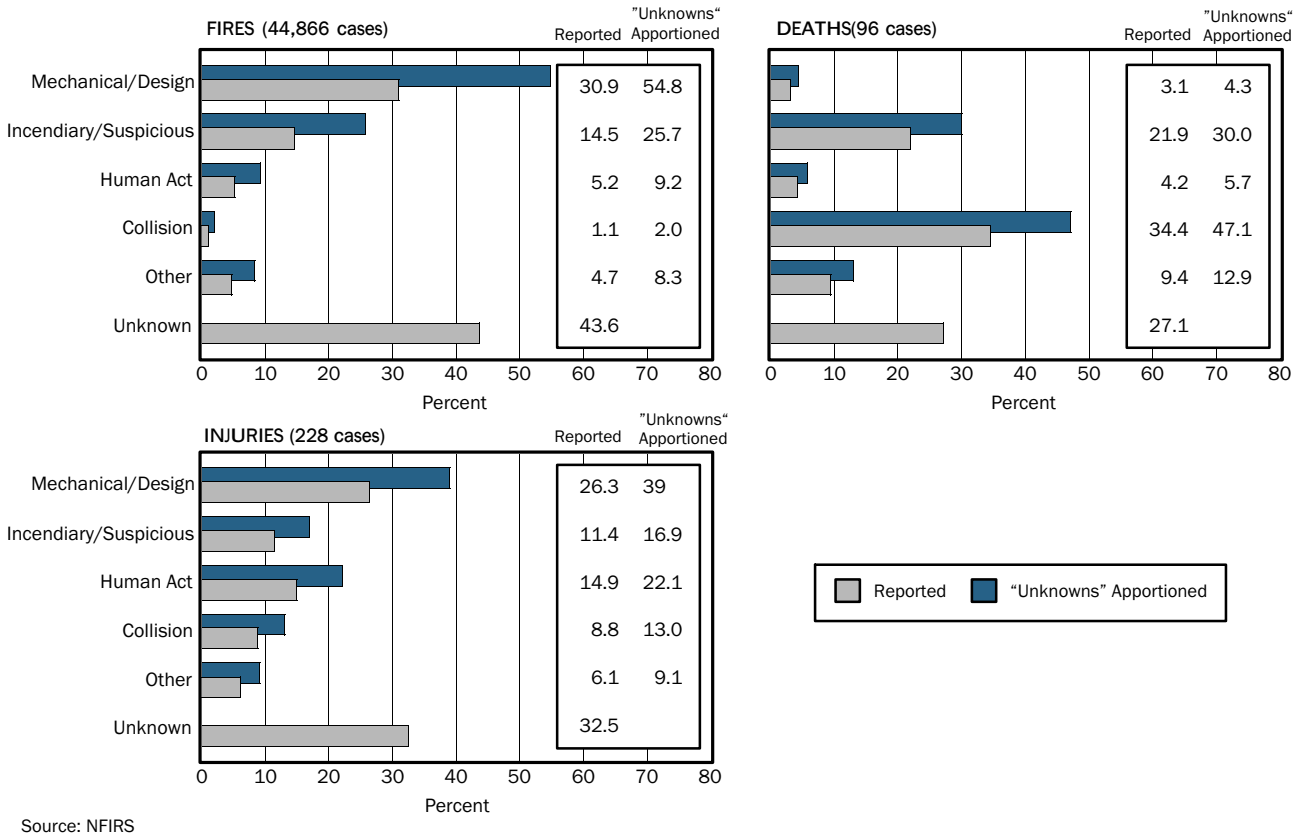
Special Data Problems

When there are fatalities associated with a mobile property accident such as a collision between two cars, it is often difficult to determine whether the fatalities were the result of the mechanical forces or the fire that ensued. Because of the very large number of vehicle fatalities occurring in this country each year and the frequency of fires associated with these accidents, there can be a significant error in estimating the total number of fire deaths if this issue is not carefully addressed. A fire fatality should be counted only if a person was trapped and killed by the fire, rather than killed on impact and subsequently exposed to the fire.



Sources: NFIRS and NFPA; data provided in Appendix B, Table B-7.

Figure 78. Trends in Ignition Factor Causes of Mobile Property Fires and Fire Casualties



Source: NFIRS

Figure 79. Ignition Factors for Automobile Fires and Fire Casualties (2001)

OUTSIDE AND OTHER PROPERTIES

The outside and other properties category includes all fires that are not structure or vehicle fires. In NFIRS terminology, this includes fires where the type of situation found is outside of the structure either where the burning material has a value or where the fire is confined to trees, brush, grass, or refuse. A subset of outside fires is wildland fires. Grouped in the "other" category are fires whose situation found is not classified, flammable liquid spills out of doors with ensuing fires, and explosions.

Outside and other fires comprise roughly 50 percent of all fires. This proportion has remained steady over the 10 years. Although large in number, they accounted for only 1 percent of fire deaths in 2001, 6 percent of reported injuries, and 2 percent of reported property losses.[6] These numbers may not, however, reflect the true nature of the problem because of under-reporting and the difficulty in setting a pricetag on outside fires. Also, many wildland fires are not reported to agencies reporting to NFIRS or to the NFPA annual survey.

[6] These percentages are derived from summary data presented in NFPA's annual survey, 2001.

Overview of Trends

Figure 80 shows the trends in outside and other fires. The numbers of reported outside fires alone are enormous—averaging 776,000 each year. The other category of fires adds, on average, an additional 140,000 fires to this already large number of fires. Over 10 years, an average of 55 deaths resulted each year from outside fires plus the miscellaneous other properties not covered elsewhere; injuries averaged 1,360. Although deaths have a 10-year downward trend of 29 percent, this is due primarily to the fluctuations in the small numbers of deaths; injuries have trended upward 12 percent. Dollar loss for outside properties trended down 15 percent, even including a $390 million timber loss in 1998 Florida wildfires. The spike in 1992 reflects a $250 million timber loss.

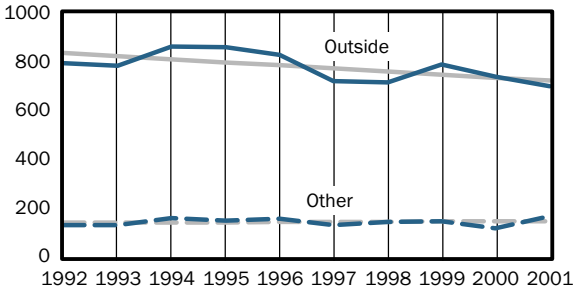
Estimating dollar loss for these fires is difficult. To illustrate this problem, consider Table 22, a comparison of property loss from outside fires derived from NFPA's annual survey and from NFIRS data. The average total loss reported in the NFIRS sample and the NFPA estimate is not remarkably different—$155 million vs. $190 million. The NFIRS sample, however, is slightly less than half the fires reflected in the NFPA survey. For 7 of the 10 years, in fact, the NFIRS total loss for outside fires exceeds the NFPA estimate. If NFIRS data were extrapolated to the NFPA estimate for fires, the NFIRS average loss for outside fires would be in the neighborhood of $300 to $350 million. Part of the difference in property loss estimates is because NFPA assigns property loss for outside fires "with value," whereas NFIRS permits property loss data collection for any fire. Which method is correct? Both are reasonable approaches but neither may be definitive.

Table 22. Comparison of NFPA and NFIRS Outside Fires Loss (millions of 2001 dollars)

	NFPA Estimates	USFA Raw Data
1992	$401.4*	$202.5
1993	77.2	194.0
1994	143.4	180.4
1995	89.5	142.7
1996	102.7	203.1
1997	109.2	165.9
1998	540.0*	133.8
1999	130.8	100.5
2000	220.1	159.5
2001	86.0	62.4
Average	$190.0	$154.5

*Includes large timber loss fires of $250 million (1992) and $390 million (1998) not reported to NFIRS.

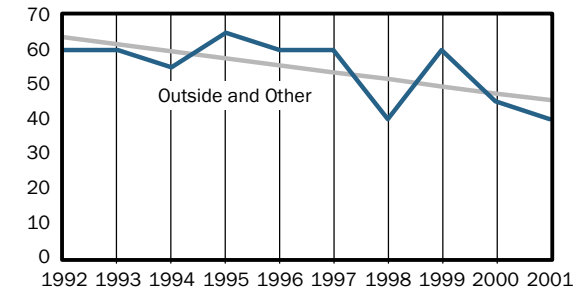
FIRES (in thousands)



	Outside	Other		Outside	Other
1992	793.5	128.5	1997	719.0	127.0
1993	783.5	127.0	1998	715.0	142.0
1994	861.5	157.0	1999	788.5	143.0
1995	838.5	147.0	2000	738.5	115.5
1996	828.5	154.5	2001	697.5	164.0

10-Year Outside Trend = –13.3%
10-Year Other Trend = +5.0%

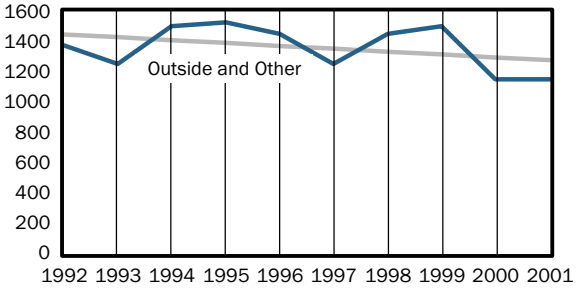
DEATHS



1992	60	1997	60
1993	60	1998	40
1994	55	1999	60
1995	65	2000	45
1996	60	2001	40

10-Year Outside and Other Trend = –28.7%

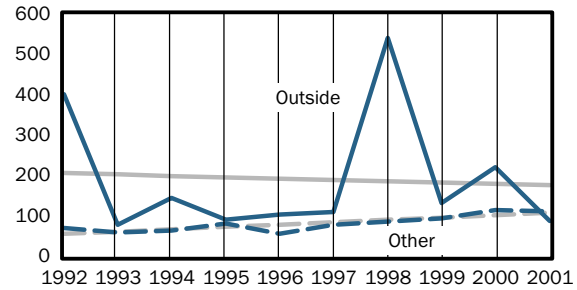
INJURIES



1992	1,375	1997	1,250
1993	1,250	1998	1,450
1994	1,500	1999	1,500
1995	1,525	2000	1,150
1996	1,450	2001	1,150

10-Year Outside and Other Trend = +11.9%

DOLLAR LOSS (in $ millions)*



	Outside	Other		Outside	Other
1992	$401.4	$ 69.4	1997	$109.2	$ 77.2
1993	77.2	57.6	1998	540.0	84.7
1994	143.4	63.3	1999	130.8	92.5
1995	89.5	80.2	2000	220.1	114.2
1996	102.7	55.3	2001	86.0	111.0

10-Year Outside Trend = –14.5%
10-Year Other Trend = +95.1%

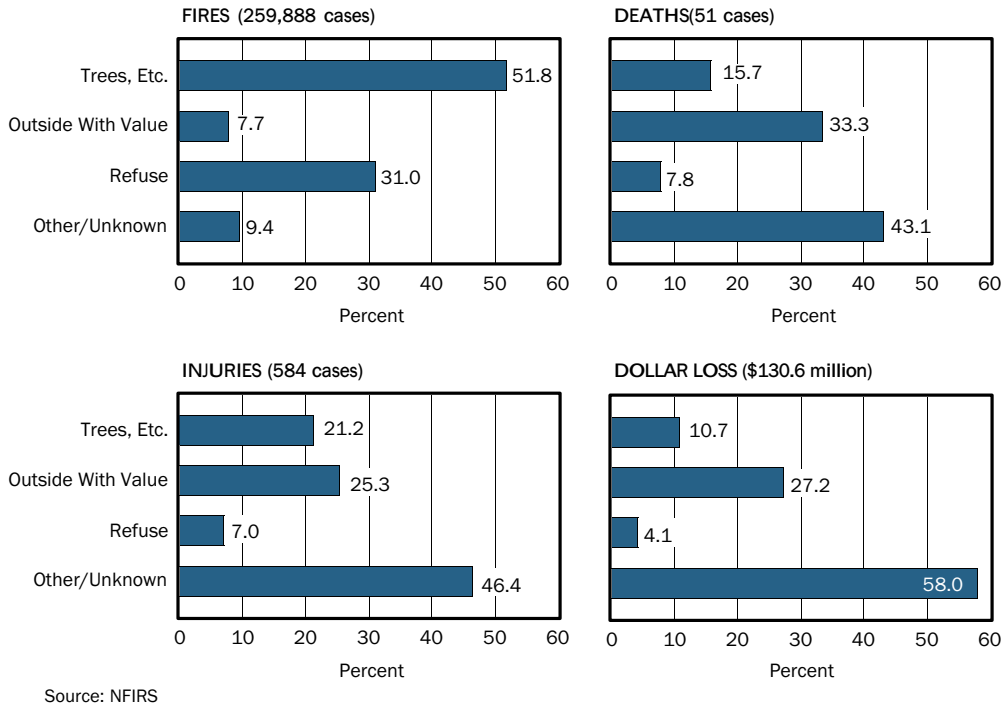
Sources: NFPA and Consumer Price Index

*Adjusted to 2001 dollars

Figure 80. Trends in Outside and Other Property Type Fires and Fire Losses

Property Types

Figure 81 shows the relative proportions of the four components of reported outside and other fires for 2001. Trees, brush, and grass fires account for more than half of all outside fires. In a large portion of deaths, injuries, and dollar losses, the outside property type is undetermined.

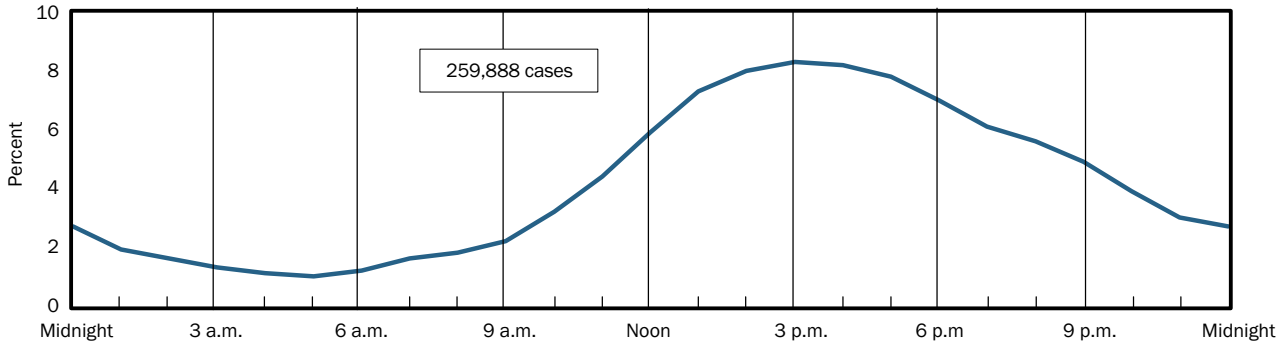


Source: NFIRS

Figure 81. Outside Fires and Fire Loss by Property Type (2001)

When Fires Occur

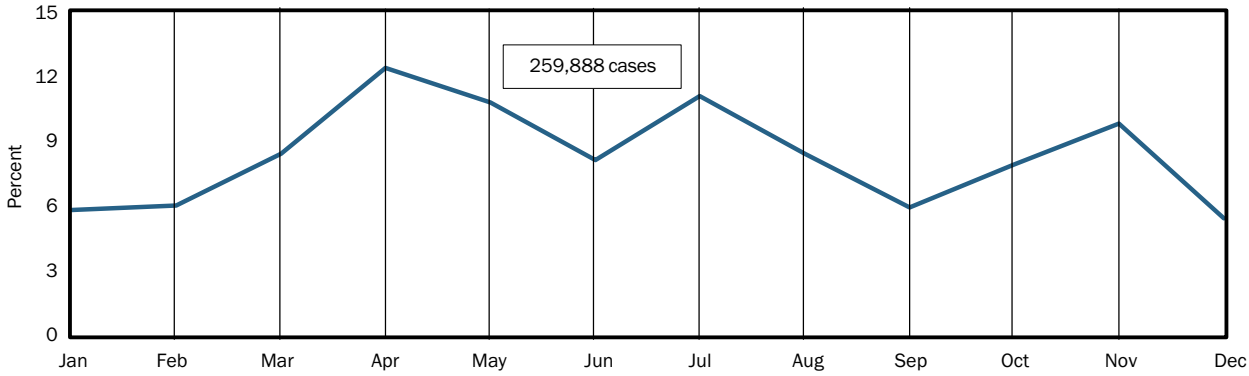
TIME OF DAY. Figure 82 shows a very interesting and clear profile for when outside and other fires are reported. At 8 a.m., fires begin to increase. They steadily rise to a peak at 3 p.m., at which time they steadily drop until 6 a.m.



Source: NFIRS

Figure 82. Time of Day of Outside and Other Fires (2001)

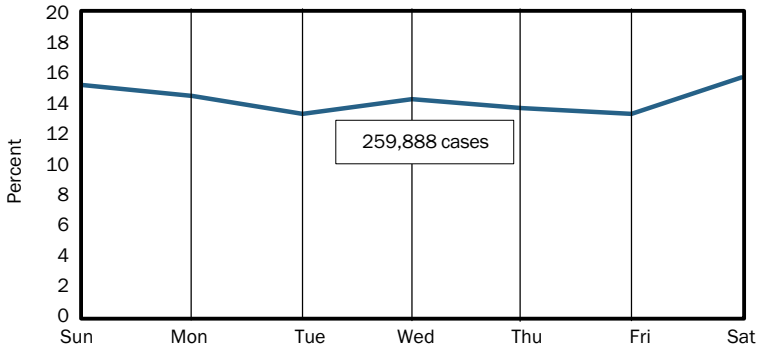
MONTH OF YEAR. Outside and other fires are usually lowest in the fall and winter months and highest during spring and summer (Figure 83). In 2001, April was the month with the highest number of fires. An increase in brush fires may have caused the July peak. In recent years, local and state governments have placed more rigorous restrictions on burning leaves, which help suppress autumn fires. Climate (rainfall, wind) also plays a major role in any one year on the number and severity of fires. What is known is that wildland fires tend to have two peaks—one in the spring and one in the fall.



Source: NFIRS

Figure 83. Month of Year of Outside and Other Fires (2001)

DAY OF WEEK. Outside fires are highest on the weekend, a time when more people are outdoors (Figure 84). This pattern is unchanged over the 10 years.

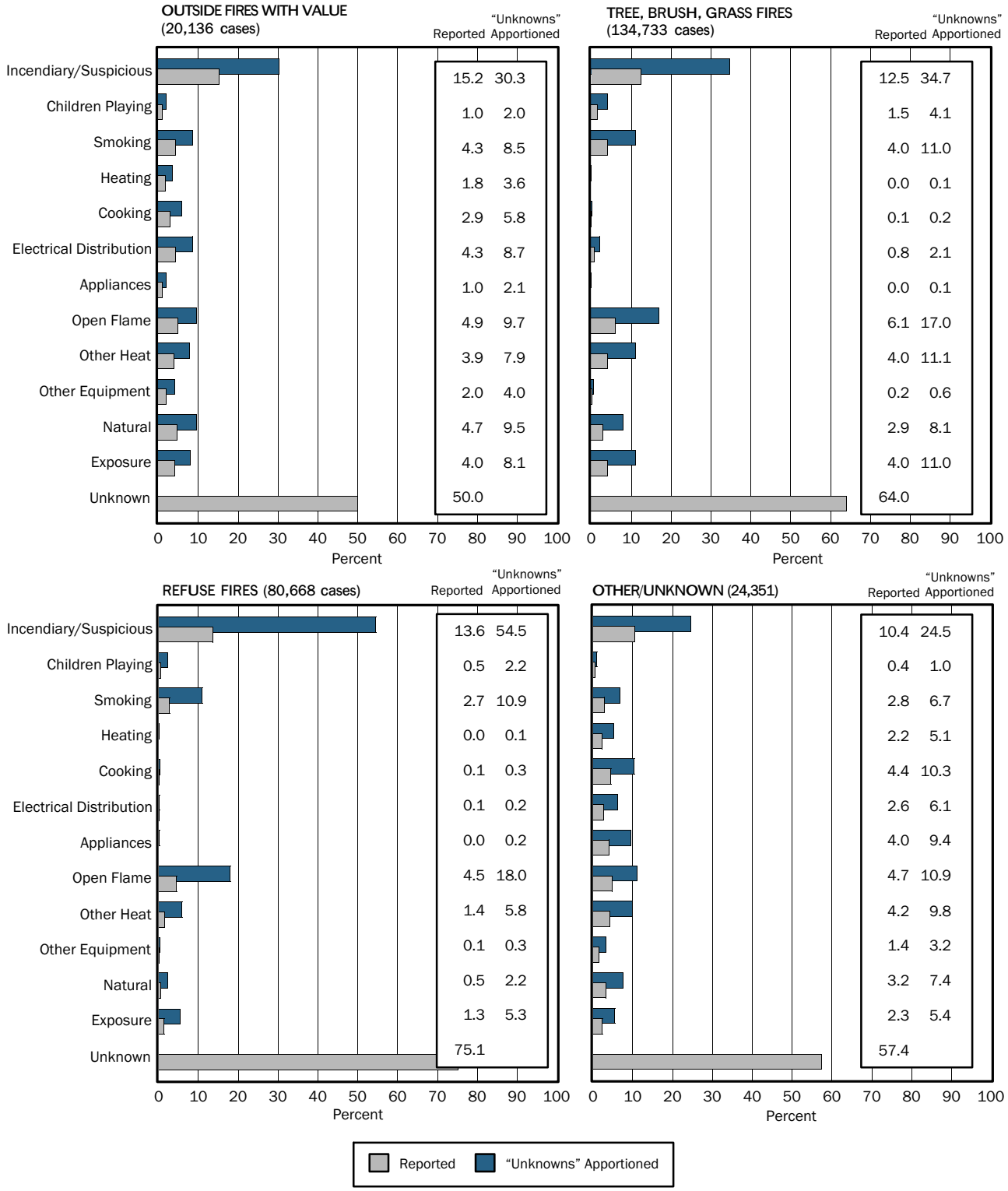


Source: NFIRS

Figure 84. Day of Week of Outside and Other Fires (2001)

Causes

As in all years, the leading cause of all forms of outside fires is arson, with many thought to be set by children and adolescents. Figure 85 shows the cause profiles for each outside or other fire category. A high percentage of outside fires have unknown causes and, as discussed under



Source: NFIRS

Figure 85. Causes of Outside Fires by Property Type (2001)

the "special data problems" section, there is little that can be done to improve this reporting. The 2001 statistics reflect that little has changed over the 10 years.

For outside fires with value, 30 percent of fires are attributed to arson. The rest of the fires are scattered across many categories, with open flame, natural (e.g., lightning strikes), and electrical distribution as other contributing causes.

Among the known causes of tree, brush, and grass fires, the two that stand out are arson and open flame, which includes open fires used for cooking. These two causes account for 52 percent of fires with cause. Following these are other heat, smoking, and exposure fires.

More than half of the reported causes of refuse fires were reported as arson, with another 18 percent from open flame (e.g., matches) and 11 percent from smoking. Note that refuse fires set inside buildings are structural fires, even if they do no damage, and are reported as part of the property type in which they occur.

Special Data Problems

Setting a value for outside fire damage is a perennial problem. It is difficult to assign a dollar value to grass, tree, and rubbish fires, yet the damage from these fires often requires labor beyond that of the fire department to clean up and restore the area. They also cause esthetic problems that are intangible. Some outside fires spread to structural properties and may be reported as structural fires rather than an outside fire with exposure to structures. Outside fires can have other indirect costs, such as the financial impact on agricultural communities where a fire destroys crops.

Forest fires and other wildfires to which local departments are not called will not be reported to NFIRS if the state or federal agency with principal authority for fighting the fire does not participate in NFIRS. To more fully analyze outside fires, NFIRS data need to be complemented with data from these other agencies.

Another problem with data on outside fires is determining their cause. Often the area of origin is obliterated, the people involved have fled, and one is not sure exactly what caused the fire—an unattended campfire, a discarded match or cigarette, lightning strikes, children playing, or even an intentionally set fire. Thus, the percent of causes determined as unknown is especially high for this category of fires.

USFA RESOURCES ON FIRES IN NON-RESIDENTIAL PROPERTIES

The USFA conducts special studies to address specific problems and current issues facing the nation's fire and rescue service. The technical reports produced under the Major Fires Investigations series analyze major or unusual fires with emphasis on sharing lessons learned. They are directed primarily to chief fire officers, training officers, fire marshals, and investigators as a resource for training and prevention.

The *Topical Fire Research* series for the non-residential fires problem can be downloaded from http://www.usfa.fema.gov/nfdc/inside-usfa/nfdc/pubs/tfrs.shtm:

2000 Wildland Fire Season
Agricultural Fires
Agricultural Storage Fires
Church Fires
Construction Site Fires
Day Care Center Fires
Fire Station Fires
Fires in the Wildland/Urban Interface
Grill Fires
Highway Vehicle Fires
Medical Facilities Fires
Landfill Fires
Lightning Fires
Nightclub Fires in 2000
Non-Residential Structure Fires in 2000
Outdoor Fires
Rail Terminal Fires
School Fires
Wildland Fires: A Historical Perspective

Major Fire Investigation reports on fires and other non-residential property incidents include:

$12 Million Dollar Fire at Dogwood Elementary School, Reston, VA, July 2002 (USFA–TR–135)
$15 Million Sight and Sound Theater Fire and Building Collapse, Lancaster County, PA (USFA–TR–097)
Amtrak Train Derailment, Nodaway, IA, September 2002(USFA–TR–143)
Bonfire Collapse, Texas A&M University, College Station, TX, November 1999 (USFA–TR–133)
Broward Marine Fire, Ft. Lauderdale, FL, September 1996 (USFA–TR–101)
Chicken Processing Plant Fires, Hamlet, NC, and North Little Rock, AR, September 1991 (USFA–TR–057)
Civil Disturbances, St. Petersburg, FL, October/November 1996 (USFA–TR–098)
Concept Sciences, Incorporated, Hanover Twp., PA, February 1999 (USFA–TR–127)
Conservative Approach to Chemical Plant Fire, Ventura County, CA, April 1989 (USFA–TR–029)
Crash of Two Subway Trains on the Williamsburg Bridge, New York City, NY (FA–163F)
CSX Tunnel Fire, Baltimore, MD, July 2001 (USFA–TR–140)
Derailment of the Sunset Limited, Big Bayou Canot, AL (FA–163B)
East Bay Hills Fire, Oakland–Berkeley, CA, October 1991 (USFA–TR–060)
Evacuation of Nanticoke, PA, Due to Metal Processing Plant Fire, March 1987 (USFA–TR–005)
Fire and Explosions at Rocket Fuel Plant, Henderson, NV, May 1988 (USFA–TR–021)
Fire Apparatus/Train Collision, Catlett, VA, September 1989 (USFA–TR–048)
Fire Department Response to Biological Threat at B'nai B'rith Headquarters, Washington, DC (USFA–TR–114)
Fires Involving Medical Oxygen Equipment: Special Report (USFA–TR–107)

Five-Fatality Highrise Office Building Fire, Atlanta, GA, November 1989 (USFA–TR–033)
Gasoline Tanker Incidents in Chicago, IL, and Fairfax County, VA: Case Studies in Hazardous Materials Planning, March/May 1989 (USFA–TR–032)
Hazardous Materials Response Technology Assessment (FA–199)
Highrise Office Building Fire, One Meridian Plaza, Philadelphia, PA, February 1991 (USFA–TR–049)
I-75 Multiple Vehicle Collision Mass Casualty Incident, Collier County, FL, January 2002 (USFA–TR–155)
Indianapolis Athletic Club Fire, Indianapolis, IN, February 1992 (USFA–TR–063)
Industrial Plastics Fire Major Triage Operation, Flint, MI, November 1988 (USFA–TR–025)
Industrial Silo Fire and Explosion, Iredell County, NC, December 21, 1997 (USFA–TR–122)
Interstate Bank Building Fire, Los Angeles, CA, May 1988 (USFA–TR–022)
Live Oak/Milstar Complex and Carpet Service Center, LaGrange, GA, January 1995 (USFA–TR–086)
Logan Valley Mall Fire, Altoona, PA, December 1994 (USFA–TR–085)
Major Propane Gas Explosion and Fire, Perryville, MD, July 1991 (USFA–TR–053)
Major Ship Fire Extinguished by Carbon Dioxide, Seattle, WA, September 1991 (USFA–TR–058)
Manufacturing Mill Fire, Methuen, MA, December 1995 (USFA–TR–110)
Massive Leak of Liquified Chlorine Gas, Henderson, NV, May 1991 (USFA–TR–052)
Multi-Agency Ocean Rescue Disaster Plan and Drill, Broward County, FL, December 6, 1994 (USFA–TR–079)
New York City Bank Building Fire: Compartmentation vs. Sprinklers, New York, NY, January 1993 (USFA–TR–071)
Phillips Petroleum Chemical Plant Explosion and Fire, Pasadena, TX, October 1989 (USFA–TR–035)
Safety and Health Considerations for the Design of Fire and Emergency Medical Services Stations (FA–168)
Santana Row Development Fire, San Jose, CA, July 2001 (USFA–TR–153)
Scrap and Shredded Tire Fires: Special Report (USFA–TR–093)
Search and Rescue Operations Following the Northridge Earthquake, Los Angeles, CA (FA–163C)
Search and Rescue Operations in California During Flooding (FA–163E)
Search and Rescue Operations in Georgia During Major Floods (FA–163D)
Seven Alarm Fire Boardwalk Stores, Wildwood, NJ, August 2000 (USFA–TR–029)
Sherwin–Williams Paint Warehouse Fire, Dayton, OH, May 1987 (USFA–TR–009)
Sprinklered Records Storage Facility, Chicago, IL, October 29, 1996 (USFA–TR–106)
Sprinklers Control Arson Fires in Rack-Storage Warehouse, Mt. Prospect, IL, October 1988 (USFA–TR–030)
Swimming Pool Chemical Plant Fire, Springfield, MA, June 1988 (USFA–TR–027)
Ten Million Dollar Marina Fire, Bohemia Bay, MD, January 1989 (USFA–TR–026)
The Danvers Butchery Meat Market and Cold Storage, Danvers, MA,January 2004 (USFA–TR–151)
The Hazards Associated With Agricultural Silo Fires–Special Report, August 1998 (USFA–TR–096)
Tire Fires: A Report to Congress (FA–187)
Tire Recycling Facility Fire, Nebraska City, NE, January 2004 (USFA–TR–145)
Urban Wildlands Fire, Pebble Beach, CA, May 1987 (USFA–TR–007)
Wanton Violence at Columbine High School, Littleton, CO, April 1999 (USFA–TR–128)
Watts Bar Hydroelectric Plant Fire (USFA–TR–147)
World Trade Center Bombing: Report and Analysis, New York City, NY, February 1993 (USFA–TR–076)

Other works published by USFA of interest to the non-residential fire problem include:

Arson and Juvenile: Responding to the Violence: Special Report (USFA–TR–095)
Arson Prevention–For America's Churches and Synagogues (L–239)
Arson Victims (FA–177)
Board Up Procedures (L–247)
Church Mutual Protection Series–Fire Safety at Your Worship Center (L–238)
Church Threat Assessment Guide (FA–207)
Class A Foam for Structural Firefighting, December 1996 (USFA–TR–083)
Compressed Air Foam Use for Structural Fire Fighting: A Field Test, Boston Fire Department, June 1993 (USFA–TR–074)
Confined Space Rescue on SS Gem State, Tacoma, WA (FA–163A)
Emergency Procedures for Employees with Disabilities in Office Occupancies (English, Cassette, and Spanish; FA–154, FA–154C, FA–154S, respectively)
Landfill Fires: Their Magnitude, Characteristics and Mitigation (FA–225)
Motor Vehicle Fires–What You Need to Know (FA–243)
New Technologies in Vehicle Extrication (FA–152)
Protecting Structures From Arson (L–241)
Rail Emergencies: Special Report (USFA–TR–094)
Rural Arson Control (FA–87)
Technical Rescue Program Development Manual (FA–159)
Technical Rescue Technology Assessment (FA–153)
Wildfire–Are You Prepared? (L–203)
Wildland Fires–Florida, 1998 (USFA–TR–126)
Wildlands Fire Management: Federal Policies and Their Implications for Local Fire Departments, 1988 (USFA–TR–045)

In addition to ordering through the online catalog, publications may be ordered by calling the Publications Center at (800) 561–3356 between 7:30 a.m. and 5:00 p.m. EST/EDT. To order publications by mail, write to:

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chapter five

Firefighter Casualties

This chapter presents the details of on-duty firefighter deaths and injuries (casualties), focusing on 2001. The term *on duty* refers to being involved in operations at the scene of an emergency, whether it is a fire or nonfire incident; responding to or returning from an incident; performing other officially assigned duties such as training, maintenance, public education, inspection, investigations, court testimony, and fundraising; and being on call, under orders, or on standby duty except at the individual's home or place of business. Ten-year (1992–2001) trends of casualties also are examined.

DEATHS

This discussion of firefighter fatalities is a synopsis of the U.S. Fire Administration's (USFA's) report, *Firefighter Fatalities in the United States in 2001*, USFA FA–237, August 2002. Supplemental data from USFA's firefighter fatality database are also included. No data from the National Fire Incident Reporting System (NFIRS) are used.

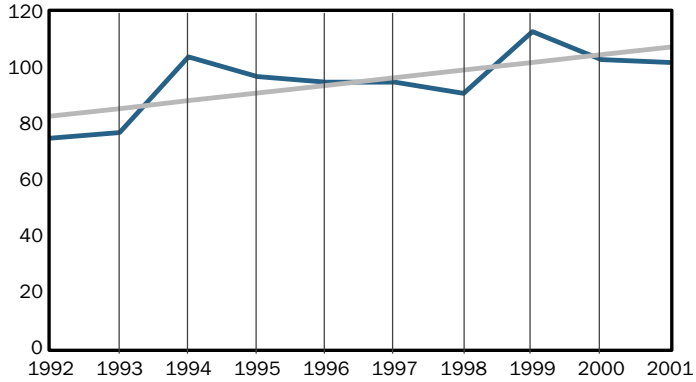
The fire service, and the nation, suffered a catastrophic loss of 341 firefighters in the World Trade Center (WTC) on September 11, 2001. This 1-day loss of firefighters, unparalleled in the annals of U.S. history, was more than triple the average number of firefighter deaths over an entire year and nine times greater than other 2001 firefighter deaths on the fireground. Although an analysis of firefighter deaths cannot ignore this event, the 10-year trends and 2001 focus become so skewed from the norm as to make comparisons from year to year difficult. Most of the charts in this section, therefore, exclude firefighter fatalities from the WTC event, except where the magnitude of that tragedy needs to be emphasized.

In 2001, 443 firefighters died, 341 at the WTC on September 11 and 102 in other operations throughout the year.[1,2] In the previous four editions of *Fire in the United States*, the calculated 10-year trends of firefighter deaths decreased (35 percent in the 9th, 10th, and 11th editions and 17 percent in the 12th edition). In the 1992–2001 period, however, the trend increased 30

[1] These totals match those in the *Firefighter Fatalities in the United States in 2001* report and are used as the basis for this investigation. USFA currently reports 449 fatalities, which includes three WTC fire safety directors who received benefits from the Department of Justice's Public Safety Officers' Benefits (PSOB) Program, and three firefighters who died subsequent to the publication of the report as a result of injuries sustained in 2001.

[2] A chronological listing of the 102 firefighters who died in 2001 and synopses of the events are presented in the U.S. Fire Administration's Appendix A, "Summary of 2001 Incidents," *Firefighter Fatalities in the United States in 2001*; Appendix B is an alphabetized listing of the 341 firefighters killed at the World Trade Center, including their ages and affiliations.

percent, excluding the WTC (Figure 86).[3] Although these trends appear significant, the total deaths are small enough that a change of even a few deaths in a year may dramatically impact the 10-year trend line. Over this 10-year period, an average of 95 firefighters died in the line of duty each year. In every year until 1992, more than 100 firefighters were fatally injured. The peak was in 1978 when 171 firefighters died. The fewest deaths (75) were recorded in 1992.



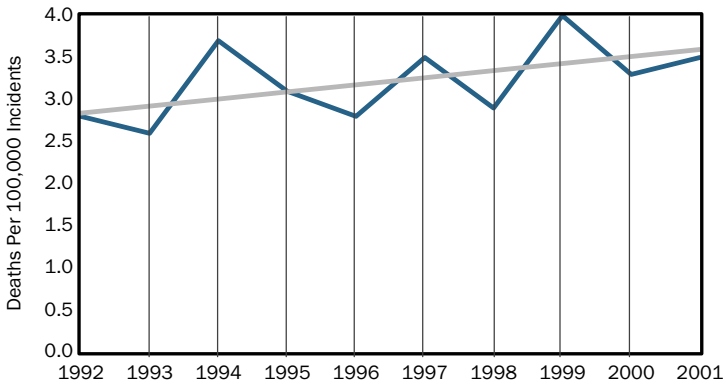
1992	75	1997	95
1993	77	1998	91
1994	104	1999	113
1995	97	2000	103
1996	95	2001 (non-WTC)	102
		2001 (WTC)	443

10-Year Trend = +29.7%

Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

Figure 86. Trends in Firefighter Deaths

The danger of a firefighter sustaining a fatal fire-related injury is shown in Figure 87. Note that this figure measures only fire-incident-related fatalities with respect to fire incidents. Despite wide fluctuations, fire-incident-related firefighter fatalities per 100,000 reported incidents have risen approximately 27 percent, with 1999 having the highest rate. By sharp contrast, the trend in fire incidence declined 15 percent. It is not clear why we seem to be doing a good job at



1992	2.8	1997	3.5
1993	2.6	1998	2.9
1994	3.7	1999	4.0
1995	3.1	2000	3.3
1996	2.8	2001 (non-WTC)	3.5

10-Year Trend = +26.7%

Note: These data include only firefighters who were reportedly engaged in response to/return from an incident, fire extinguishment/incident neutralization, or suppression support activities at the time of their deaths.

Sources: U.S. Fire Administration firefighter fatality database and NFPA

Figure 87. Trends in Fire-Incident-Related Firefighter Fatalities Per 100,000 Incidents

[3] The 2001 on-duty fatalities do not include two firefighters who died during the year from injuries sustained in previous years. They are included in the year in which the injury occurred.

reducing the number of fires but not reducing the number of fire-incident-related fatalities. Perhaps, the number of small fires has been reduced, but not the more serious fires where firefighters are killed; or perhaps firefighter equipment has become so effective that firefighters are inadvertently pushing the limits of the equipment and unwittingly putting themselves in harm's way. This is an area that merits further attention and further study.

The 102 fatalities represented 27 career firefighters and 75 volunteers (Table 23). Five of the 102 fatalities were women. Fifteen seasonal firefighters died during wildland firefighting operations, including 6 in aircraft accidents. All 341 of the WTC fatalities were career firefighters and all were males.

Table 23. Firefighter Deaths (2001)

Firefighter Type/Gender	Fatalities
Firefighter	
Volunteer	75
Career	368
Wildland Firefighter	
Career/Military	0
Volunteer	3
Seasonal/Part Time	12
Municipal/Local Fire Departments	
Career	368
Volunteer	60
Men	438
Women	5

Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

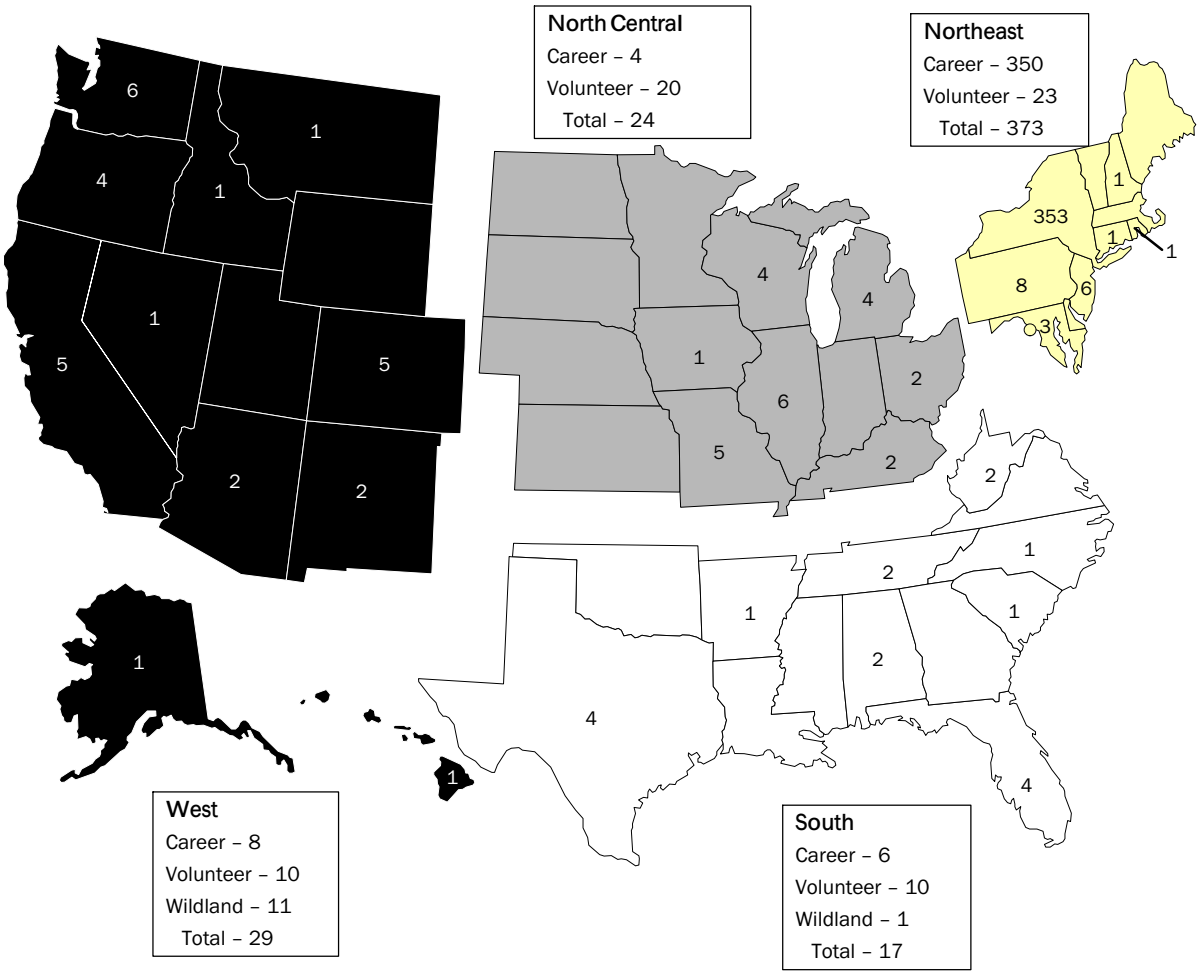
Region

Firefighter deaths in 2001 were distributed as follows: 50 (391 including WTC) deaths in urban/suburban areas,[4] 40 in rural areas, and 12 in federal or state parks/wildland areas. Figure 88 shows these deaths by area of the country and by individual state. Thirty-three states had at least one firefighter fatality. Even excluding the 341 WTC fatalities, New York had the highest number of deaths (12) followed by Pennsylvania (8).

Activity

On-duty firefighter activities are in two categories, emergency and non-emergency. Emergency activities include responding to an emergency, actions performed while at the emergency scene, or returning from or immediately following the emergency incident. Sixty-six firefighters died during emergency incidents (Figure 89). The remainder (36) occurred during non-

[4] This total is 391 deaths when the WTC fatalities are included.



Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

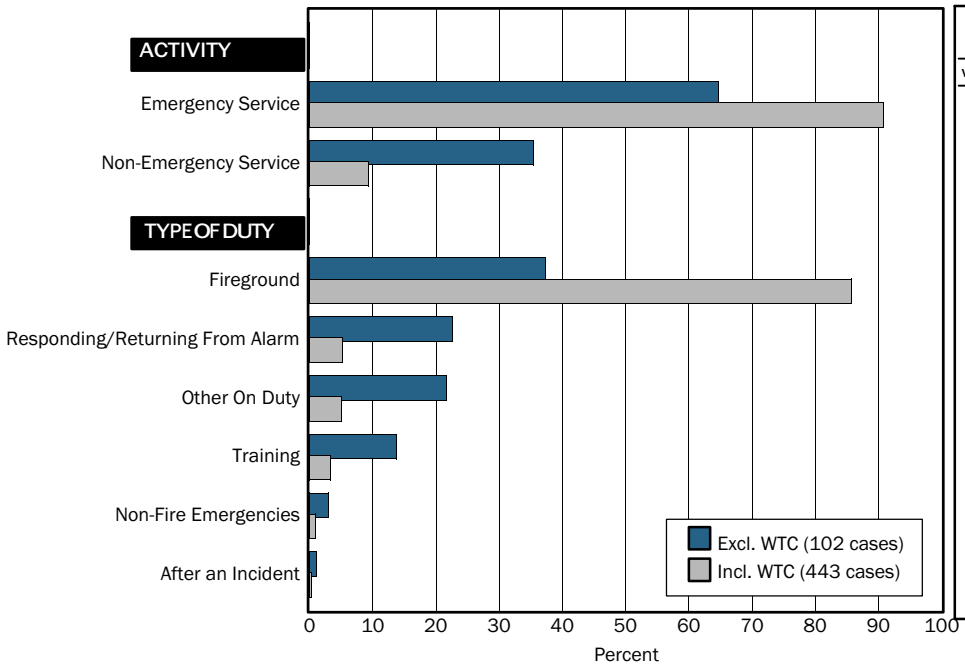
Figure 88. Firefighter Deaths by Region and State (2001)

emergency duties, which include training, administrative activities, or performing other functions not related to an emergency incident.

Type of Duty

As in all years since such data were recorded, the largest number of deaths in 2001 (38) occurred during fireground operations (Figure 89). Of these fireground deaths, 12 resulted from heart attacks on the emergency scene, 14 from asphyxiation, 5 from internal trauma, 4 from burns, and 3 from building collapses.[5] Of the 38 deaths, 27 occurred during structural firefighting operations where the fixed property use was known. Seventeen of these deaths (63 percent) were in residential structures and 10 were in commercial structures (37 percent).

[5] The 341 firefighters who perished in the WTC were performing emergency services on the fireground and were assumed crushed from the collapses of the two buildings.



	Percent of Cases		Number of Cases	
	w/o WTC	WTC	w/o WTC	WTC
Emergency Service	64.7	90.7	66	407
Non-Emergency Service	35.3	9.3	36	36
Fireground	37.3	85.6	38	379
Responding/Returning From Alarm	22.5	5.2	23	23
Other On Duty	21.6	5.0	22	22
Training	13.7	3.2	14	14
Non-Fire Emergencies	3.9	0.9	4	4
After an Incident	1.0	0.2	1	1

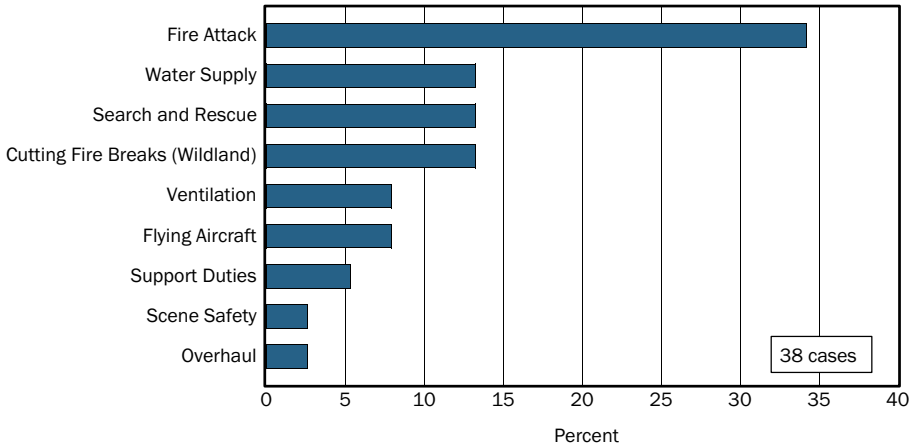
Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

Figure 89. Firefighter Deaths by Activity and Type of Duty (2001)

It is important to look at the activities these 38 firefighters were performing on the fireground at the time they were stricken (Figure 90). Thirteen firefighters were killed as they engaged in direct fire attack, such as advancing or operating a hoseline at a fire scene; all were in residential structures. Heart attacks killed 5 firefighters performing water supply activities at their apparatus. Four of the 5 fatalities in search-and-rescue operations were in residential buildings where the firefighters became trapped, and 1 was trapped by an explosion in a hardware store. Five firefighters died cutting fire breaks during wildfire operations. Three firefighters were killed while performing ventilation duties, 2 when a hardware store wall collapsed and 1 from a heart attack at an apartment building fire. Three seasonal firefighters died in two separate airplane accidents (3 other firefighters who died in airplane crashes are not included since they were performing maintenance duties). During support operations, 1 firefighter was killed by a falling tree, and the other collapsed of a heart attack while opening gates to admit other firefighters to a mulch fire. A firefighter was struck by a passing vehicle as he directed traffic to ensure scene safety. One firefighter suffered a heart attack as he was overhauling a lightning-caused structure fire.

The second leading category or activity resulting in firefighter deaths, as in all years, is responding to or returning from an emergency. Twenty-three firefighters died in 2001, 12 in motor vehicle collisions and 11 from heart attacks; 20 of these were volunteers.

Twenty-two firefighters died in other on-duty activities: 9 suffered heart attacks, 3 were injured in falls, 3 died in a single helicopter crash during maintenance operations, 1 was crushed



Percent of Cases	Number of Cases
34.2	13
13.2	5
13.2	5
13.2	5
7.9	3
7.9	3
5.3	2
2.6	1
2.6	1

Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

Figure 90. Firefighter Deaths on Fireground by Type of Activity (Excludes WTC) (2001)

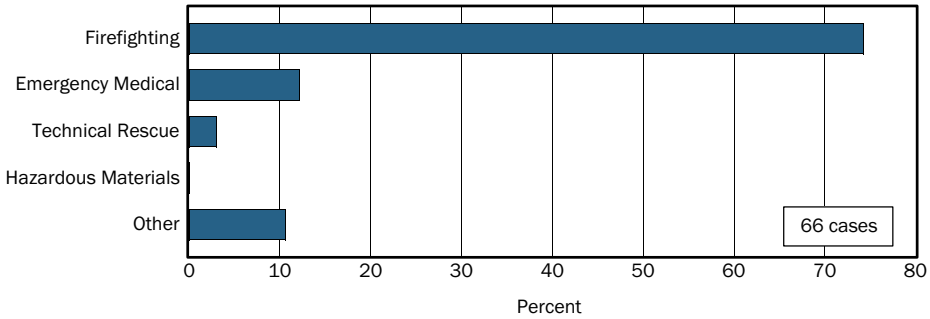
by a falling tree, 1 was electrocuted in the fire station, 1 died from head trauma while cleaning up after a fire department-sponsored carnival, 1 was killed in a car collision en route to a meeting, 1 died after a tire blew out on a tanker that he was returning after maintenance, 1 was shot by another firefighter, and 1 was killed after being hit by a water tank that went airborne after being overpressurized.

More firefighters died (14) during training exercises than in any of the previous 10 years. Nine deaths were from heart attacks, 1 from a fall from an aerial ladder, 1 drowned during dive rescue training, 1 died of surgical complications following a back injury, 1 died in a motorcycle collision while returning from training, and 1 was trapped by fire progress in a structural fire training exercise.

Non-fire emergency duties claimed the lives of 4 firefighters. Two drowned while attempting to recover the body of a boater; 1 suffered a fatal cerebrovascular accident (CVA) (stroke) following duty at the scene of a vehicle accident, and 1 was struck by a vehicle as he directed traffic at a vehicle crash. One firefighter suffered a heart attack after returning from a small structural fire.

Type of Emergency Duty

As shown in Figure 91, 74 percent of emergency duty firefighter deaths in 2001 were related directly to emergency activities (49). The remaining 17 deaths included 10 during EMS calls, 1 while responding to a false alarm, 1 during a severe weather standby, 2 attempting a water rescue, 2 after returning from an emergency (a heart attack and a CVA), and 1 directing traffic at an accident scene.



Percent of Cases	Number of Cases
74.2	49
12.1	8
3.0	2
0	0
10.6	7

Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

Figure 91. Firefighter Deaths During Emergency Duty (Excludes WTC) (2001)

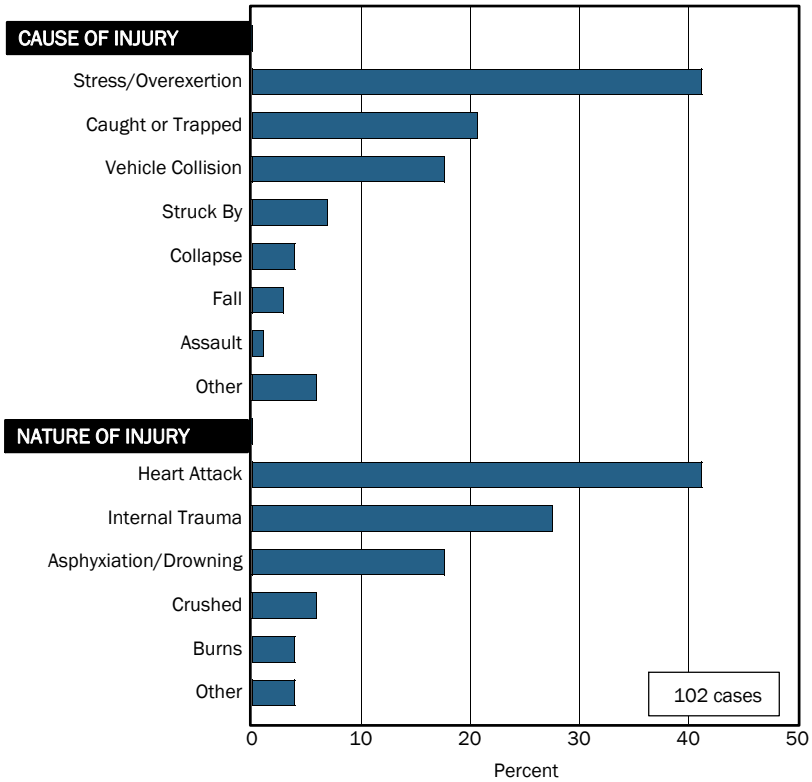
Cause and Nature of Fatal Injury or Illness

The word *cause* refers to the action, lack of action, or circumstances that directly resulted in the fatal injury; the word *nature* refers to the medical nature of the fatal injury or illness, or what is often referred to as the cause of death. A fatal injury usually is the result of a chain of events, the first of which is recorded as the cause. For example, if a firefighter is struck by a collapsing wall, becomes trapped in the debris, runs out of air before being rescued, and dies of asphyxiation, the cause of the fatal injury is recorded as "struck by collapsing wall" and the nature of the fatal injury is "asphyxiation." Likewise, if a wildland firefighter is overrun by a fire and dies of burns, the cause of death would be listed as "caught/trapped," and the nature would be "burns." This follows the convention used in NFIRS casualty reports, which are based on NFPA fire reporting standards. Figure 92 shows the distribution of deaths both by cause and by nature of fatal injury or illness.

CAUSE. As in all previous years, the most frequent cause (42 deaths) in 2001 was stress or overexertion. Firefighting has been shown to be one of the most physically demanding activities that the human body performs, and the nature of most stress-related deaths was from heart attacks (41); the other death was a CVA (stroke). Eighteen of the 42 deaths reported as stress/exertion occurred during non-emergency operations.

The second leading cause of firefighter fatalities was by being caught or trapped. The 21 deaths in this category were higher than the total for any of the past 5 years. Five firefighters were trapped by the rapid progress of a wildland fire, 2 were killed when a fire trapped them in a home basement, 7 became disoriented in six residential fires and became lost, 2 drowned while attempting a body recovery, 1 drowned during dive rescue training, 1 was trapped on the second floor of a house acquired for training, 2 fell through floors in separate residential fires, and 1 was trapped by a falling garage door and sustained fatal burns.

Vehicle collisions killed 18 firefighters in 2001. Six wildland aircraft firefighters were killed in three incidents: 3 died in a helicopter crash during a maintenance flight, 2 died when their air tankers collided, and 1 was killed in his single-engine air tanker. The other 12 fatalities were the



	Percent of Cases	Number of Cases
Stress/Overexertion	41.2	42
Caught or Trapped	20.6	21
Vehicle Collision	17.6	18
Struck By	6.9	7
Collapse	3.9	4
Fall	2.9	3
Assault	1.0	1
Other	5.9	6
NATURE OF INJURY		
Heart Attack	41.2	42
Internal Trauma	27.5	28
Asphyxiation/Drowning	17.6	18
Crushed	5.9	6
Burns	3.9	4
Other	3.9	4

Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

Figure 92. Firefighter Deaths by Cause and Nature of Injury (Excludes WTC) (2001)

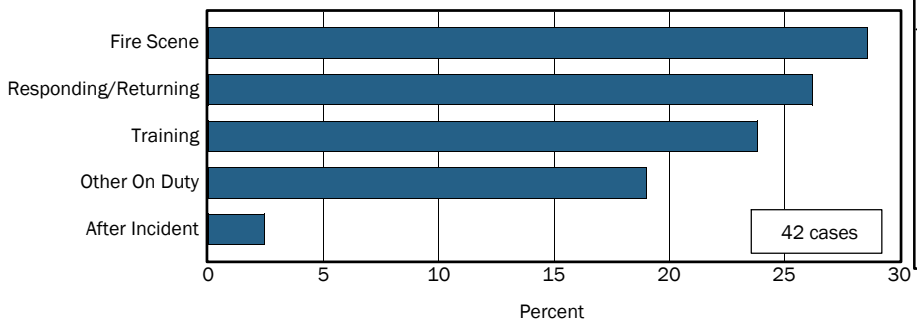
result of road collisions: 6 were going to or coming from an incident in their personal vehicles, 4 were involved in tanker collisions, 1 was in a pumper crash, and 1 was in a command vehicle responding to an EMS incident.

The 7 firefighters who were struck by or came into contact with an object included 3 firefighters who were struck by vehicles as they directed traffic, 3 who were killed by falling trees, and 1 who died when an overpressurized water tank exploded.

The remaining 14 firefighter deaths included 4 who where killed due to collapses, 3 who died from falls, 1 who was shot by another firefighter, 1 who slipped on ice, 1 who was electrocuted working on a light fixture in the firehouse, 1 who was crushed by an engine following an incident, 1 who was killed on a carnival ride during the cleanup from a fire department function, 1 who died in his sleep of a seizure, and 1 who died of an abnormal heart rhythm.

All 341 World Trade Center deaths are attributed to collapse, although the specifics in most cases are unknown.

NATURE. The lower portion of Figure 92 shows the distribution of fatalities by the medical nature of the fatal injury or illness. The leading nature of death was heart attack, with 42 fatalities.



Percent of Cases	Number of Cases
28.6	12
26.2	11
23.8	10
19.0	8
2.4	1

Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

Figure 93. Firefighter Heart Attack Deaths by Type of Duty (2001)

The type of duty in which the heart attack victims were involved is shown in Figure 93. There were no heart attack fatalities at non-fire emergencies, down from 6 such deaths in 2000.

Internal trauma was the second leading nature of fatalities, responsible for 28 deaths as follows: 18 killed in vehicles (including aircraft), 3 struck by vehicles, 3 died from falls, 1 hit with an exploding water tank, 1 fatality shot, 1 struck by a falling tree, and 1 killed at a carnival sponsored by the local fire service.

The 18 firefighters who were asphyxiated included 4 while fighting a wildland fire, 10 in residential structure fires, 3 drownings, and 1 in a structural training burn.

Six firefighters died from crushing injuries: 2 from a collapsing wall at a hardware store fire, 1 under debris at a restaurant fire, 2 by falling trees, and 1 by his apparatus as he directed the driver at the conclusion of an incident.

Four firefighters died from burns: 3 in residential structure fires and 1 when a fire overran his position and he was unable to escape to a safe zone.

Four fighters were killed in situations where the nature of their fatal injuries does not fit into any of the above categories. One suffered a CVA (stroke) after returning home from a vehicle crash, 1 was electrocuted at the fire station, 1 died of a seizure, and 1 died from a surgical error that was made during surgery to repair broken bones suffered from a fall on the ice.

Age of Firefighters

Table 24 shows the distribution of firefighter deaths by age and by nature of death. Younger firefighters were more likely to have died as a result of traumatic injuries from an apparatus accident or after becoming caught or trapped during firefighting operations; trauma and asphyxiation were responsible for most of their deaths. Stress was more of a contributing factor in firefighter deaths as age increased. Heart attacks accounted for 55 percent of deaths of firefighters older than 40.

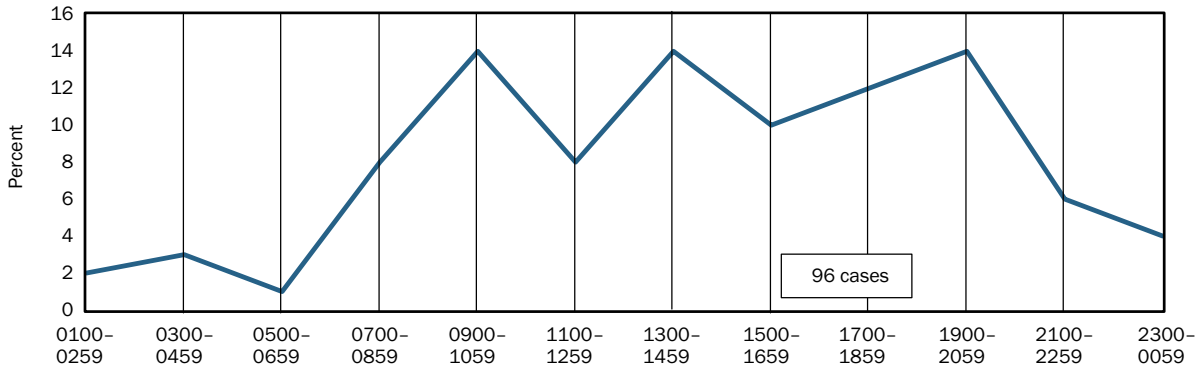
Table 24. Firefighter Ages and Nature of Fatalities (Includes WTC) (2001)

Nature of Fatality	Age									Total
	Under 21	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	51 to 60	Over 60	
Trauma/Asphyxiation										
WTC	0	6	36	69	74	76	47	27	6	341
Non-WTC	3	7	7	2	12	5	11	7	4	58
Heart Attack/CVA	0	0	3	3	5	5	4	11	13	44
Total	3	13	46	74	91	86	62	45	23	443

Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

When Deaths Occur

TIME OF INJURY. The distribution of firefighter injuries by time of day that resulted in death is shown in Figure 94. (Time of day was not reported in 6 cases.) Fourteen firefighters died during each of the following time periods: 9–11 a.m., 1–3 p.m., and 7–9 p.m. There is little difference between deaths during late evening and nighttime hours (6 p.m. to 6 a.m.) and daylight hours (6 a.m. to 6 p.m.): 49 percent vs. 51 percent, respectively. By contrast, civilian fire deaths are much more likely to occur late at night and in the early morning hours.



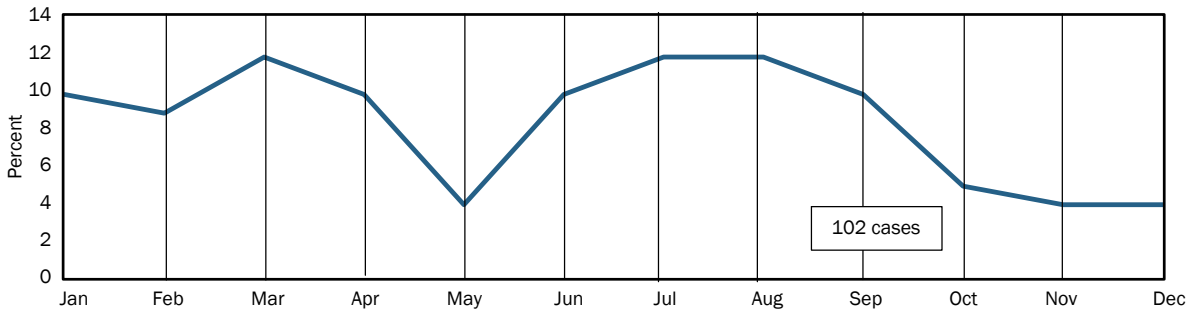
Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

Figure 94. Firefighter Deaths by Time of Fatal Injury (Excludes WTC) (2001)

MONTH OF YEAR. Figure 95 distributes firefighter fatalities by month of the year in 2001. Twelve firefighters died in each of the months of March, July, and August. Obviously, September was the highest month when the WTC fatalities are included.

FirefighterHealth

Each year, heart attacks and strokes take a terrible toll on firefighters (42 firefighters in 2001). In fact, from 1996 through 2001, 256 firefighters succumbed to heart attacks and strokes. A large majority of these deaths (75 percent in 2001) were men over the age of 40.



Source: U.S. Fire Administration, *Firefighter Fatalities in the United States in 2001*

Figure 95. Firefighter Deaths by Month of Year (Excludes WTC) (2001)

The USFA recommends the implementation of effective firefighter health and wellness programs to reduce the incidence of heart attacks and strokes. Such programs, procedures, and activities include:

- The Fire Service Joint Labor Management Wellness–Fitness Initiative developed by the International Association of Firefighters (IAFF) and the International Association of Fire Chiefs (IAFC).
- The *Health and Wellness Guide for the Volunteer Fire Service* produced as a partnership between the National Volunteer Fire Council (NVFC) and the USFA. This may be ordered free of charge from USFA.
- The Candidate Physical Ability Test (CPAT), which is a method of testing the health of recruits, also developed by the IAFF and IAFC.
- Periodic medical evaluations of all firefighters.
- The availability of emergency medical care at least at the basic life support (BLS) level, including an automatic external defibrillator (AED), at every incident and all training events.
- The Heart-Healthy Firefighter Program developed and administered by the NVFC.

In USFA's *Firefighter Fatalities in the United States in 2001*, recommendations that may have an immediate impact on lessening heart disease are examined in detail. These include:

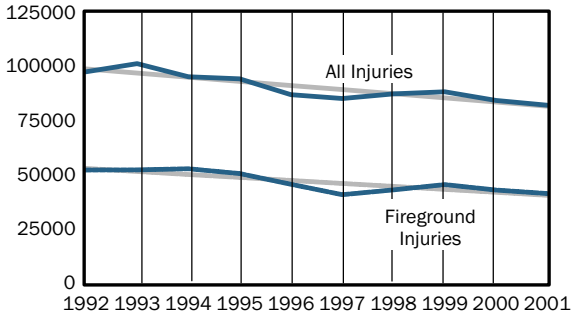
- Have a medical exam.
- Modify eating habits.
- Take a walk.
- Quit smoking.

The U.S. Fire Administration has a number of partnerships and programs in firefighter fitness and wellness. Further information may be obtained from the USFA Web site http://www.usfa.fema.gov/inside-usfa/research/safety/fitness.shtm.

A detailed review of firefighter fatalities during the 1990–2000 period is presented in USFA's *Firefighter Fatality Retrospective Study*, U.S. Fire Administration FA–220, April 2002, http://www.usfa.fema.gov/applications/publications/display.cfm.

INJURIES

Nearly twice as many firefighters are injured each year performing fireground duties as there are fire injuries to the civilian population (41,400 versus 21,100 in 2001)[6]. In all, 82,250 firefighters were injured while on duty.[7] The 10-year trend, however, in both total firefighter injuries and fireground injuries continued downward trends—17 and 23 percent, respectively (Figure 96). This section examines firefighter injuries from several perspectives with the objective of highlighting areas of concern that could lead to corrective action. Most of the statistics presented are from the NFIRS database.



	All Injuries	Fireground		All Injuries	Fireground
1992	97,700	52,290	1997	85,400	40,920
1993	101,500	52,895	1998	87,500	43,080
1994	95,400	52,875	1999	88,500	45,550
1995	94,500	50,640	2000	84,550	43,065
1996	87,150	45,725	2001	82,250	41,395

10-Year All Injuries Trend = –17.3%
10-Year Fireground Injuries Trend = –23.4%

Source: NFPA

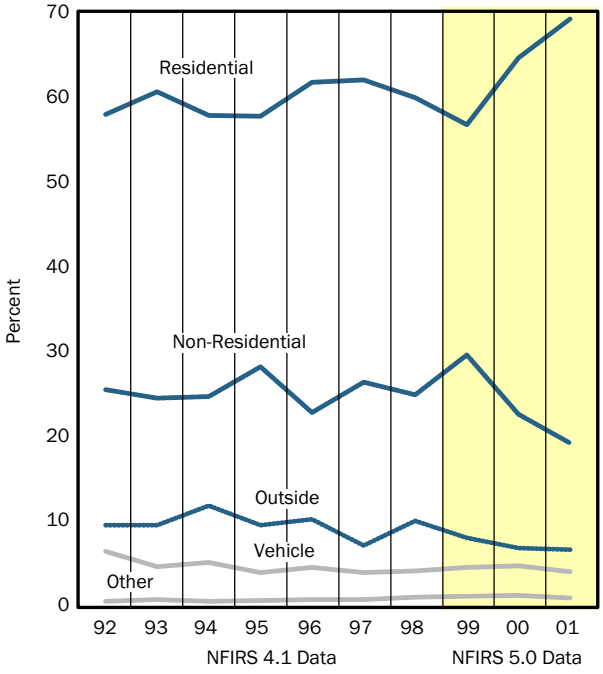
Figure 96. Trends in Firefighter Injuries

Injuries by Property Type

Eighty-nine percent of firefighter injuries reported to NFIRS in 2001 are associated with structure fires. Of these, more than three and one-half times as many injuries occur in residential structures as in non-residential structures (Figure 97). Residential structure fires account for 69 percent of firefighter injuries. The proportion of residential to non-residential injuries was quite consistent over the 9-year period 1992–2000 (2.4 to 1), but the gap began widening in 2000, perhaps as an artifact of the data system change. Outside, vehicle, and other fires combined represent 12 percent of firefighter injuries in 2001. Injuries in residential structures reached a 10-year high in 2001, with a sharp increase from 1999 to 2001; and a 10-year low in non-residential structures, with a corresponding sharp decrease over the same 2 years.

[6] The National Fire Protection Association's (NFPA's) annual survey estimates fireground injuries as 41,395. To this should be added a portion of the injuries categorized as responding to or from an incident (which includes, but is not limited to fires).

[7] On-duty activities include both fireground and non-fireground operations.



	Residential	Non-Residential	Vehicle	Outside	Other
1992	58.0%	25.5%	6.4%	9.5%	0.5%
1993	60.7	24.5	4.6	9.5	0.7
1994	57.9	24.7	5.1	11.8	0.5
1995	57.8	28.2	3.9	9.5	0.6
1996	61.8	22.8	4.5	10.2	0.7
1997	62.1	26.4	3.9	7.1	0.7
1998	60.0	24.9	4.1	10.0	1.0
1999	56.8	29.6	4.5	8.0	1.1
2000	64.7	22.6	4.7	6.8	1.2
2001	69.3	19.2	4.0	6.6	0.9

Figure 97. Trends in Firefighter Injuries by General Property Type

Figure 98 is a more detailed picture of the relative proportion of firefighter injuries by type of structure. One- and two-family dwelling fires account for 56 percent of all firefighter injuries. Apartment fires account for 20 percent.

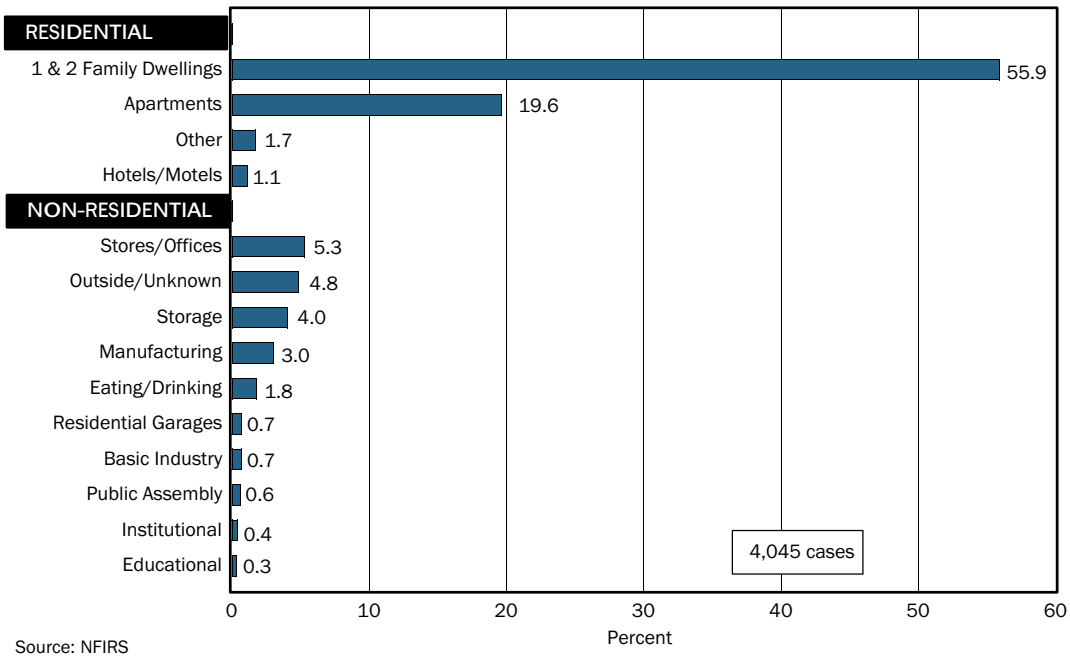
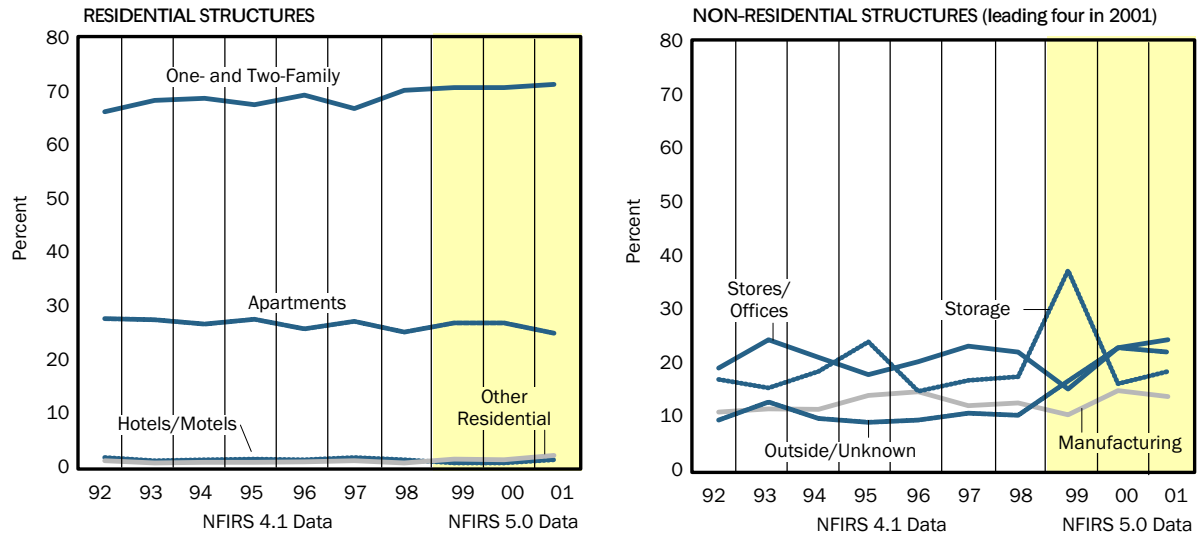


Figure 98. Firefighter Injuries by Property Type (2001) (Structure Fires Only)

The proportions of injuries in residential structures are similar over the 1992–2001 period (Figure 99). The percentages of firefighter injuries in structures have remained in a narrow range over the 10 years: in one- and two-family dwellings, between 68 and 72 percent; in apartments, between 25 and 29 percent; and in other residences, between 2 and 4 percent. Firefighter injuries in apartments reached a 10-year low (25 percent) in 2001.

Figure 99 also shows four of the non-residential property types where 79 percent of firefighters injuries occur. Stores/offices have been the leading non-residential structures in which firefighters have been injured in 8 out of the last 10 years. A peak occurred in storage fire injuries in 1999 due to the abandoned cold storage warehouse fire in Worcester, MA in December in which 399 firefighters were injured.[8]



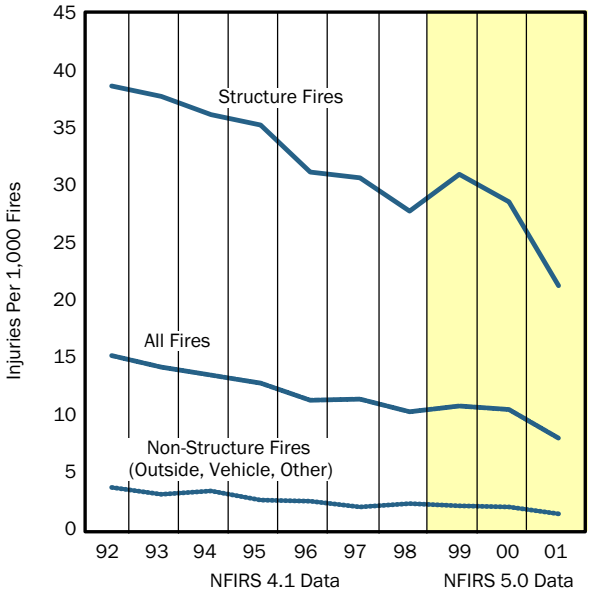
Note: Data provided in Appendix B, Table B-8.

Figure 99. Trends in Firefighter Injuries in Structure Fires

Injuries Per Fire

Firefighter injuries per 1,000 fires continued their downward trend in the 1992–2001 period—41 percent in all fires, 38 percent in structure fires, and 57 percent in non-structure fires (Figure 100). Firefighters are nearly 15 times more likely to be injured in structure fires than in non-structure fires. Although the rate of injuries in structure fires reached a low point in 2001, the fact that 21 firefighters are injured for every 1,000 structure fire responses is cause for concern and should be investigated further.

[8] In previous editions, vacant and under construction property was a separate property type. Since 1999, firefighter injuries at such sites have been merged with other property types. The proportion of injured firefighters in vacant and under construction properties, however, is 3.4 (1999), 4.8 (2000), and 6.5 percent (2001).



INJURIES PER 1,000 FIRES

	All Fires	Structure Fires	Non-Structure Fires
1992	15.2	38.7	3.7
1993	14.2	37.8	3.1
1994	13.5	36.2	3.4
1995	12.8	35.3	2.6
1996	11.3	31.2	2.5
1997	11.4	30.7	2.0
1998	10.3	27.8	2.3
1999	10.8	31.0	2.1
2000	10.5	28.6	2.0
2001	8.0	21.3	1.4
10-Year Trend	-41.0%	-37.5%	-56.6%

Figure 100. Trends in Firefighter Injury Rate

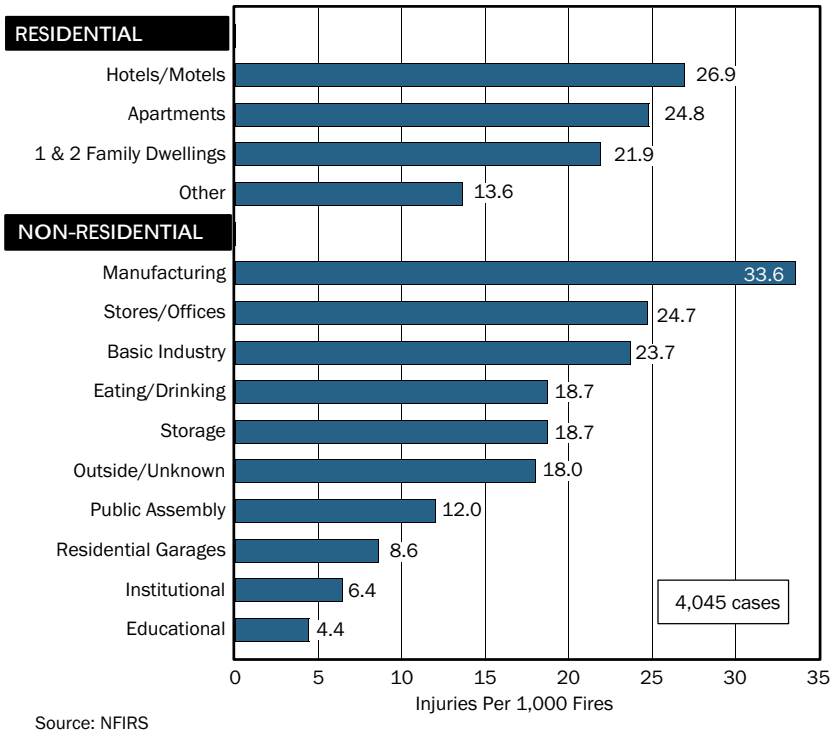
All residential property types have less risk of firefighter injury per fire than manufacturing properties (Figure 101). In the residential category, hotels/motels had the highest injury rate (27 per 1,000 fires). This is surprising in that this property type traditionally has had the lowest injury rate. In the non-residential category, manufacturing properties had the highest injury rate of any property type with 34 firefighter injuries per 1,000 fires. Firefighter injuries in the top three non-residential properties shown in the figure average 27 per 1,000 fires.

The decline of firefighter injuries per fire in residential and non-residential structures is further displayed in Figure 102. In 2001, firefighter injuries per 1,000 fires in both residential and non-residential properties reached 10-year lows. The injury rate for hotels/motels is down despite its recent upswing, but this category fluctuates considerably from year to year because of small sample sizes.

The reduction in the total number of firefighter injuries appears to be due to a reduction in injuries rather than a reduction in the number of fires. Either the nature of fires changed or the safety practices or equipment changed. This fact might warrant further investigation.

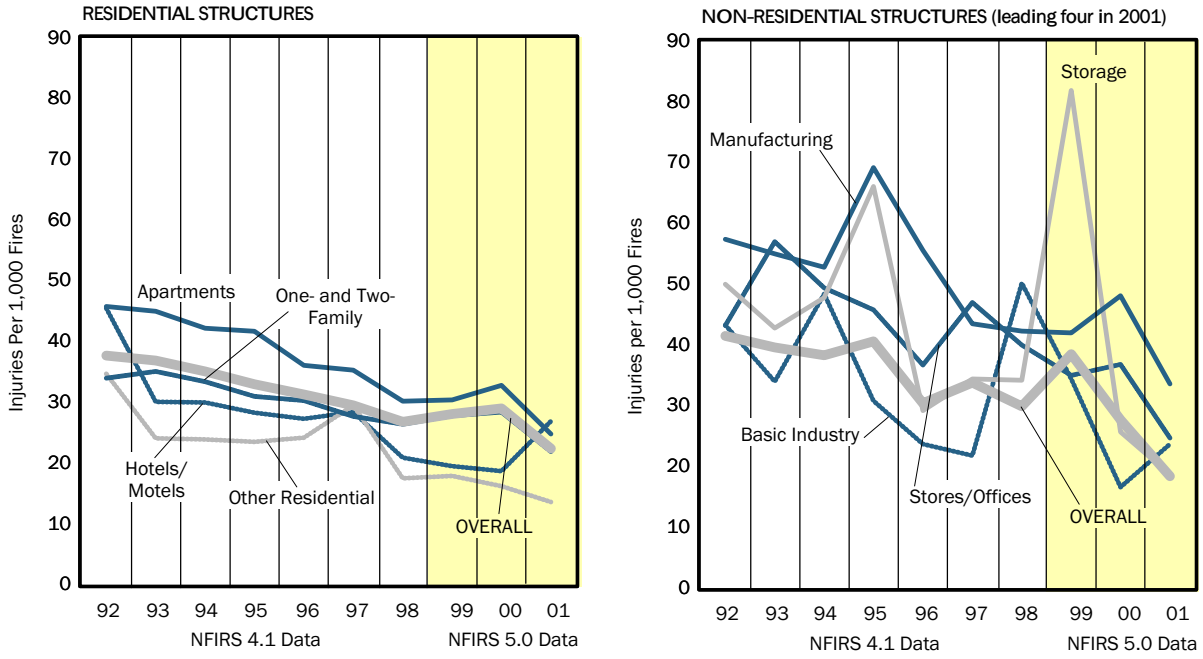
Figure 103 shows the rate of firefighter injuries in structures that are vacant or under construction. (This includes all fires of any property use.) Although the sample size is relatively small, the figure shows that 105 firefighters are injured per 1,000 fires in vacant industrial properties such as warehouse, utility, defense, agriculture, and mining properties. These are usually very large fires.

Vacant and under construction properties have long been a firefighting concern as high-risk sites. The most dangerous fires often are those in vacant properties and properties under construction. These fires are frequently arson-related with multiple ignition points. In non-



Source: NFIRS

Figure 101. Firefighter Injury Rate in Structures (2001)



Note: Data provided in Appendix B, Table B-9

Figure 102. Trends in Firefighter Injury Rate in Structures

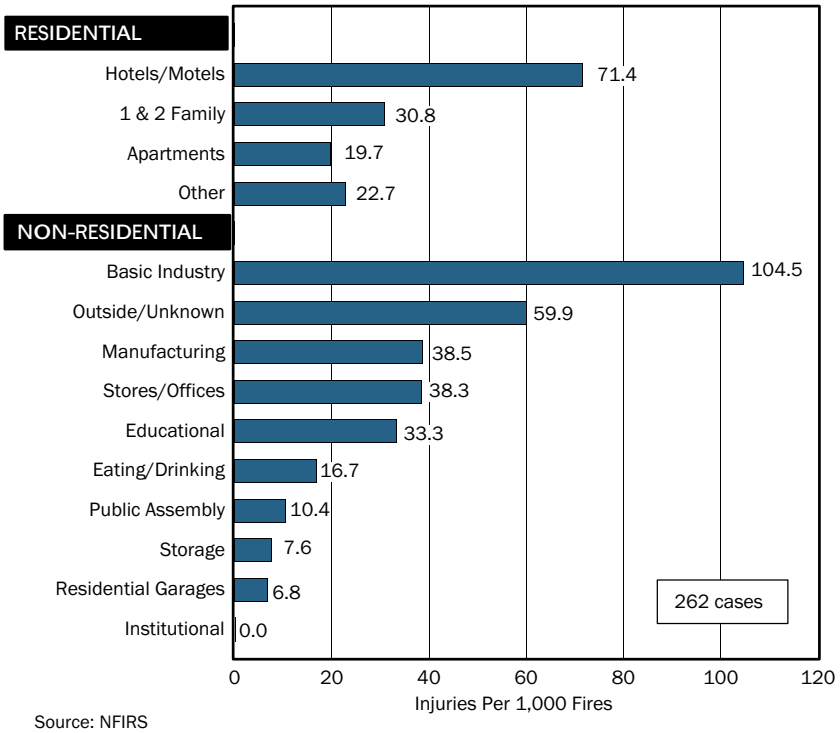


Figure 103. Firefighter Injury Rate in Vacant or Under Construction Structures (2001)

residential structures, the layout is often unfamiliar and, for properties under construction, continually changing from week to week. Fire defenses built into such structures are often not working or working only partially. Also, construction equipment, materials, and debris scattered about the site increase the risk of serious injury. Many of these fires are started when no one is around and the fire spreads rapidly before the fire department is called. This combination continues to make these properties hazardous—in 2001, the overall injury rate for vacant and under construction properties was 34 firefighters per 1,000 fires. This injury rate made these properties one of the most dangerous for firefighters in 2001. As a result of the experience at the Worcester warehouse fire, today there is less of an inclination to risk firefighters' lives when fighting fires in vacant properties.

Age

Figure 104 shows the profile of firefighter injuries by age for all property types. The percentages of injuries have not changed markedly over the past 10 years. More than one-third of all injuries occurred to firefighters aged 30–39. The types of injuries incurred by firefighters vary with age. Typically, the leading cause of injury among younger firefighters relates to smoke inhalation, and among older firefighters strains and sprains are more common injuries. These results relate to physical fitness variations with age, to the effect of age on assignments, and perhaps to the bravado of younger firefighters.

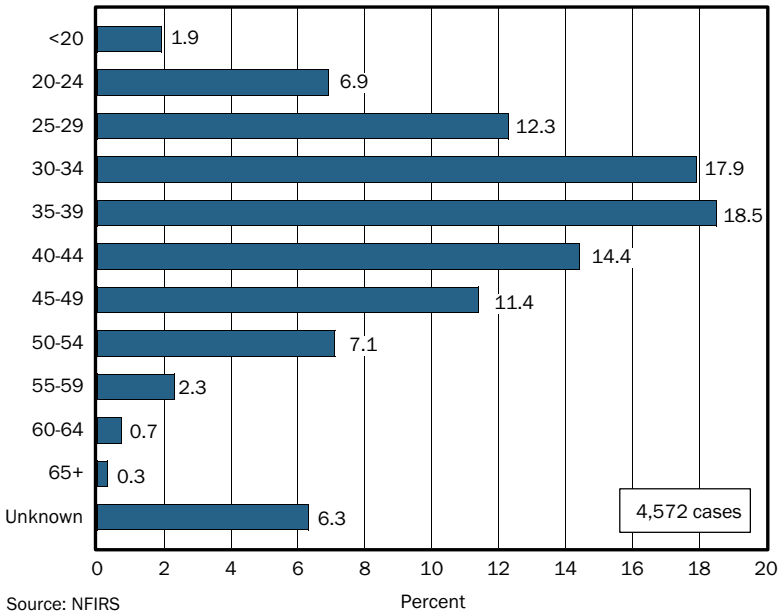


Figure 104. Firefighter Injuries by Age (2001)

When Injuries Occur

TIME OF DAY. Injuries to firefighters begin to decline at 3 a.m. and reach their lowest point at 7 a.m. Half of all firefighter injuries occur between 11 a.m. and 7 p.m. (Figure 105). The times that are most hazardous to civilians (evening mealtimes for injuries) are also the times when the greatest number of firefighters are injured.

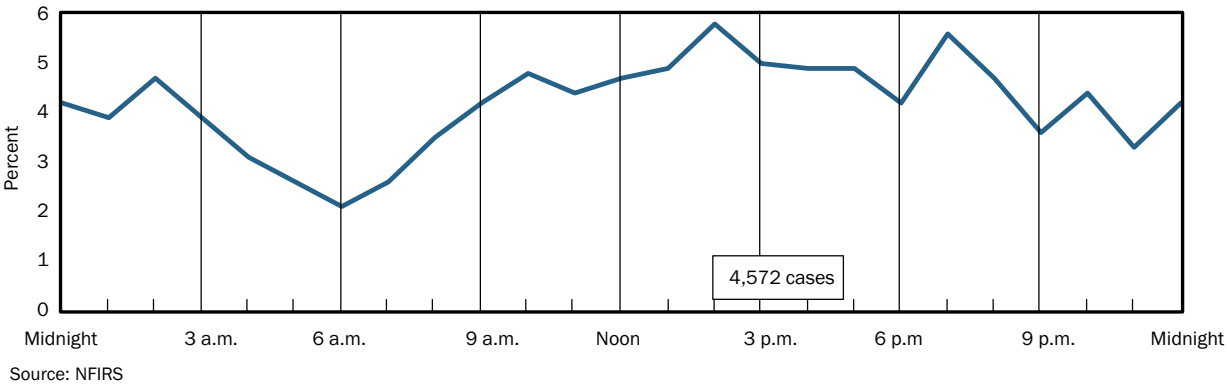
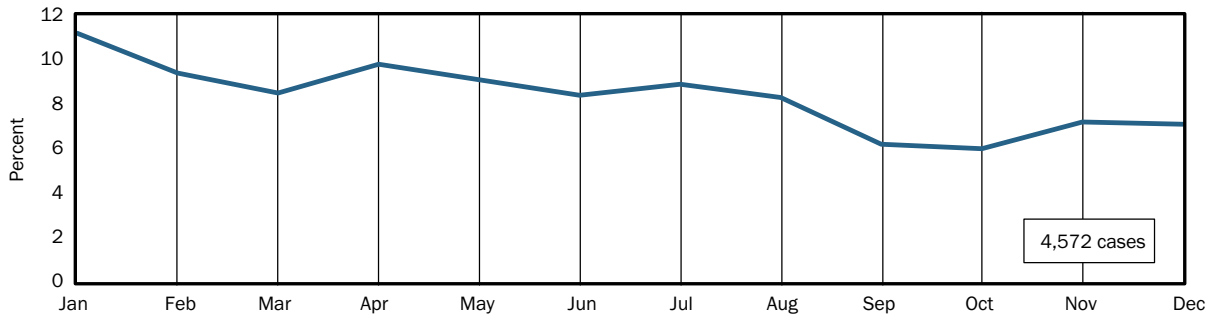


Figure 105. Firefighter Injuries by Time of Day (2001)

MONTH OF YEAR. Firefighter injuries are somewhat higher in the winter (January–March) when residential fires peak (and conditions are more severe in much of the nation) (Figure 106). Injuries dip from August to November.

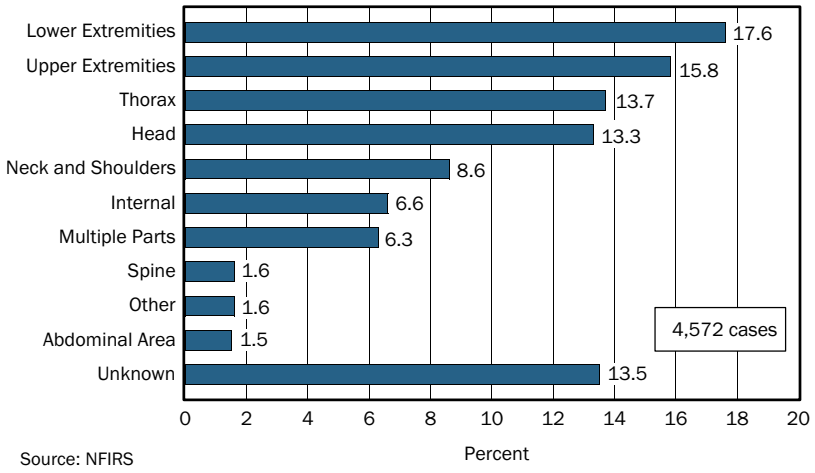


Source: NFIRS

Figure 106. Firefighter Injuries by Month of Year (2001)

Part of Body Injured

One-third of firefighter injuries in 2001 were to the upper and lower extremities (torso, arms/hands, and legs/feet) (Figure 107). All areas of the body are vulnerable, including internal injuries from smoke inhalation.



Source: NFIRS

Figure 107. Firefighter Injuries by Part of Body Injured (2001)

Causes

As shown in Figure 108, the greatest cause of firefighter injuries associated with fires was reported to be overexertion and strains (19 percent), followed by contact with or exposure to flames or smoke (17 percent). (The cause of firefighter injury was undetermined in 19 percent of cases.) These two injury causes reinforce the fact that firefighting is a physically exhausting and dangerous profession.

Where Injuries Occur

At least three-quarters of the 2001 firefighter injuries occur at the fire scene (Figure 109). (Location was not reported in 22 percent of injuries.) This percentage is nearly equally divided

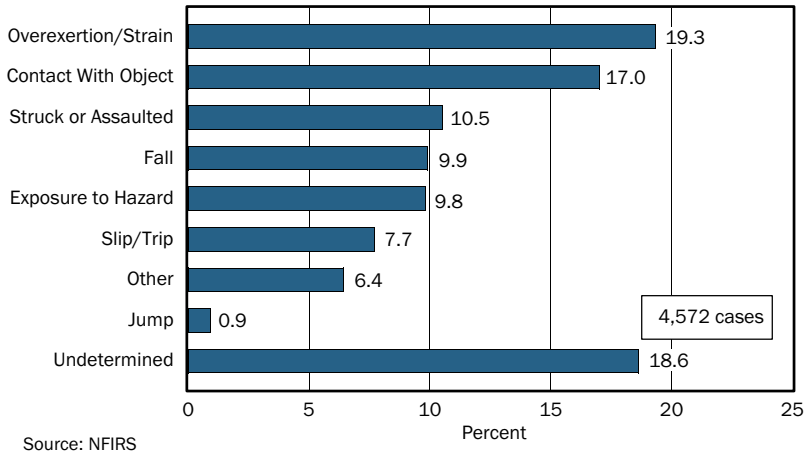


Figure 108. Firefighter Injuries by Cause (2001)

Figure 109. Firefighter Injuries by Where Injury Occurs (2001)

between injuries occurring inside and outside the structure. This distribution is little changed from 1998.

The striking point here is that many firefighter injuries (41 percent) occur in areas outside the fire building, a place where the firefighter may feel relatively safe. There often are more firefighters operating outside the fire building and exposed to injury than there are inside. At-scene outside structure fires include vehicle fires, which contribute to this high incidence of injuries.

Type of Activity When Injured

As in 1998, 42 percent of firefighter injuries in 2001 occurred while extinguishing the fire; suppression support accounted for 21 percent (Figure 110).

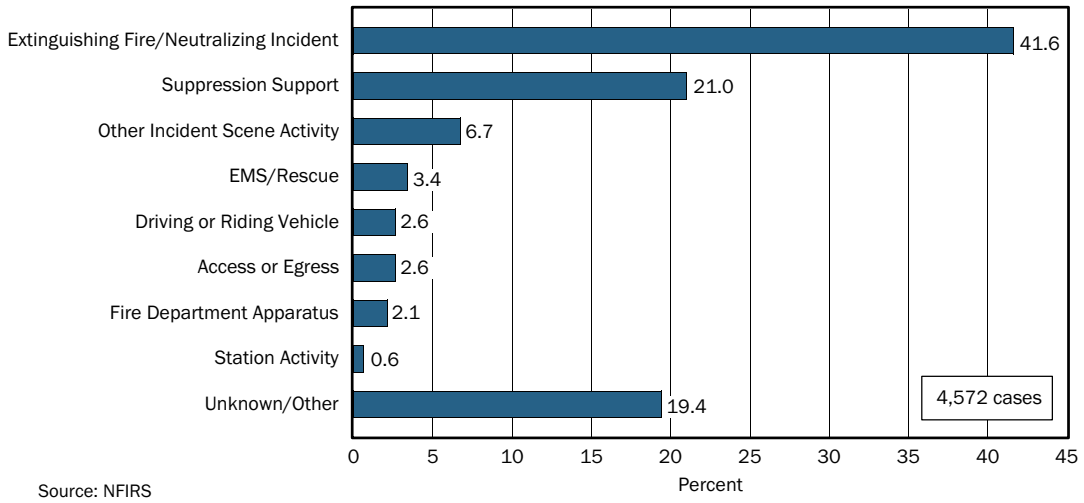


Figure 110. Firefighter Injuries by Type of Activity (2001)

Nature of Injury

There is a sharp contrast between the nature of firefighter injuries and the nature of deaths. Heart attacks, internal trauma, and asphyxiation accounted for 86 percent of firefighter fatalities (Figure 92), but these same categories accounted for just 6 percent of firefighter injuries (Figure 111). Sprains and strains and cuts and wounds accounted for 34 percent of injuries. Burns and pain combined accounted for an additional 22 percent.

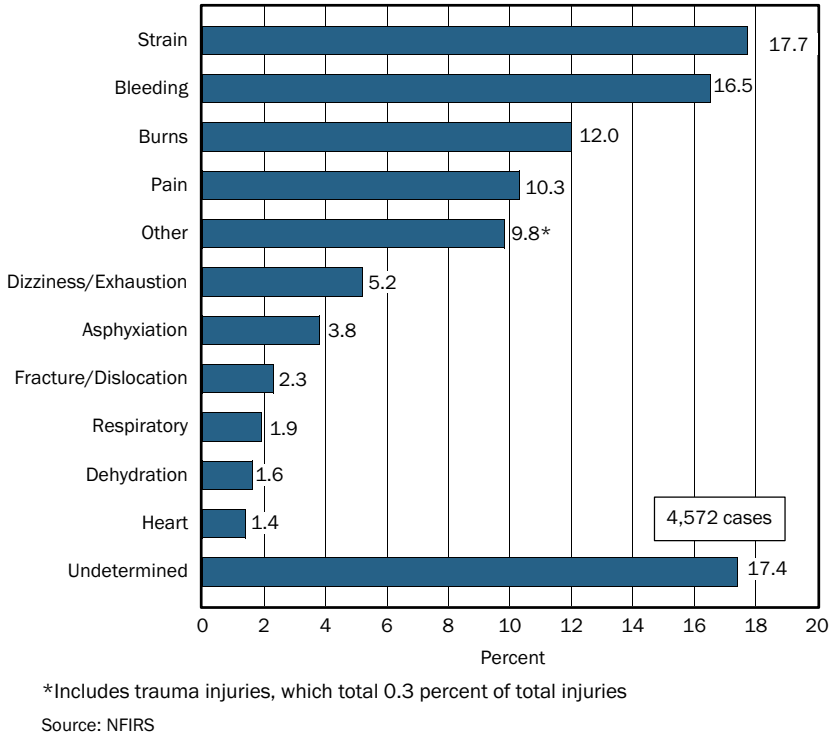


Figure 111. Firefighter Injuries by Nature of Injury (2001)

Type of Medical Care

Forty-eight percent of the reported fire injuries associated with fires in 2001 were treated at hospitals (Figure 112). Another 30 percent were treated but not transported.

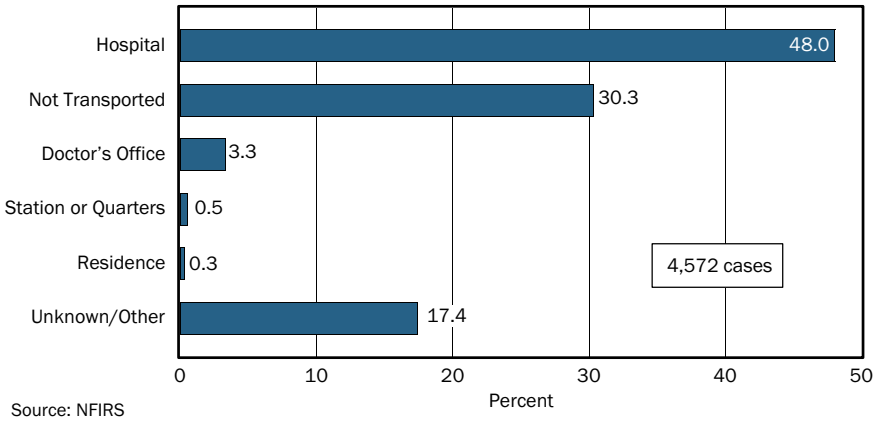


Figure 112. Firefighter Injuries by Where Treated (2001)

USFA RESOURCES ON FIREFIGHTER CASUALTIES

The USFA recently revised its NFIRS Firefighter Casualty Report to improve the quality of available data in its annual review of firefighter line-of-duty deaths. The 2002 report of the Firefighter Fatality Project, *Firefighter Fatalities in the United States in 2002* (FA–260), describes the data collected on line-of-duty firefighter deaths. This and other USFA-supported research and development are intended to increase the safety and well-being of emergency response personnel. USFA encourages the sharing of research findings and incorporation of innovations in equipment available to firefighters and other responders through programs that focus on health and safety studies; research, training, and awareness; emergency medical services; search and rescue; and equipment and technology development.

Because crashes are one of the leading causes of firefighter death and injury, USFA has numerous program initiatives and resources on the subject of emergency vehicle safety; these are detailed on USFA's Web site http://www.usfa.fema.gov/inside-usfa/research/safety/vehicle.shtm. USFA publications of interest in this area include the newly developed *Emergency Vehicle Safety Initiative* (FA–272) that details training, technological, and other programs that can reduce vehicle crashes as well as enhance operational safety of firefighters operating on the roadway; *SafeOperations of Fire Tankers* (FA–248) that provides comprehensive information regarding the safety practices and principals of operating fire tanker vehicles for local-level fire departments; *Alive on Arrival–Tips for Safe Emergency Vehicle Operations* (FA–255), a pamphlet that describes actions that emergency vehicle operators, passengers, and officers-in-charge can take to improve safety; and *Emergency Vehicle Driver Training* (FA–110), a training package that includes both an instructor manual and a student workbook. Also available is a special report titled *Fire Apparatus/Train Collision*

(USFA–TR–048) that presents the investigation of the collision near Catlett, Virginia, on September 28, 1989.

Publications addressing incident response issues have been developed for fire and EMS departments. Among these are *EmergencyIncident Rehabilitation* (FA–114), a booklet that includes a sample standard operating procedure and guidelines for establishing a rehab area to reduce heat- or cold-related injuries to emergency response personnel operating in labor-intensive or extreme climate conditions.

The USFA also emphasizes the study of protective clothing for chemical, emergency medical, and search-and-rescue emergencies as well as structural firefighting protective clothing and self-contained breathing apparatus (SCBA). For example, USFA has been involved in the development of a new test method for evaluating the performance of complete firefighter protective clothing ensembles. A suit integrity field test was conducted during hazardous materials training for USFA's study, *Qualitatively Evaluating the Comfort, Fit, Function, and Integrity of Chemical Protective Suit Ensembles*(FA–107). Three protective clothing ensembles were evaluated in *Physiologic Field Evaluation of Hazardous Materials Protective Ensembles* (FA–109). Another study, the *Non-Destructive Testing and Field Evaluation of Chemical Protective Clothing* (FA–106), details a procedure, field tested by the Cambridge, MA, Fire Department, developed for assessing the presence of contamination before or after decontamination of chemical protective clothing.

The USFA has supported research into health hazards faced by firefighters, including the *Northwest Firefighters Mortality Study* (FA–105). USFA also supports symposia on the occupational health and hazards of the fire service focusing on emerging firefighter safety and health issues.

The USFA developed a publication for emergency response managers on infection control programs based on federal laws, regulations, and standards. The *Guide to Developing and Managing an Emergency Service Infection Control Program* (FA–112) addresses modes of disease transmission, measures for prevention, incident response and recovery, station issues, and training/role modeling. The manual provides a step-by-step approach to designing, implementing, managing, and evaluating a fire or emergency medical services department infection control program. The guide is also a key resource in a National Fire Academy course on infection control.

A manual has been developed for fire service and EMS managers interested in instituting programs for firefighter health promotion and injury prevention. The *Fire and Emergency Service Hearing Conservation Program* (FA–118) outlines measures to reduce the risk of occupationally induced hearing loss. USFA also is conducting research to identify causes and to develop solutions for reducing stress levels in EMS providers.

The *Topical Fire Research* series for firefighter casualties can be downloaded from http://www.usfa.fema.gov/inside-usfa/nfdc/pubs/tfrs.shtm:

Firefighter Fatalities in 2000
Firefighter Injuries
Firefighter Injuries in Structures

Reports produced under the USFA's Major Fires Investigation series are directed primarily to chief fire officers, training officers, fire marshals, and investigators as a resource for training and prevention. The recent Technical Report Series on incidents involving firefighter deaths and injuries include:

Abandoned Cold Storage Warehouse Multi Firefighter Fatality Fire, Worchester, MA, December 3, 1999 (USFA–TR–134)

Aerial Ladder Collapse Incidents (April 1996) (USFA–TR–081)

Confined Space Rescue on SS Gem State, Tacoma, WA (FA–163A)

Detroit Warehouse Fire Claims Three Firefighters, March 1987 (USFA–TR–003)

Entrapment in Garage Kills One Firefighter, San Francisco, CA, March 9, 1995 (USFA–TR–084)

Floor Collapse Claims Two Firefighters, Pittston, PA, March 1993 (USFA–TR–073)

Four Firefighters Die in Seattle Warehouse Fire, Seattle, WA, January 15, 1995 (USFA–TR–077)

Four Firefighters Killed, Trapped by Floor Collapse, Brackenridge, PA, December 1991 (USFA–TR–061)

Highrise Office Building Fire, One Meridian Plaza, Philadelphia, PA, February 1991 (USFA–TR–049)

Indianapolis Athletic Club Fire, Indianapolis, IN, February 1992 (USFA–TR–063)

LP–Gas Tank Explosion Kills Two Volunteer Firefighters Carthage, IL, January 2004 (USFA–TR–120)

Santana Row Development Fire, San Jose, CA, July 2001 (USFA–TR–153)

Six Firefighter Fatalities in Construction Site Explosion, Kansas City, MO, November 1988 (USFA–TR–024)

Sodium Explosion Critically Burns Firefighters, Newton, MA, October 1993 (USFA–TR–075)

Structural Collapse at Dwelling Fire Results in Two Firefighter Fatalities, Stockton, CA, June 2003 (USFA–TR–102)

Three Firefighter Fatalities in Training Exercise, Milford, MI, October 1987 (USFA–TR–015)

Three Firefighters Die in Pittsburgh House Fire, Pittsburgh, PA, February 1995 (USFA–TR–078)

Two Firefighters Deaths in Auto Parts Store Fire, Chesapeake, VA, March 1996 (USFA–TR–087)

Wood Truss Roof Collapse Claims Two Firefighters, Memphis, TN, December 1992 (USFA–TR–069)

Other USFA works of interest while analyzing firefighter casualties include:

A Heat Transfer Model for Fire Fighter's Protective Clothing (FA–192)

A Needs Assessment of the U.S. Fire Service (FA–240)

Aftermath of Firefighter Fatality Incidents: Preparing for the Worst: Special Report (USFA–TR–089)

America at Risk (FA–223)

Citizen Corps Opportunities for America's First Responders (FA–263)

Developing Effective Standard Operating Procedures for Fire & EMS Departments (FA–197)

Emergency Medical Services (EMS) Recruitment and Retention Manual (FA–157)

EMS Safety Techniques and Applications (FA–144)

Fire and Emergency Medical Services Ergonomics – A Guide for Understanding and Implementing An Ergonomics Program in Your Department (FA–161)

Fire Department Communications Manual: A Basic Guide to System Concepts and Equipment (FA–160)

Fireboats: Then and Now (USFA–TR–146)

Firefighter Arson: Special Report (USFA–TR–141)

Firefighter Autopsy Protocol (FA–156)

Firefighter Fatalities in the United States series [for years 1986–2002]

Firefighter Fatalities Retrospective Study 1990–2000 (FA–220)

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Abandoned Cold Storage Warehouse Multi Firefighter Fatality Fire, Worchester, MA, December 3, 1999 (USFA–TR–134)

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Fire Department Communications Manual: A Basic Guide to System Concepts and Equipment (FA–160)

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Funding Alternatives for Fire and Emergency Services (FA–141)
Health and Wellness Guide for the Volunteer Fire Service (FA–267)
Health and Safety Issues of the Female Emergency Responder (FA–162)
HMEP Guidelines for Haz Mat/WMD Response, Planning and Prevention Training
If You Respond to Fire on Federal Property (FA–218)
Implementation of EMS in the Fire Service (FA–167)
Improving Firefighter Communications – Special Report (USFA–TR–099)
Many Faces, One Purpose: A Manager's Handbook on Women in Firefighting (FA–196)
Many Women Strong: A Handbook for Women Firefighters (FA–195)
Northwest Firefighters Mortality Study (FA–105)
Orientation Manual for First Responders on the Evacuation of People with Disabilities (FA–235)
Personnel Accountability System Technology Assessment (FA–198)
Prevention of Self-Contained Breathing Apparatus Failures: Special Report (USFA–TR–088)
Rapid Intervention Teams and How To Avoid Needing Them (USFA–TR–123)
Regional Delivery Brochure (FA–238)
Report of the Joint Fire/Police Task Force on Civil Unrest (FA–142)
Risk Management Planning for Hazardous Materials: What It Means for Fire Service Planning (USFA–TR–124)
Risk Management Practices in the Fire Service (FA–166)
Safe Operations of Fire Tankers (FA–248)
Safety and Health Considerations for the Design of Fire and Emergency Medical Services Stations (FA–168)
Small Board and Care Fire Evacuations: A Guide for the Fire Safety Professional
State Weekend Brochure (FA–224)
Strategies for Marketing Your Fire Department Today and Beyond (FA–182)
Taking Care of Our Own: A Resource Guide
Trends and Hazards in Firefighter Training: Special Report (USFA–TR–100)
US Fire Administration 2004–2005 Training Catalog (FA–273)
Volunteer Incentive Program 2005 (FA–247)

The USFA Web site discusses efforts related to firefighter health and safety: http://www.usfa.fema.gov/fire-service/health/health.shtm. The site that lists USFA publications dealing with this area is http://www.usfa.fema.gov/fire-service/health/health-pubs.shtm; and the site that covers research efforts in health and safety is http://www.usfa.fema.gov/inside-usfa/research/safety.shtm.

In addition to ordering through the online catalog, publications may be ordered by calling the Publications Center at (800) 561–3356 between 7:30 a.m. and 5:00 p.m. EST/EDT. To order publications by mail, write to:

Publications Center
United States Fire Administration
16825 S. Seton Avenue
Emmitsburg, MD 21727

Please include your name, mailing address, daytime telephone number, date required, title(s) of the publication, and the quantity you need when ordering by phone or mail. Also, publications

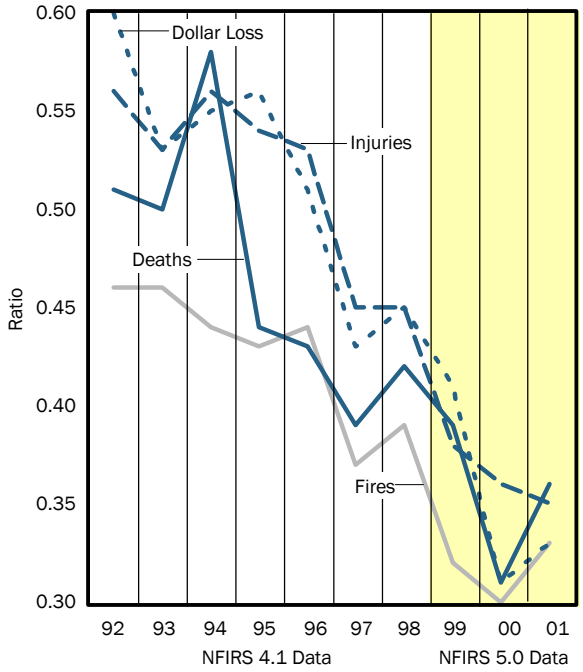
may be ordered online at http://www.usfa.fema.gov/applications/publications. Please include the parenthetical publication number, if given, in your request.

appendix A

Differences Between NFPA and NFIRS Estimates

The National Fire Incident Reporting System collects data from an average of 13,000 fire departments each year. The National Fire Protection Association's annual survey of fire departments[1] collects data from more than 3,000 fire departments. Neither is a perfect random sample; not all fire departments asked to participate do so. The distribution of fire departments is not the same in the two samples. And the NFPA survey collects tallied totals whereas NFIRS collects individual incident reports. Not surprisingly, therefore, there are differences between the NFPA annual survey results and the NFIRS results. In 9 of the 10 years examined (1992–2001), the deaths reported to NFIRS represent a larger fraction of the NFPA national estimate of deaths than the NFIRS number of fires is of the NFPA estimate of fires. NFIRS injuries and dollar loss are even larger fractions of the NFPA totals than are deaths or fires (Figure A-1).

Looking at the problem another way, Figure A-2 shows the number of deaths per fire, injuries per fire, and dollar loss per fire from NFIRS and NFPA from 1992 to 2001. Deaths per fire are similar for NFIRS and NFPA, with an average annual difference of 10 percent and a maximum

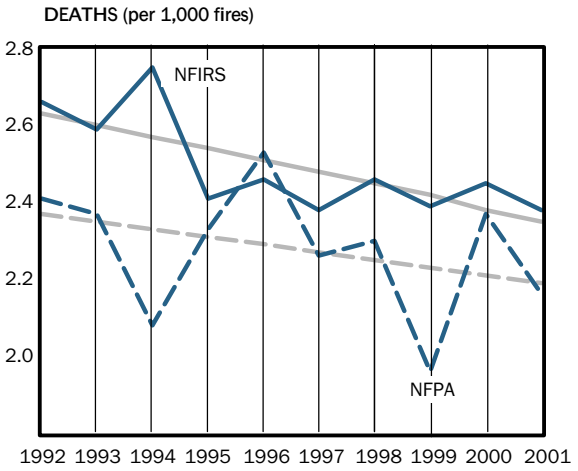


	Fires	Deaths	Injuries	Dollar Loss
1992	0.46	0.51	0.56	0.60
1993	0.46	0.50	0.53	0.53
1994	0.44	0.58	0.56	0.55
1995	0.43	0.44	0.54	0.56
1996	0.44	0.43	0.53	0.51
1997	0.37	0.39	0.45	0.43
1998	0.39	0.42	0.45	0.45
1999	0.32	0.39	0.38	0.41
2000	0.30	0.31	0.36	0.31
2001	0.33	0.36	0.35	0.33

Sources: NFPA and NFIRS

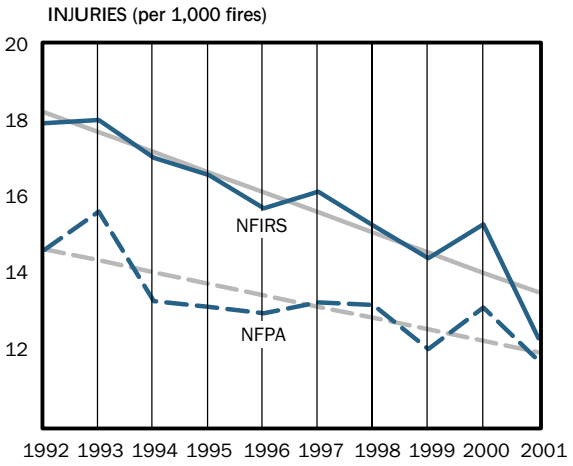
Figure A-1. Ratio of Raw NFIRS Sample to NFPA National Estimates

[1] "Fire Loss in the United States," *NFPA Journal*, generally the September/October issue each year.



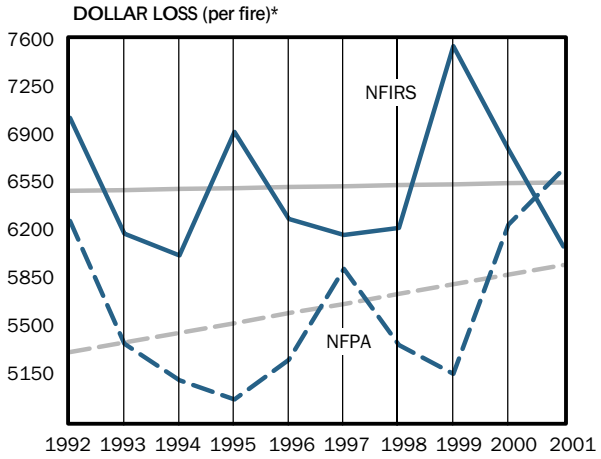
	NFIRS	NFPA
1992	2.66	2.41
1993	2.59	2.37
1994	2.75	2.08
1995	2.41	2.33
1996	2.46	2.53
1997	2.38	2.26
1998	2.46	2.30
1999	2.39	1.96
2000	2.45	2.37
2001	2.38	2.16

10-Year NFIRS Trend = –10.7%
10-Year NFPA Trend = –7.5%



	NFIRS	NFPA
1992	17.92	14.61
1993	18.01	15.61
1994	17.02	13.26
1995	16.57	13.11
1996	15.69	12.94
1997	16.14	13.23
1998	15.25	13.16
1999	14.38	12.00
2000	15.27	13.09
2001	12.29	11.70

10-Year NFIRS Trend = –26.0%
10-Year NFPA Trend = –18.5%



	NFIRS	NFPA
1992	$7,019	$6,266
1993	6,171	5,363
1994	6,012	5,098
1995	6,916	4,956
1996	6,280	5,248
1997	6,163	5,915
1998	6,215	5,358
1999	7,547	5,143
2000	6,769	6,239
2001	6,079	6,645

10-Year NFIRS Trend = +1.0%
10-Year NFPA Trend = +12.0%

*Adjusted to 2001 dollars

Sources: NFPA and NFIRS

Figure A-2 NFIRS vs. NFPA Survey: Losses Per Fire

difference of 32 percent in 1994. Injuries and dollar loss per fire are higher in the NFIRS sample than in the NFPA estimates by an average of 19 percent for injuries and 17 percent for dollar loss.

Other differences appear when reviewing losses by property type as shown in Figure A-3. Of interest is that the distribution of fires across property types between NFIRS and NFPA are quite similar with only small differences, which is quite reassuring. Over the 10-year period, the proportion of structure fires (both residential and non-residential) is virtually identical in the two sources. Vehicles are slightly more represented in the NFIRS sample; outside and other fires are slightly more represented in the NFPA estimate. Regardless of the specifics, the distributions are quite comparable.

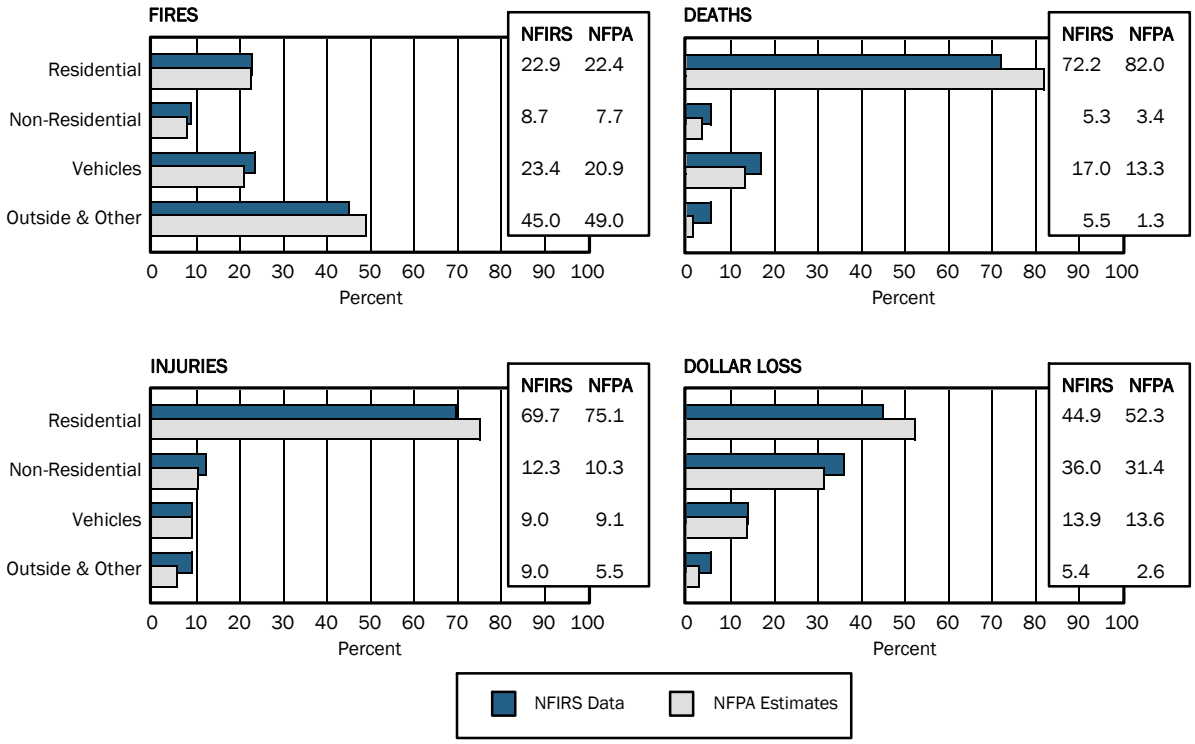


Figure A-3. Comparison of NFIRS Data With NFPA Estimates by General Property Type (10-year average)

But the deaths, injuries, and dollar losses that result from these fires are very different and are consistently more heavily represented in residential structures. The other major categories (except vehicular fire injuries) are consistently less for each of the loss measures.

One of the more important consequences of these distributions is in the creation of estimates of the various parts of the U.S. fire problem. For example, in Chapter 3, it is noted that NFPA residential estimates reflect 84 percent of fire deaths (3,140 of 3,745) and 77 percent of fire injuries (15,575 of 20,300). If USFA percentages for deaths (77 percent) and injuries

(73 percent) were applied to the overall NFPA estimates, as is the general case when creating estimates of the fire problem, the estimates would yield approximately 2,890 deaths and 14,880 injuries, both of which are substantially less.

The reasons for these differences are not known. It may be that some departments reporting summary data to NFPA inadvertently undercount their casualties and losses when reporting on the NFPA survey forms. Another possibility is that there are data entry errors in NFIRS, with larger numbers of deaths, injuries, and dollar loss creeping into the database despite edit checks at state and federal levels. (It appears that at least some of the dollar loss difference is due to this.)

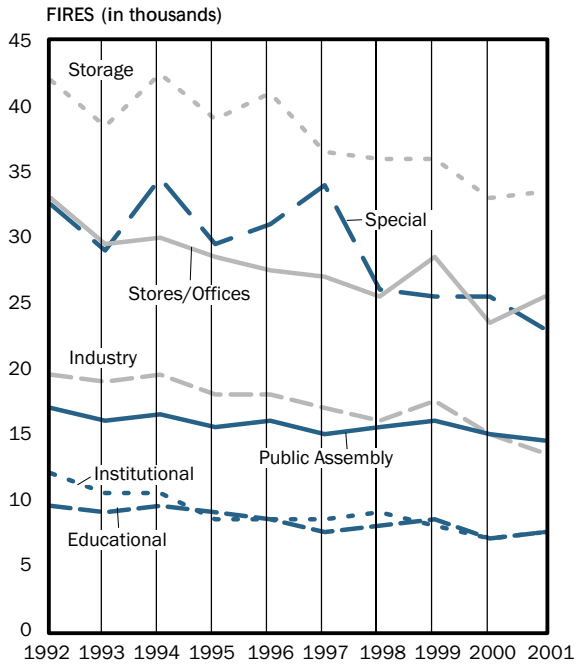
A third possibility for the differences is that fire departments might not report some minor fires to NFIRS that they include in their own totals that are reported to NFPA. It is known that, prior to the introduction of abbreviated reporting of small, no-loss confined fires, some departments did not fill out NFIRS forms for minor fires such as food on stoves or chimney fires. It is not clear whether these fires were or were not included in the department's report to NFPA nor the extent of the problem.

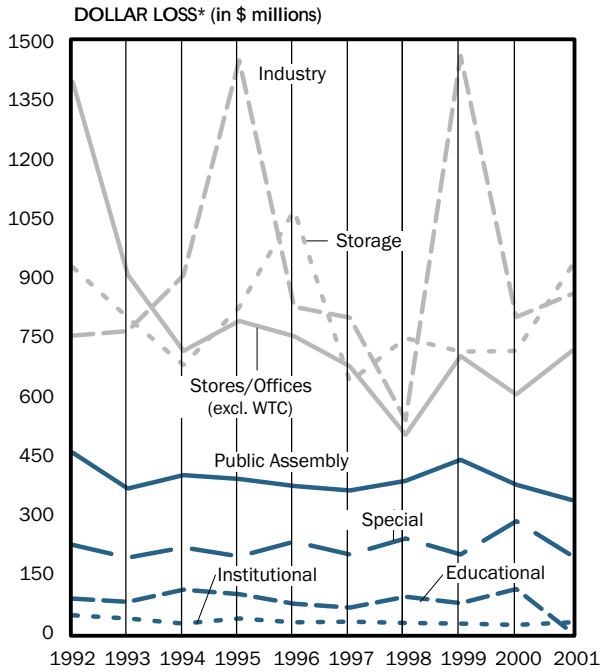
A fourth possibility is that some jurisdictions use NFIRS as a tracking system for fire casualty information without providing the related incident data. We know that this possibility does indeed occur from time to time in NFIRS. Again, we are unsure of how these deaths and their corresponding incidents are reported to NFPA.

Lastly, it could be that techniques used to generate the NFPA estimates unintentionally favor residential structures or that the NFIRS sample, because it is not a true random sample, may have a bias that results in fewer residential losses.

Resolving the differences between the two major sources of fire statistics in the United States is important to prevent confusion among users of the data.

Figure A-4 represents the NFPA survey trends for non-residential property fires and dollar loss.





Year	Public Assembly	Education	Institution	Stores/Offices	Industry	Storage	Special
1992	17,000	9,500	12,000	33,000	19,500	42,000	32,500
1993	16,000	9,000	10,500	29,500	19,000	38,500	29,000
1994	16,500	9,500	10,500	30,000	19,500	42,500	34,500
1995	15,500	9,000	8,500	28,500	18,000	39,000	29,500
1996	16,000	8,500	8,500	27,500	18,000	41,000	31,000
1997	15,000	7,500	8,500	27,000	17,000	36,500	34,000
1998	15,500	8,000	9,000	25,500	16,000	36,000	26,000
1999	16,000	85,00	8,000	28,500	17,500	36,000	25,500
2000	15,000	7,000	7,000	23,500	15,000	33,000	25,500
2001	14,500	7,500	7,500	25,500	13,500	33,500	23,000
Dollar Loss* ($ millions)							
1992	$456	$ 86	$44	$1,395	$ 754	$ 927	$223
1993	365	78	37	908	764	798	191
1994	399	109	24	715	906	679	216
1995	390	98	36	791	1,450	825	194
1996	372	73	27	751	827	1,071	231
1997	361	64	28	675	798	637	199
1998	385	91	25	502	539	746	239
1999	438	75	24	701	1,462	713	199
2000	375	111	21	604	800	714	283
2001	(excl WTC) 336	170	27	715	858	930	195
2001	(incl. WTC) 336	170	27	34,155	858	930	195

*Adjusted to 2001 dollars

Source: NFPA

Figure A-4. Trends in NFPA Non-Residential Structure Fires and Dollar Loss by Property Type

appendix B

Data Supporting Selected Fire and Loss Charts

The tables in this appendix provide the actual data used in developing the 10-year trend charts in Chapters 2–5 where there was insufficient space to present the numbers.

Table B-1. Proportions of Losses by General Property Type (percent)

Cause	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fires										
Residential	23.4	23.2	22.1	22.2	22.1	23.9	22.9	21.9	23.4	24.8
Non-Residential	9.3	8.8	8.7	8.9	8.5	8.9	8.6	8.4	8.6	8.3
Vehicle	23.5	23.9	23.6	23.4	23.9	24.2	24.0	22.4	22.2	21.5
Outside	42.2	42.5	44.0	43.7	43.7	41.2	42.5	45.0	42.7	41.1
Other	1.6	1.6	1.6	1.7	1.8	1.9	2.1	2.4	3.1	4.3
Deaths										
Residential	72.6	69.8	70.9	72.1	70.4	74.1	71.1	70.1	74.6	77.2
Non-Residential	5.3	5.4	4.9	6.4	7.8	4.4	7.4	5.3	3.9	3.4
Vehicle	17.1	15.9	16.7	17.0	18.1	16.8	16.2	19.8	17.0	15.6
Outside	2.2	2.9	2.6	2.1	1.9	2.1	2.4	1.8	1.5	2.1
Other	2.8	6.0	4.9	2.4	1.7	2.6	2.9	3.0	3.0	1.6
Injuries										
Residential	70.1	66.5	68.3	69.6	69.2	70.9	70.7	70.1	72.1	73.3
Non-Residential	12.8	13.1	12.9	12.8	12.0	12.8	11.2	11.8	11.9	10.0
Vehicle	9.1	11.4	9.6	8.9	8.7	7.8	8.1	9.3	6.7	8.4
Outside	4.1	5.2	4.6	4.9	5.8	4.1	4.3	5.4	5.2	4.4
Other	4.0	3.8	4.6	3.7	4.2	4.4	5.6	3.4	4.1	3.9
Dollar Loss										
Residential	43.9	48.3	43.1	38.5	43.8	47.7	47.0	37.9	47.5	54.0
Non-Residential	41.1	34.9	31.4	46.3	35.2	33.0	31.1	42.8	30.3	28.3
Vehicle	11.2	13.1	12.8	12.3	17.0	14.9	15.4	15.3	12.7	13.9
Outside	2.6	2.6	4.9	2.0	3.0	3.2	2.4	2.3	4.7	1.6
Other	1.2	1.1	7.8	0.8	1.0	1.2	4.2	1.6	4.8	2.2

Note 1: These data support Figure 16 and Table 10, Chapter 2.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

Source: NFIRS

Table B-2. Losses Per Fire by General Property Type

Cause	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Deaths (per 1,000 fires)										
Residential	8.2	7.8	8.8	7.8	7.8	7.4	7.8	7.7	7.8	7.4
Non-Residential	1.5	1.6	1.5	1.8	2.3	1.2	2.2	1.5	1.1	1.0
Vehicle	1.9	1.7	1.9	1.6	1.9	1.7	1.7	2.1	1.9	1.7
Outside	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other	4.1	2.4	5.1	3.1	2.3	2.9	3.3	3.1	2.3	0.9
Injuries (per 1,000 fires)										
Residential	53.6	51.6	52.5	51.0	49.0	47.8	47.1	46.0	47.1	36.4
Non-Residential	24.7	26.9	25.3	24.1	22.3	23.4	20.0	20.3	21.2	14.7
Vehicle	6.9	8.6	6.9	5.9	5.7	5.2	5.1	6.0	4.6	4.8
Outside	1.5	2.0	1.6	1.5	1.9	1.4	1.4	1.7	1.9	1.3
Other	42.4	43.2	47.6	36.6	37.0	36.9	40.0	20.7	20.2	11.1
Adjusted (2001) Dollar Loss (per fire)										
Residential	$13,500	$13,200	$12,300	$11,800	$12,700	$12,500	$13,200	$13,000	$13,800	$13,200
Non-Residential	31,900	25,500	23,100	35,900	26,900	23,800	23,700	38,700	24,000	20,600
Vehicle	3,400	3,500	3,400	3,400	4,500	3,900	4,100	5,200	3,900	3,900
Outside	500	500	500	400	500	600	500	400	700	200
Other	5,200	4,700	27,400	3,200	3,600	3,700	13,200	4,900	10,100	3,100

Note 1: These data support Figure 18 and Table 11, Chapter 2.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

Source: NFIRS and Consumer Price Index

Table B-3. Causes of Residential Fires and Fire Losses

Cause	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fires										
Incendiary/Suspicious	66,589	61,888	61,966	56,761	59,607	51,091	51,893	44,638	43,595	41,026
Children Playing	25,463	25,215	25,876	21,545	20,081	18,060	16,402	15,081	12,808	7,910
Smoking	28,814	27,931	26,498	26,056	25,714	23,494	23,124	24,789	24,088	21,428
Heating	87,728	88,695	77,439	73,352	66,228	63,292	51,000	53,655	57,090	61,426
Cooking	118,605	116,919	107,408	101,988	104,024	108,093	97,796	96,597	96,994	125,120
Electrical	43,084	45,089	44,552	44,117	43,586	43,453	40,458	40,252	35,907	27,108
Appliances	34,748	35,322	35,094	34,532	33,278	33,520	31,715	33,294	30,672	26,450
Open Flame	27,797	28,232	30,050	28,468	31,495	30,483	29,543	31,518	32,544	35,229
Other Heat	6,417	6,641	6,927	6,293	6,904	6,348	6,881	8,070	10,389	15,808
Other Equipment	6,564	6,020	7,017	4,983	8,820	4,627	6,245	5,338	5,117	5,418
Natural	8,951	10,164	10,197	9,359	9,485	8,835	9,557	9,823	10,744	10,841
Exposure	17,241	17,885	17,975	18,046	18,779	15,203	16,885	19,945	19,552	18,738
Total	472,000	470,000	451,000	425,500	428,000	406,500	381,500	383,000	379,500	396,500
Deaths										
Incendiary/Suspicious	698	756	505	737	662	675	592	563	801	739
Children Playing	398	423	426	333	288	294	224	174	222	114
Smoking	994	913	817	971	1,052	797	782	747	733	791
Heating	516	570	503	496	670	455	373	374	431	262
Cooking	280	371	314	283	399	313	422	358	216	353
Electrical	354	353	409	437	415	308	319	221	357	233
Appliances	99	112	147	167	164	113	128	95	86	125
Open Flame	245	168	179	187	218	269	244	174	283	290
Other Heat	80	35	62	29	66	78	41	84	105	114
Other Equipment	29	70	73	25	103	20	66	58	37	91
Natural	13	14	15	8	8	15	21	32	43	6
Exposure	61	38	15	21	37	54	37	42	129	23
Total	3,765	3,825	3,465	3,695	4,080	3,390	3,250	2,920	3,445	3,140
Injuries										
Incendiary/Suspicious	2,772	2,521	2,593	2,126	2,366	1,082	2,010	1,829	1,881	1,994
Children Playing	3,019	2,997	2,784	2,514	2,133	2,070	1,725	1,703	1,570	990
Smoking	2,767	2,907	2,436	2,388	2,523	2,755	1,987	1,865	2,211	1,734
Heating	2,278	2,595	2,003	1,970	1,858	1,456	1,514	1,493	1,550	1,135
Cooking	5,499	6,143	5,022	4,982	5,001	5,317	4,942	4,182	4,566	4,187
Electrical	1,730	1,854	1,546	1,680	1,544	1,477	1,297	1,171	1,232	876
Appliances	1,180	1,300	1,518	972	1,048	1,133	1,156	976	1,103	1,007
Open Flame	1,352	1,377	1,514	1,629	1,772	1,696	1,620	2,071	2,287	2,244
Other Heat	343	332	285	374	311	317	314	390	447	786
Other Equipment	277	245	359	170	413	166	288	329	177	247
Natural	153	154	148	116	116	160	153	148	173	170
Exposure	228	175	148	205	215	145	170	267	201	204
Total	21,600	22,600	20,025	19,125	19,300	17,775	17,175	16,425	17,400	15,575
Adjusted (2001) Dollar Loss ($ millions)										
Incendiary/Suspicious	$1,077.9	$1,091.9	$1,083.4	$1,065.2	$1,138.5	$ 969.7	$ 942.0	$ 919.3	$1,010.3	$1,075.6
Children Playing	278.1	345.4	335.6	315.8	304.4	302.8	243.9	269.3	266.7	216.7
Smoking	277.0	353.7	324.1	339.6	320.3	339.5	305.8	368.6	380.0	356.2
Heating	739.2	784.9	754.8	772.9	861.1	704.7	576.9	714.7	762.5	556.5
Cooking	469.7	602.0	635.5	469.2	520.2	542.9	461.0	556.7	554.3	410.2
Electrical	646.8	877.6	732.3	803.8	797.9	818.1	772.9	848.1	840.2	721.0
Appliances	267.6	344.4	314.9	300.8	357.1	346.1	297.0	316.5	381.3	566.3
Open Flame	259.1	357.9	339.1	368.2	477.6	404.5	392.1	553.4	596.2	660.3
Other Heat	63.8	71.6	74.0	87.2	85.5	94.9	95.1	121.9	214.4	255.6
Other Equipment	176.8	123.5	139.3	84.4	196.7	91.1	158.0	125.2	124.7	134.0
Natural	157.5	220.4	202.5	228.3	189.9	183.0	232.1	290.4	312.1	345.9
Exposure	484.2	762.4	223.1	234.7	351.6	262.0	294.0	328.8	392.8	344.6
Total	$4,898.0	$5,936.0	$5,159	$5,070.0	$5,601.0	$5,059.0	$4,771.0	$5,413.0	$5,836	$5,643

Note 1: These data support Figure 24 and Table 13, Chapter 3. Columns may not add exactly to the totals due to rounding.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

Sources: NFIRS, NFPA, and Consumer Price Index

Table B-4. Causes of One- and Two-Family Dwelling Fires and Fire Casualties

Cause	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fires										
Incendiary/Suspicious	46,977	43,838	43,811	39,721	42,841	36,001	36,964	30,999	31,329	30,493
Children Playing	18,722	18,519	18,981	16,228	15,554	13,706	12,453	11,577	9,749	6,020
Smoking	16,761	16,339	16,057	16,079	15,804	14,288	14,056	15,131	14,325	13,160
Heating	84,132	84,730	72,554	67,831	61,090	57,893	45,201	48,856	52,835	56,888
Cooking	73,887	72,053	66,283	62,723	64,037	65,841	59,283	56,435	57,086	74,739
Electrical	35,855	37,539	36,904	36,082	36,376	35,800	33,351	34,545	31,205	23,405
Appliances	27,746	28,284	27,824	27,212	26,959	26,757	25,456	25,286	23,510	20,247
Open Flame	22,562	23,264	24,332	23,054	25,383	24,443	23,179	24,878	26,014	28,743
Other Heat	5,122	5,419	5,484	4,888	5,591	5,003	5,474	6,319	8,169	13,005
Other Equipment	4,682	4,478	5,403	3,774	6,540	3,548	4,881	4,303	4,114	4,429
Natural	8,498	9,669	9,659	8,695	8,971	8,149	8,849	8,994	9,989	10,197
Exposure	13,055	13,868	13,708	13,713	14,855	10,972	12,854	15,179	15,175	14,174
Total	358,000	358,000	341,000	320,000	324,000	302,500	283,000	282,500	283,500	295,500
Deaths										
Incendiary/Suspicious	554	653	400	580	515	482	533	360	623	529
Children Playing	338	310	270	247	248	236	218	142	205	89
Smoking	745	653	608	711	797	533	573	588	560	592
Heating	485	514	444	434	673	461	373	376	417	236
Cooking	248	269	236	202	351	261	324	272	199	357
Electrical	338	318	383	429	371	261	315	207	324	242
Appliances	86	65	120	161	178	113	111	82	81	102
Open Flame	212	147	174	192	158	205	173	147	237	287
Other Heat	61	24	48	35	50	67	36	82	100	108
Other Equipment	29	53	68	25	84	15	62	60	37	102
Natural	16	16	17	5	10	15	18	33	31	0
Exposure	49	12	17	15	35	51	40	27	106	6
Total	3,160	3,035	2,785	3,035	3,470	2,700	2,775	2,375	2,920	2,650
Injuries										
Incendiary/Suspicious	1,375	1,498	1,441	1,326	1,360	942	1,174	924	1,131	1,311
Children Playing	2,229	2,009	1,976	1,792	1,571	1,416	1,346	1,374	1,198	753
Smoking	1,581	1,569	1,370	1,351	1,451	1,216	1,088	1,182	1,486	1,060
Heating	2,093	2,327	1,783	1,758	1,642	1,330	1,300	1,339	1,455	937
Cooking	3,693	4,083	3,340	3,364	3,307	3,380	2,995	2,608	2,821	2,807
Electrical	1,450	1,480	1,320	1,224	1,281	1,197	995	983	980	772
Appliances	960	1,055	874	707	844	885	912	767	874	814
Open Flame	1,057	1,055	1,146	1,216	1,410	1,298	1,235	1,496	1,805	1,780
Other Heat	287	235	231	291	246	242	227	270	355	634
Other Equipment	234	169	311	198	290	143	249	254	142	237
Natural	161	128	124	85	117	134	135	114	173	147
Exposure	156	92	83	139	179	118	144	239	155	147
Total	15,275	15,700	14,000	13,450	13,700	12,300	11,800	11,550	12,575	11,400

Note 1: These data support Figure 35 and Table 14, Chapter 3. Columns may not add exactly to the totals due to rounding.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

Sources: NFIRS and NFPA

Table B-5. Causes of Apartment Fires and Fire Casualties

Cause	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fires										
Incendiary/Suspicious	16,014	14,571	14,693	13,736	13,587	12,162	11,948	11,130	10,012	8,829
Children Playing	6,263	6,230	6,400	5,105	5,052	4,108	3,641	3,366	2,916	1,865
Smoking	9,306	9,228	8,573	8,366	8,276	7,687	7,624	8,024	7,933	6,748
Heating	5,647	5,940	5,362	5,528	5,470	5,167	4,480	4,651	4,633	4,725
Cooking	41,060	41,376	38,306	37,553	37,143	40,324	36,372	36,093	35,092	42,882
Electrical	5,406	5,775	5,700	6,017	5,954	5,887	5,290	5,288	4,585	3,567
Appliances	5,587	5,581	5,681	5,895	5,833	5,515	5,107	6,625	6,100	5,401
Open Flame	4,794	4,643	5,274	4,945	4,893	5,481	5,487	5,855	5,869	5,968
Other Heat	1,225	1,198	1,347	1,279	1,268	1,293	1,339	1,459	1,734	2,332
Other Equipment	1,539	1,211	1,321	953	945	797	1,027	842	820	710
Natural	631	719	641	720	715	705	715	787	772	695
Exposure	3,528	3,526	3,701	3,905	3,864	3,874	3,468	4,379	4,033	4,277
Total	101,000	100,000	97,000	94,000	93,000	93,000	86,500	88,500	84,500	88,000
Deaths										
Incendiary/Suspicious	110	122	133	138	112	173	64	178	165	151
Children Playing	80	119	130	89	49	60	12	23	18	23
Smoking	187	235	193	241	214	242	175	150	165	158
Heating	30	29	40	31	23	4	15	9	18	35
Cooking	37	58	59	45	59	47	89	84	18	23
Electrical	24	42	40	28	26	47	9	14	30	12
Appliances	11	16	6	21	10	4	15	14	6	23
Open Flame	32	23	25	10	36	60	52	28	43	12
Other Heat	19	10	14	0	16	13	3	5	6	12
Other Equipment	4	6	0	0	13	4	6	0	0	0
Natural	0	0	0	0	0	0	3	0	12	0
Exposure	11	26	0	3	7	4	0	14	18	12
Total	545	685	640	605	565	658	443	520	500	460
Injuries										
Incendiary/Suspicious	1,080	892	952	819	808	680	741	769	645	534
Children Playing	823	941	704	702	565	634	416	349	381	244
Smoking	1,017	1,128	872	811	931	680	788	604	652	551
Heating	255	266	223	190	188	149	222	174	160	207
Cooking	1,685	1,965	1,616	1,504	1,635	1,830	1,902	1,441	1,535	1,267
Electrical	267	357	277	314	247	284	280	215	244	114
Appliances	200	224	255	205	190	222	158	193	166	186
Open Flame	291	293	385	403	403	376	333	517	456	447
Other Heat	74	91	52	92	70	75	81	103	88	145
Other Equipment	51	58	56	51	85	18	28	68	23	17
Natural	10	20	22	28	9	23	22	31	13	31
Exposure	72	64	62	81	45	28	28	37	36	59
Total	5,825	6,300	5,475	5,200	5,175	5,000	5,000	4,500	4,400	3,800

Note 1: These data support Figure 45 and Table 15, Chapter 3. Columns may not add exactly to the totals due to rounding.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

Sources: NFIRS and NFPA

Table B-6. Causes of Non-Residential Structure Fires and Fire Losses

Cause	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fires										
Incendiary/Suspicious	53,794	45,888	46,472	43,859	42,404	36,089	34,651	33,457	28,986	26,203
Children Playing	5,235	4,550	4,934	5,085	4,114	2,648	2,964	2,620	1,819	1,072
Smoking	7,933	7,410	6,794	6,520	6,792	6,528	6,110	7,025	6,088	5,164
Heating	11,024	10,798	9,927	10,676	10,874	10,997	10,315	10,594	10,791	10,124
Cooking	13,239	12,617	11,959	12,298	13,016	15,753	13,481	12,892	13,193	18,899
Electrical	17,198	16,765	15,871	15,656	17,053	18,419	16,596	15,930	13,797	10,778
Appliances	9,613	9,442	8,849	8,801	8,854	10,340	8,968	8,347	7,243	6,931
Open Flame	16,435	14,447	15,934	15,739	15,279	15,867	14,640	13,369	11,439	12,113
Other Heat	2,956	2,769	2,999	2,838	2,938	2,989	2,898	4,119	4,551	6,827
Other Equipment	11,782	11,650	11,879	10,850	12,627	13,446	11,972	10,226	9,118	8,480
Natural	5,133	5,277	5,417	5,082	4,834	5,502	5,041	6,235	5,850	5,923
Exposure	11,158	9,888	10,463	10,595	11,716	6,922	8,365	15,186	13,125	11,986
Total	165,500	151,500	151,500	148,000	150,500	145,500	136,000	140,000	126,000	124,500
Deaths										
Incendiary/Suspicious	63	57	21	51	47	30	55	46	33	3
Children Playing	4	4	0	0	2	5	4	0	0	8
Smoking	20	15	24	34	13	18	8	12	13	22
Heating	6	21	15	23	18	15	8	7	3	3
Cooking	4	6	10	6	4	0	16	7	3	14
Electrical	20	15	12	40	9	20	12	12	0	11
Appliances	6	6	0	6	0	0	0	0	0	0
Open Flame	26	9	21	57	22	25	36	16	10	11
Other Heat	9	3	5	0	9	0	4	5	23	0
Other Equipment	15	9	17	45	13	5	24	14	3	3
Natural	0	7	0	28	2	0	0	0	0	3
Exposure	4	3	0	2	2	3	4	2	0	3
Total	175	155	125	290	140	121	171	120	90	80
Injuries										
Incendiary/Suspicious	556	811	577	441	404	404	413	336	222	212
Children Playing	65	102	76	55	63	44	26	46	39	42
Smoking	214	285	182	132	170	188	147	125	102	52
Heating	255	326	227	259	204	250	168	213	198	143
Cooking	264	413	298	296	258	296	256	202	246	202
Electrical	340	478	353	241	309	292	263	253	345	124
Appliances	166	196	284	200	189	283	140	151	162	114
Open Flame	290	357	366	348	345	299	197	287	270	232
Other Heat	74	78	60	73	72	64	55	125	114	85
Other Equipment	378	746	498	417	441	319	450	287	348	346
Natural	90	122	156	107	76	136	123	51	69	33
Exposure	32	37	22	32	44	25	12	23	84	65
Total	2,725	3,950	3,100	2,600	2,575	2,600	2,250	2,100	2,200	1,650
Adjusted (2001) Dollar Loss ($ millions)										
Incendiary/Suspicious	$2,274.9	$1,009.6	$1,081.7	$1,351.3	$ 941.9	$ 717.1	$ 729.6	$1,622.4	$ 800.0	$ 964.3
Children Playing	23.4	34.2	27.4	28.9	19.4	20.5	18.8	15.8	23.8	8.8
Smoking	64.1	62.1	84.3	187.4	93.8	76.1	50.3	208.3	70.8	52.1
Heating	211.3	191.5	232.9	208.4	233.8	210.4	145.3	231.3	237.0	194.8
Cooking	107.8	84.4	115.3	133.9	159.4	83.0	108.6	75.2	114.9	86.6
Electrical	366.3	493.1	408.4	423.4	418.1	407.0	416.4	527.9	413.9	363.1
Appliances	97.1	105.4	90.9	99.3	86.2	123.7	142.6	46.9	103.0	107.4
Open Flame	180.7	315.6	260.4	296.4	302.6	477.3	181.5	223.9	265.2	482.0
Other Heat	49.7	52.6	51.8	403.0	47.9	55.7	62.8	18.8	145.9	159.9
Other Equipment	231.2	340.5	413.2	295.1	674.2	333.8	377.0	290.0	377.4	291.9
Natural	115.0	154.5	171.4	152.5	155.8	156.7	144.3	153.7	174.1	289.8
Exposure	162.4	297.6	125.1	205.3	220.5	99.3	150.1	165.9	181.4	230.3
Total	$3,884.1	$3,141.2	$3,062.8	$3,784.9	$3,353.5	$2,760.8	$2,527.2	$3,612.2	$2,907.4	$3,231.0

Note 1: These data support Figure 60 and Table 18, Chapter 4. Columns may not add exactly to the totals due to rounding.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

Sources: NFIRS, NFPA, and Consumer Price Index

Table B-7. Ignition Factor Causes of Mobile Property Fires and Fire Casualties

Ignition Factor	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fires (thousands)										
Incendiary/Suspicious	73.4	68.1	66.5	66.2	74.4	64.6	66.4	58.0	68.0	80.7
Collision	6.9	6.9	7.1	7.4	7.4	7.2	7.5	7.4	7.0	7.3
Human Act	45.4	46.9	47.3	44.1	43.1	42.3	39.3	37.8	34.0	34.3
Mechanical/Design	270.1	288.4	291.6	279.3	277.9	271.4	256.2	237.1	211.2	198.8
Other	9.2	10.2	9.5	9.5	10.6	11.5	11.7	28.2	28.3	30.5
Deaths										
Incendiary/Suspicious	30	48	54	67	62	43	36	38	82	114
Collision	520	367	400	279	432	253	369	272	259	221
Human Act	86	70	43	91	88	77	77	43	13	29
Mechanical/Design	51	66	113	80	95	68	80	51	51	42
Other	42	44	20	19	33	39	13	66	60	78
Injuries										
Incendiary/Suspicious	158	107	161	133	121	123	164	96	95	222
Collision	669	308	480	495	415	253	406	250	303	232
Human Act	766	494	738	606	637	662	657	440	381	481
Mechanical/Design	1,316	1,703	1,130	1,229	1,000	1,069	963	633	692	808
Other	92	63	116	63	52	59	35	431	128	182

Note 1: These data support Figure 78 and Table 21, Chapter 4. Columns may not add exactly to the totals due to rounding.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

Sources: NFIRS and NFPA

Table B-8. Firefighter Injuries by Type of Structure (percent)

Type of Structure	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Residential Structures										
One- and Two-Family Dwellings	66.3	68.4	68.8	67.6	69.4	66.9	70.3	70.8	70.8	71.4
Apartments	27.7	27.5	26.7	27.6	25.8	27.2	25.2	26.9	26.9	25.0
Hotels/Motels	1.8	1.2	1.4	1.5	1.4	1.8	1.4	0.8	0.8	1.4
Other Residential	1.2	0.8	0.9	0.9	1.0	1.2	0.8	1.5	1.4	2.2
Non-Residential Structures										
Public Assembly	4.6	4.0	3.7	3.8	4.3	4.2	2.9	4.4	5.6	3.0
Eating/Drinking	7.4	5.5	6.0	5.7	7.6	6.1	5.9	4.3	5.6	8.1
Educational	3.6	2.2	2.6	1.7	2.8	2.2	2.5	2.2	2.8	1.4
Institutional	2.8	2.7	3.1	1.1	1.3	2.8	1.6	1.0	1.6	2.1
Stores/Offices	19.1	24.4	21.1	17.9	20.3	23.2	22.1	15.2	22.9	24.4
Basic Industry	2.8	2.2	3.5	2.1	2.2	1.8	5.0	2.5	1.5	3.4
Manufacturing	10.9	11.5	11.4	14.0	14.7	12.1	12.6	10.4	14.9	13.8
Storage	17.0	15.4	18.5	24.0	14.8	16.8	17.5	37.3	16.2	18.5
Residential Garages	4.1	4.6	4.7	4.8	5.5	7.0	7.2	5.9	5.9	3.3
Vacant/Under Construction	18.2	14.6	15.4	15.9	16.9	13.0	12.4	*	*	*
Outside Structure/ Unknown	9.4	12.8	9.7	9.0	9.4	10.7	10.3	16.7	22.9	22.1

Note 1: These data support Figure 99, Chapter 5. Columns may not add exactly to the totals due to rounding.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

*Vacant/under construction in NFIRS 5.0 can be any property type.

Source: NFIRS

Table B-9. Firefighter Injuries Per 1,000 Fires by Type of Structure

Type of Structure	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Residential Structures										
One- and Two-Family Dwellings	34.0	35.1	33.4	31.0	30.3	27.7	26.4	27.8	28.4	21.9
Apartments	45.8	45.0	42.2	41.7	36.1	35.3	30.2	30.4	32.8	24.8
Hotels/Motels	45.5	30.1	30.0	28.3	27.3	28.4	20.9	19.5	18.7	26.9
Other Residential	34.7	24.1	23.9	23.5	24.2	29.5	17.5	17.9	16.2	13.6
Overall Residential	**37.7**	**36.9**	**35.1**	**33.0**	**31.3**	**29.5**	**26.8**	**28.1**	**29.0**	**22.4**
Non-Residential Structures										
Public Assembly	49.5	39.5	36.2	41.1	31.4	36.2	18.8	39.5	36.8	12.0
Eating/Drinking	43.4	29.8	32.6	32.4	31.1	26.5	22.4	21.5	20.2	18.7
Educational	29.1	16.6	19.5	12.9	17.2	14.3	15.3	15.8	13.6	4.4
Institutional	17.2	15.0	18.1	7.3	6.3	13.4	7.3	6.8	7.9	6.4
Stores/Offices	43.2	57.0	49.4	45.8	36.7	47.0	40.0	35.0	36.8	24.7
Basic Industry	43.3	34.0	48.4	30.8	23.7	21.8	50.2	34.4	16.6	23.7
Manufacturing	57.4	55.0	52.8	69.2	55.6	43.5	42.3	42.0	48.1	33.6
Storage	50.0	42.8	47.8	66.1	29.2	34.4	34.2	81.9	25.7	18.7
Residential Garages	17.8	18.8	17.6	19.5	18.0	25.3	21.8	23.1	17.3	8.6
Vacant/Under Construction	67.8	52.8	49.6	56.1	51.8	59.0	40.9	60.7	66.7	40.4
Outside Structure/ Unknown	29.3	37.4	29.2	25.3	19.5	26.8	23.2	31.5	29.4	18.0
Overall Non-Residential	**41.5**	**39.6**	**38.3**	**40.6**	**30.4**	**33.8**	**29.9**	**38.5**	**27.7**	**18.4**

Note 1: These data support Figure 102, Chapter 5. Columns may not add exactly to the totals due to rounding.
Note 2: Unshaded columns are NFIRS 4.1 data; shaded columns are NFIRS 5.0 data.

Source: NFIRS

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