

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.

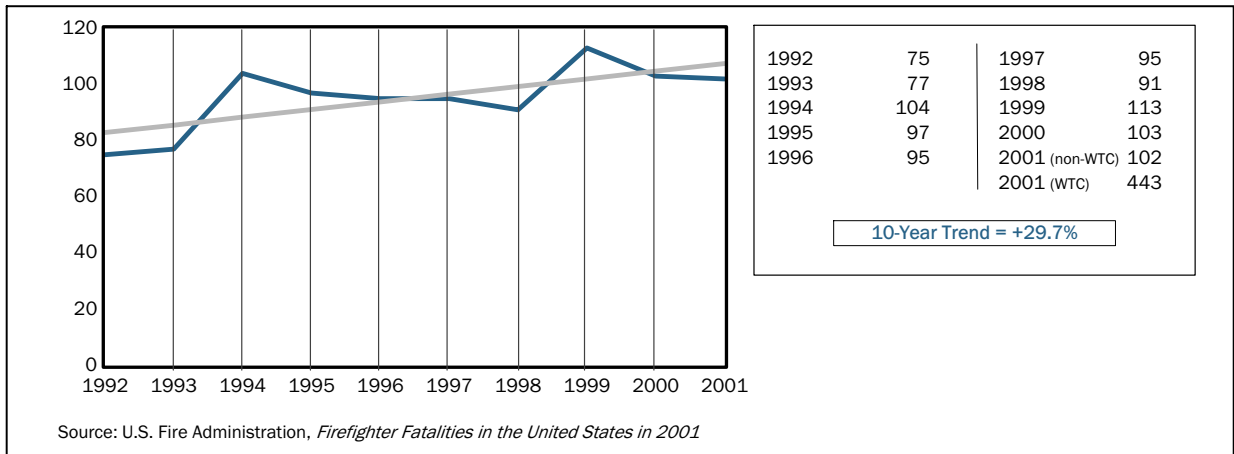


Figure 86. Trends in Firefighter Deaths

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

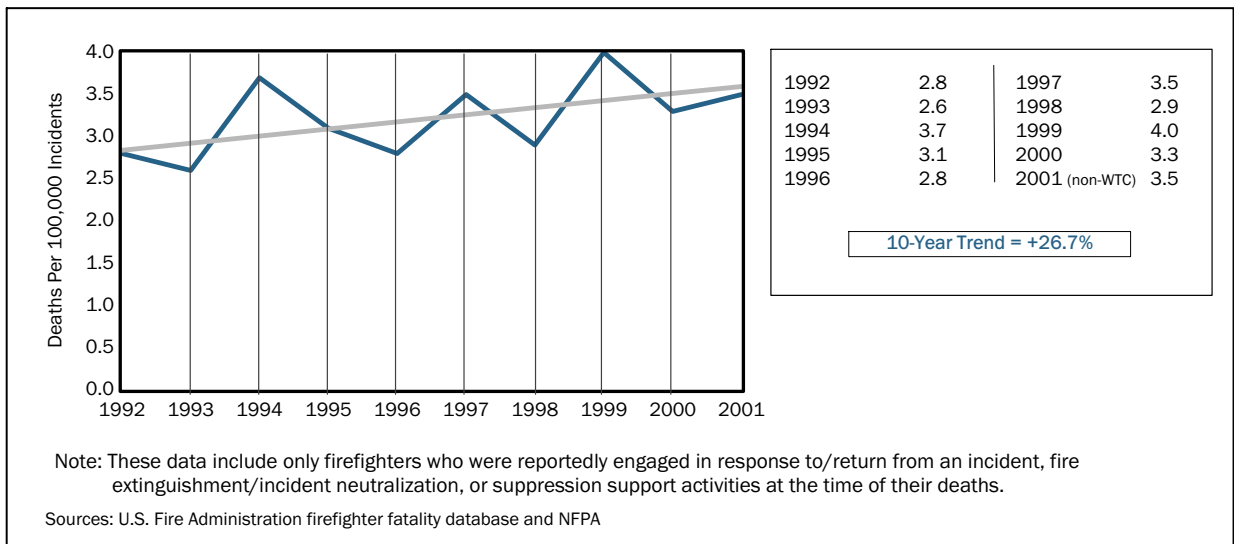


Figure 87. Trends in Fire-Incident-Related Firefighter Fatalities Per 100,000 Incidents

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.

in fire incidence declined 15 percent. It is not clear why we seem to be doing a good job at 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.

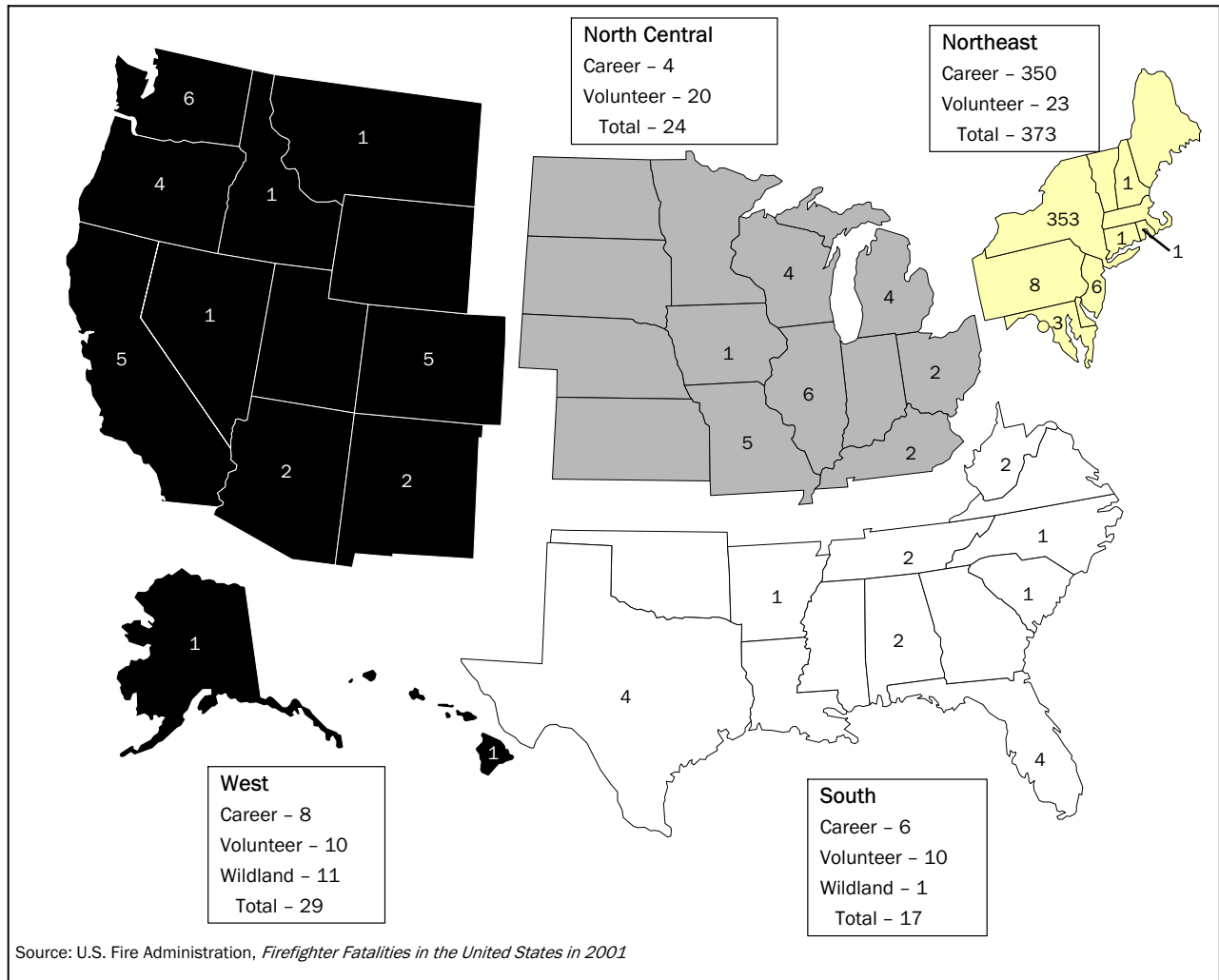


Figure 88. Firefighter Deaths by Region and State (2001)

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.

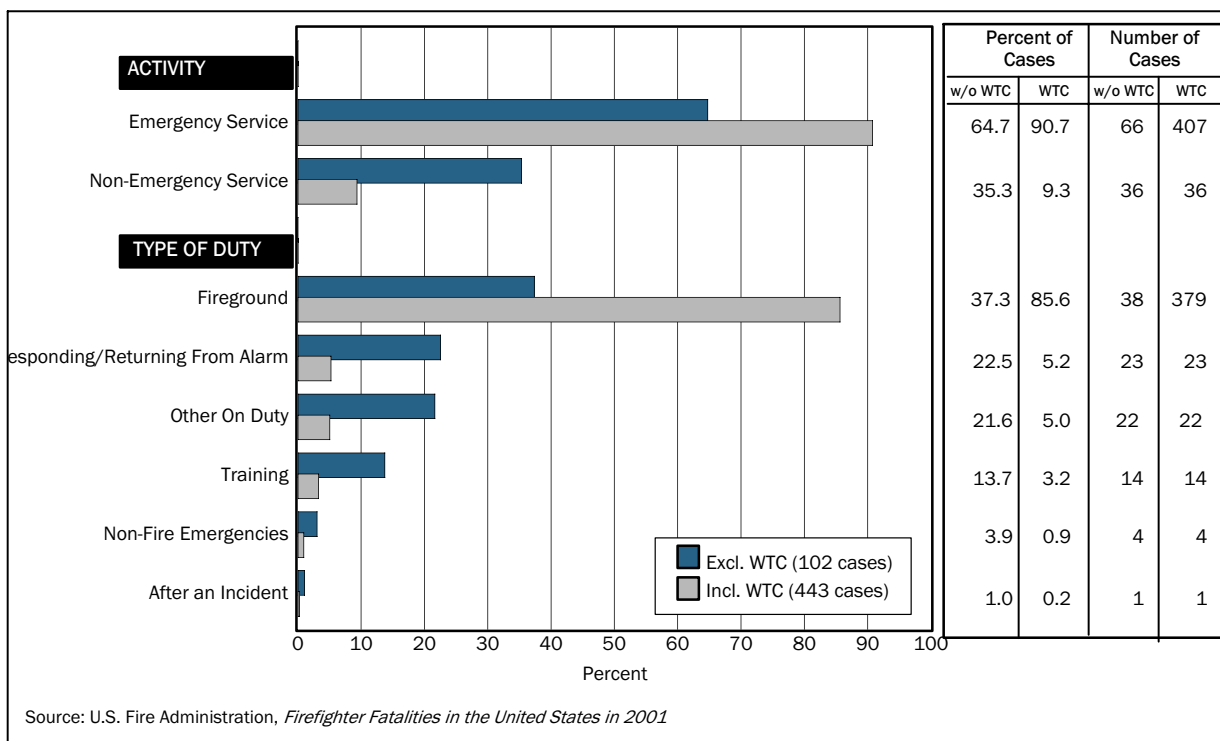


Figure 89. Firefighter Deaths by Activity and Type of Duty (2001)

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

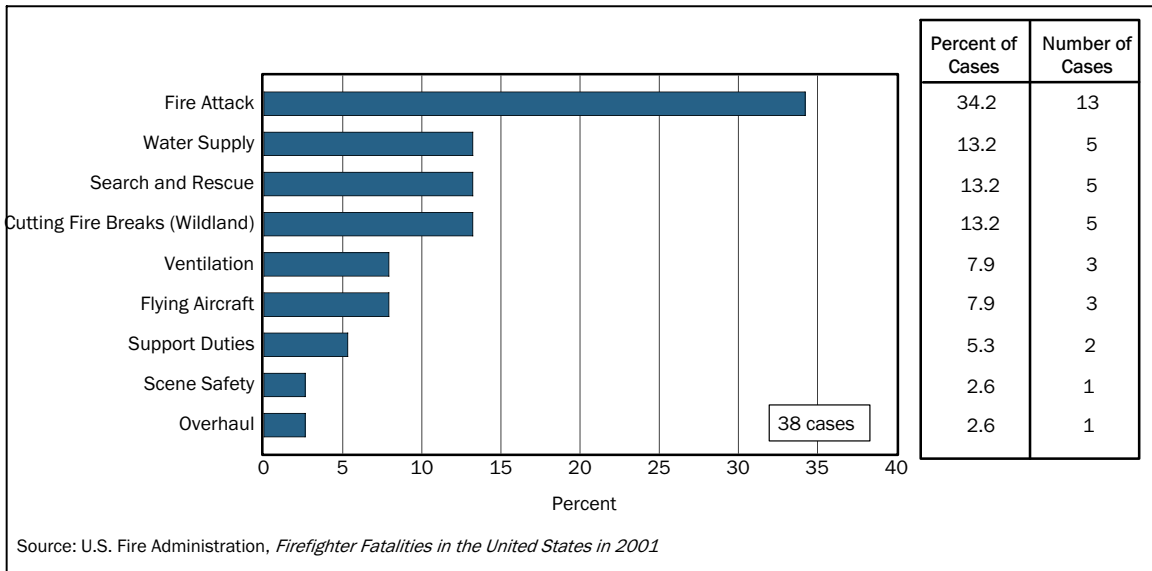


Figure 90. Firefighter Deaths on Fireground by Type of Activity (Excludes WTC) (2001)

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.

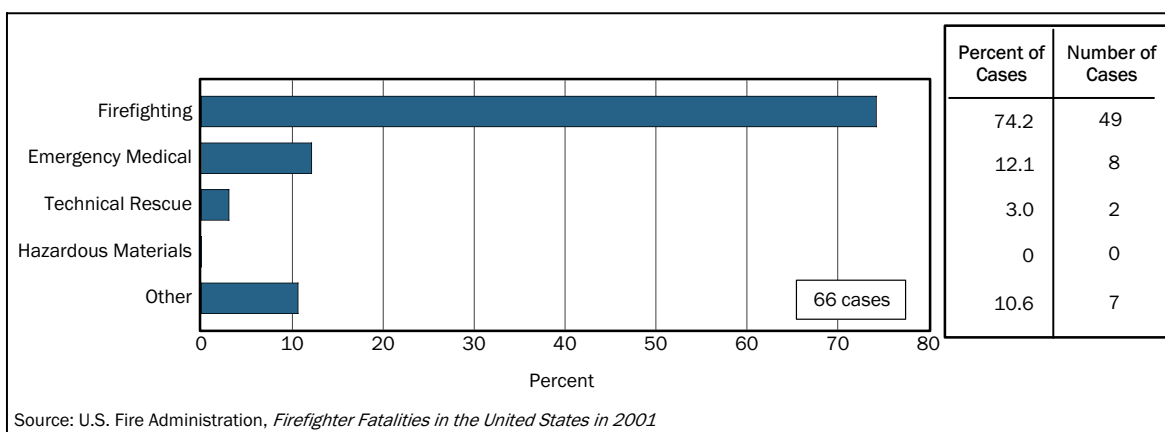


Figure 91. Firefighter Deaths During Emergency Duty (Excludes WTC) (2001)

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

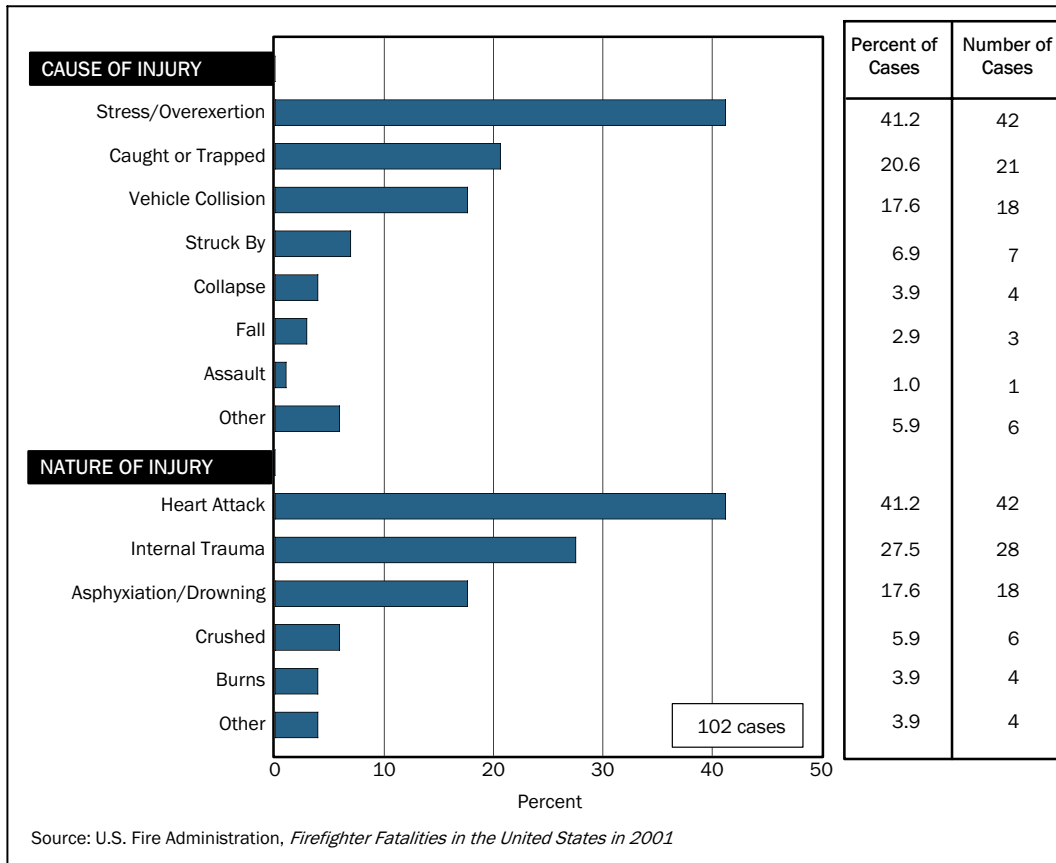


Figure 92. Firefighter Deaths by Cause and Nature of Injury (Excludes WTC) (2001)

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 were 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.

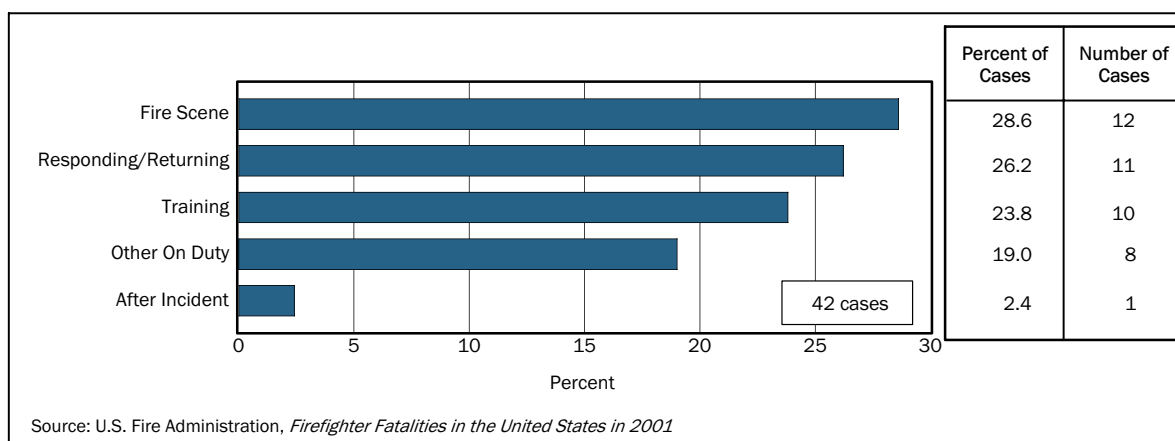


Figure 93. Firefighter Heart Attack Deaths by Type of Duty (2001)

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.

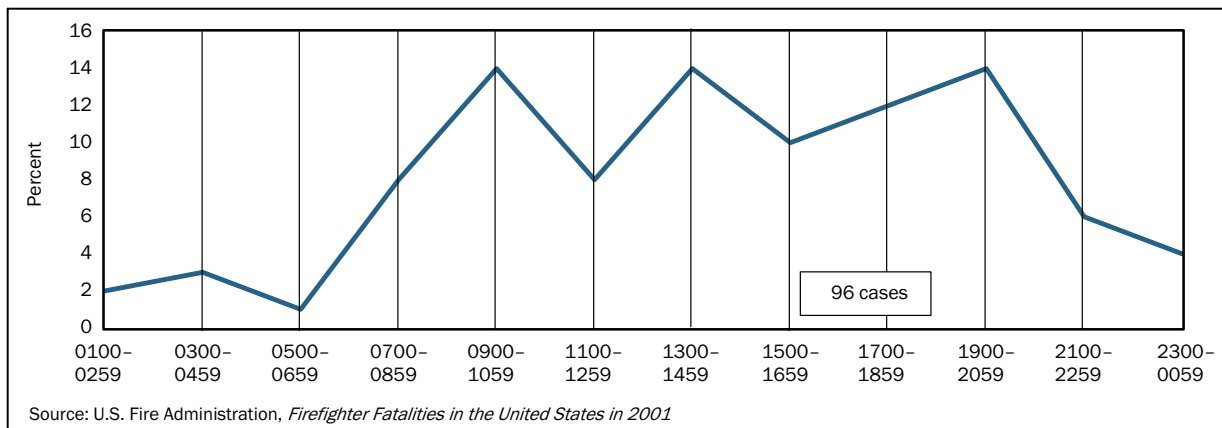


Figure 94. Firefighter Deaths by Time of Fatal Injury (Excludes WTC) (2001)

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.

Firefighter Health

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.

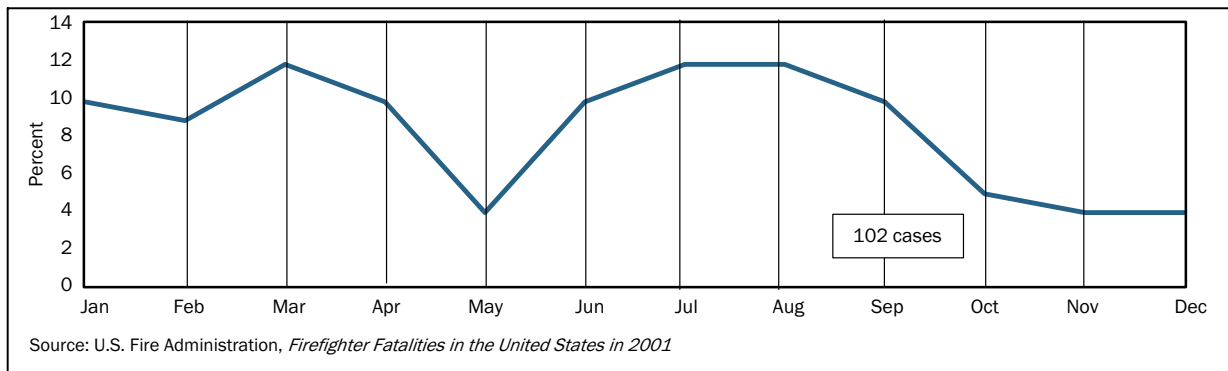


Figure 95. Firefighter Deaths by Month of Year (Excludes WTC) (2001)

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.

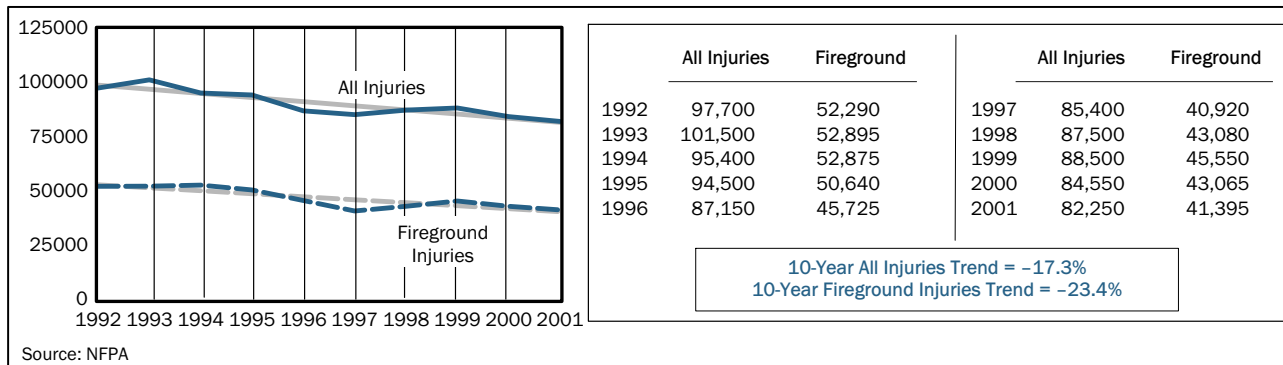


Figure 96. Trends in Firefighter Injuries

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.

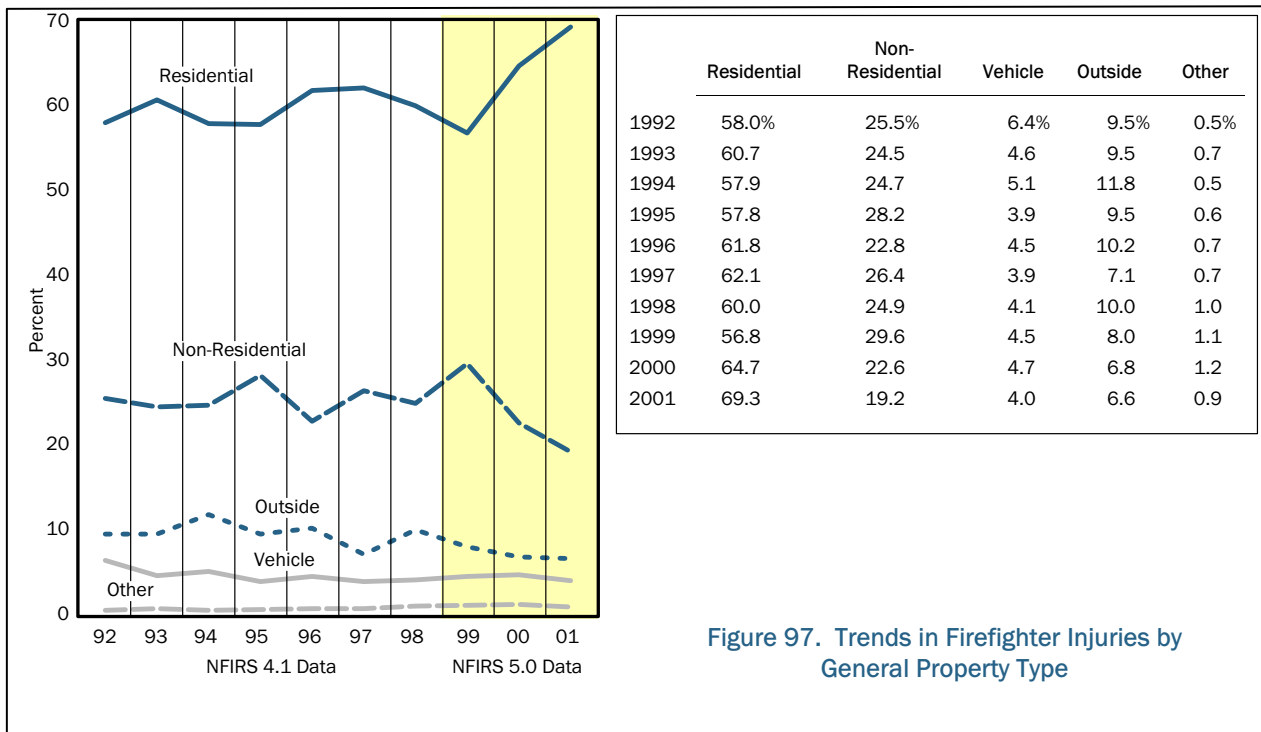


Figure 97. Trends in Firefighter Injuries by General Property Type

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.

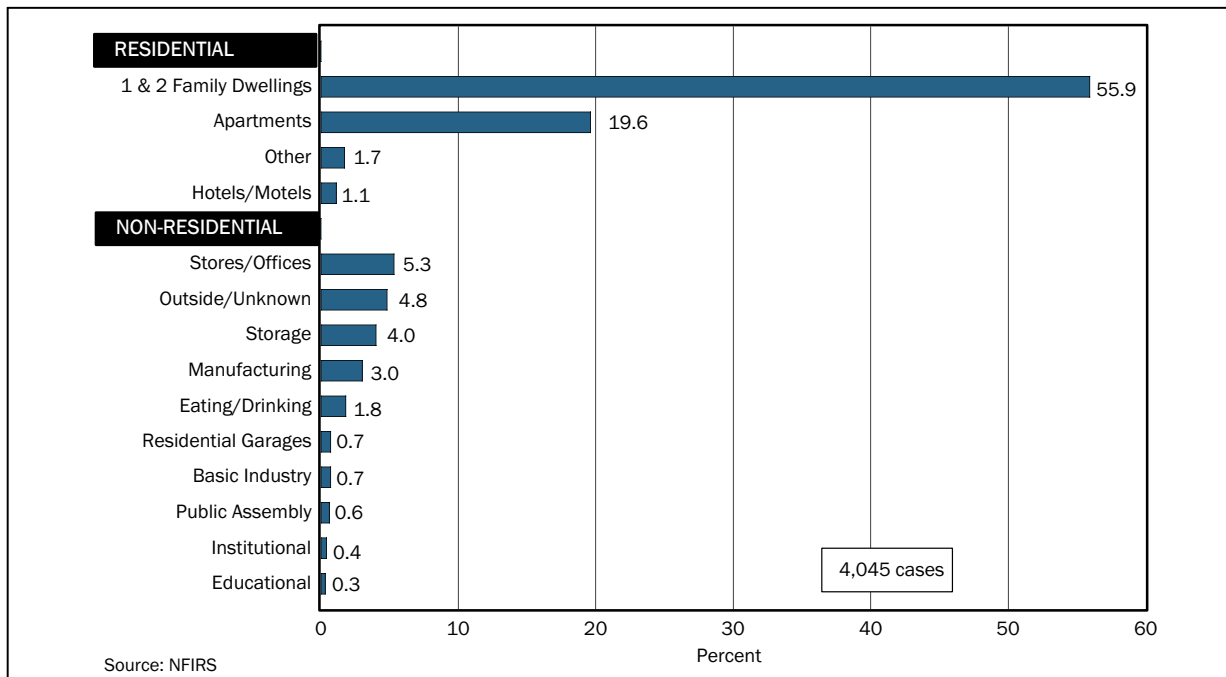


Figure 98. Firefighter Injuries by Property Type (2001) (Structure Fires Only)

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

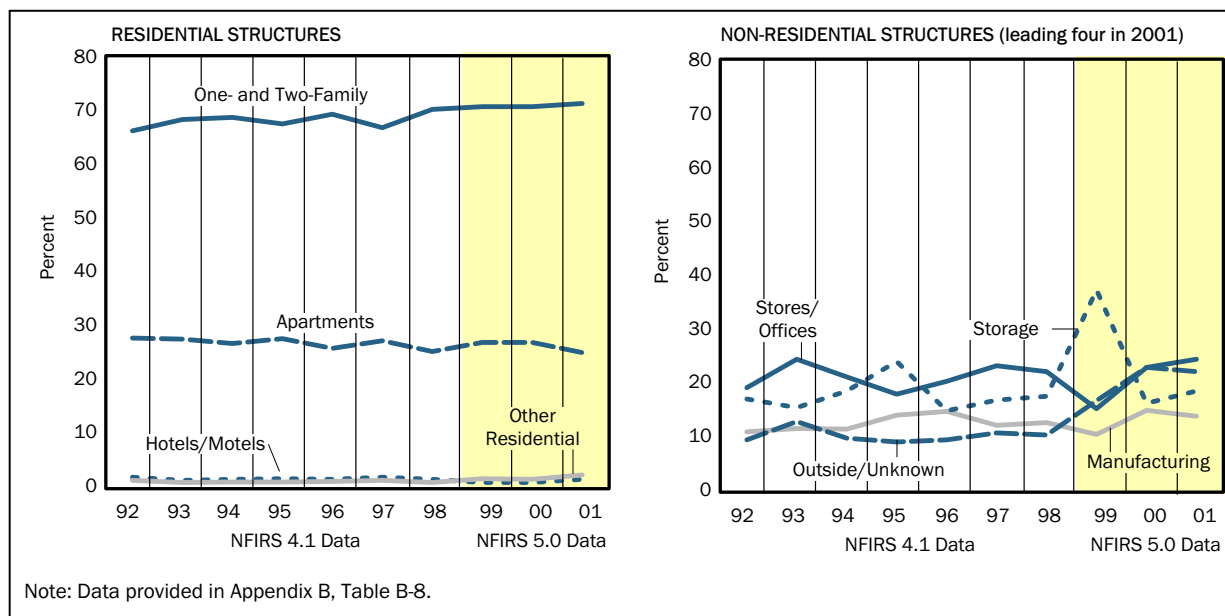


Figure 99. Trends in Firefighter Injuries in Structure Fires

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).

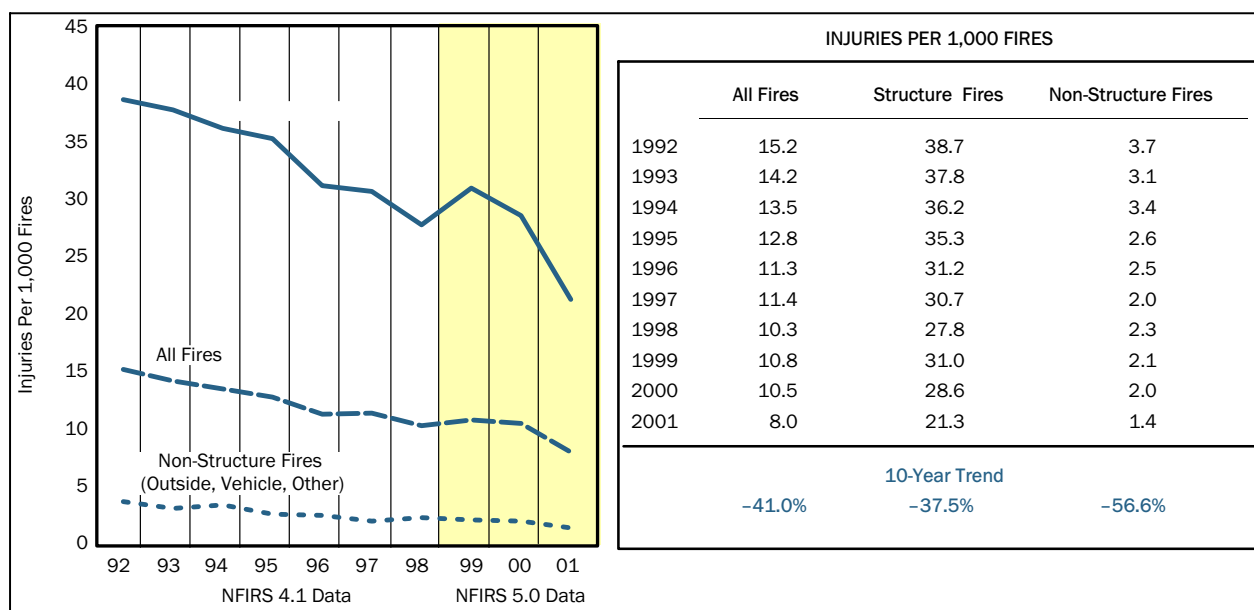


Figure 100. Trends in Firefighter Injury Rate

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-

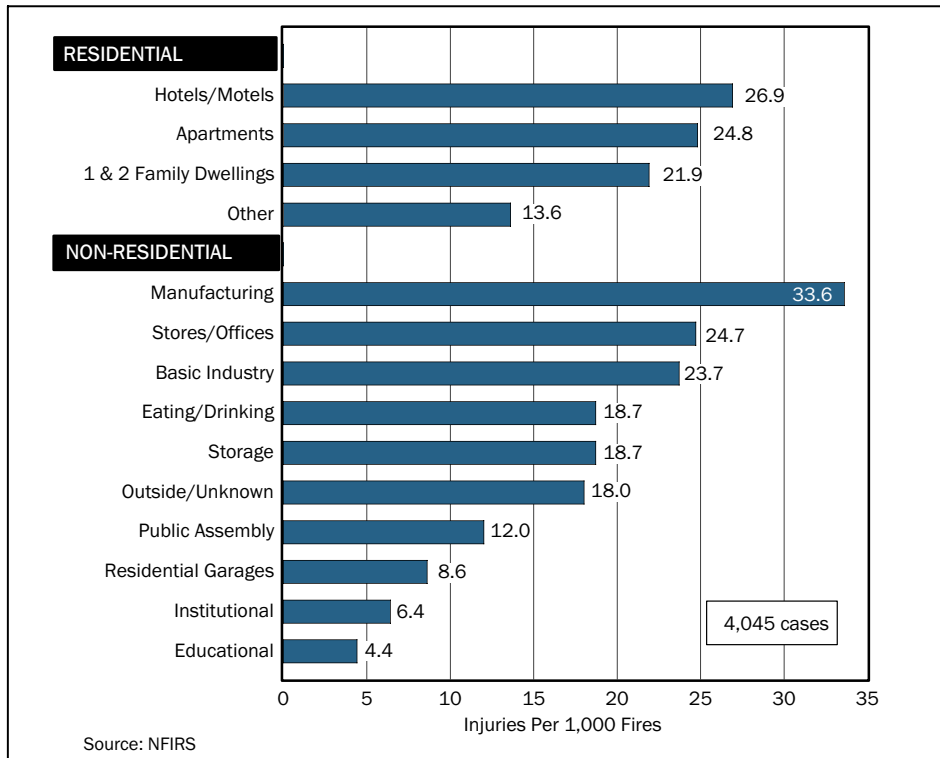


Figure 101. Firefighter Injury Rate in Structures (2001)

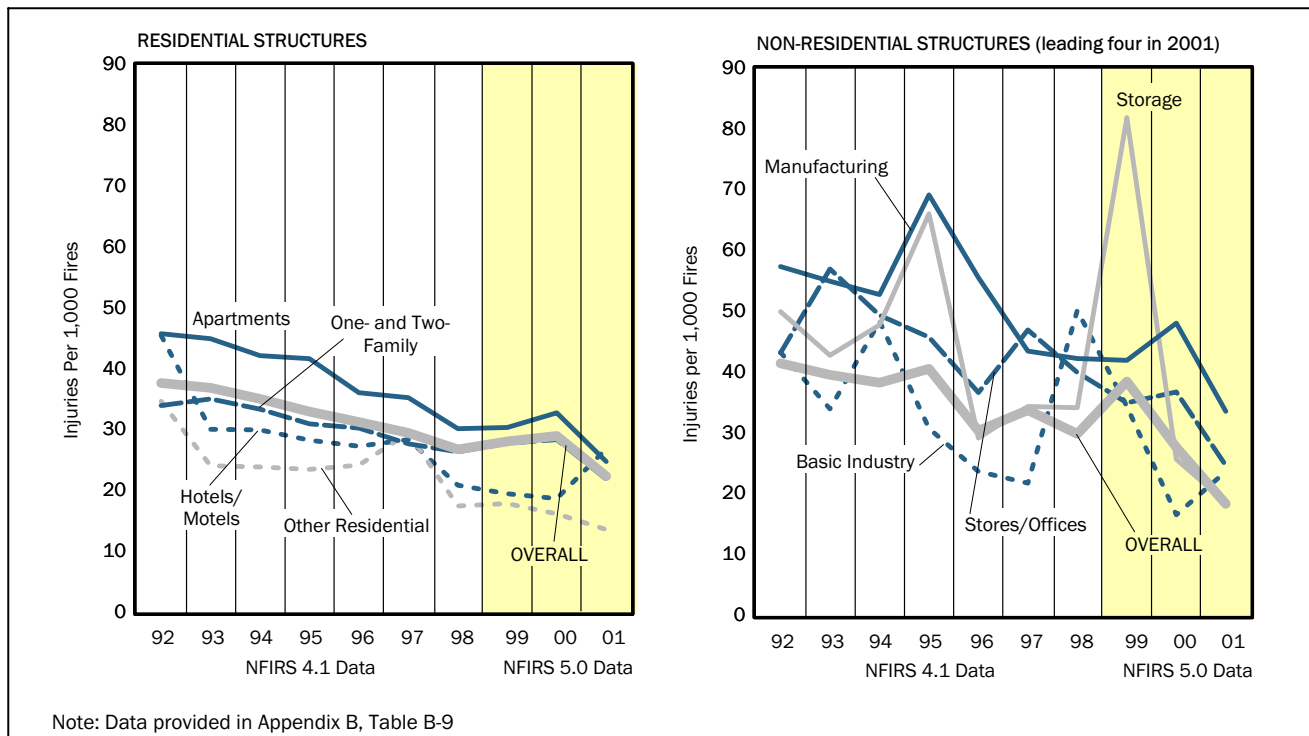


Figure 102. Trends in Firefighter Injury Rate in Structures

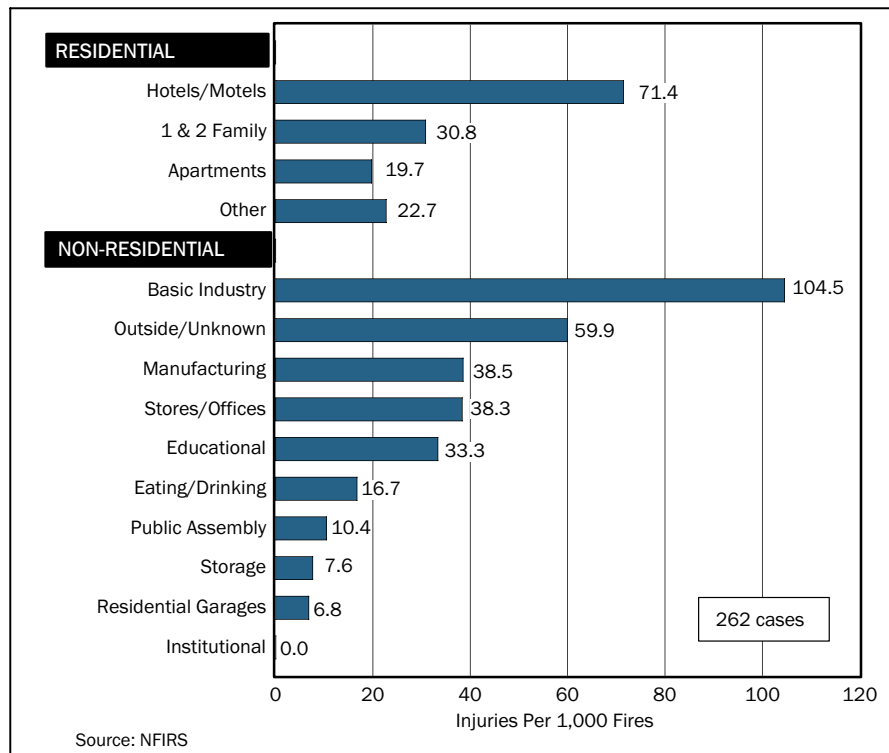


Figure 103. Firefighter Injury Rate in Vacant or Under Construction Structures (2001)

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.

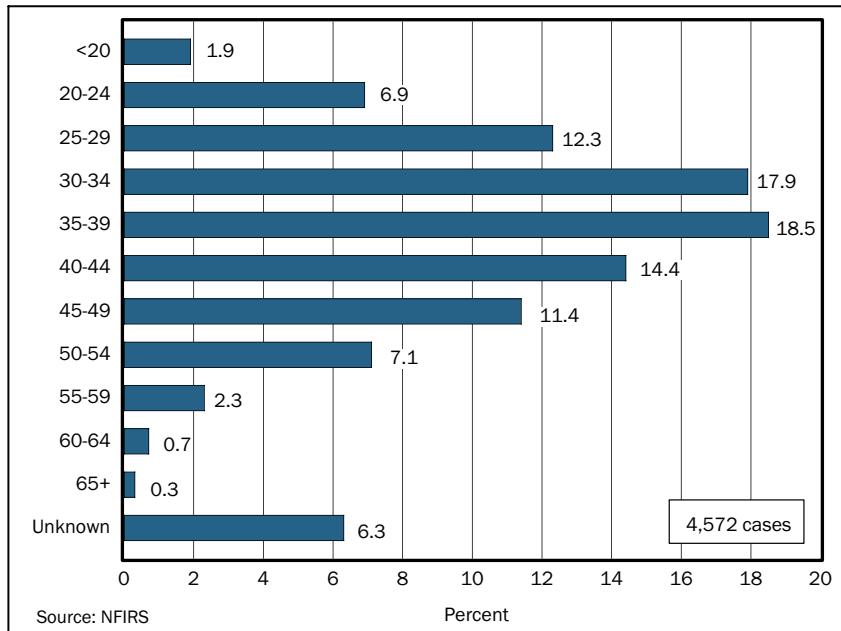


Figure 104. Firefighter Injuries by Age (2001)

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.

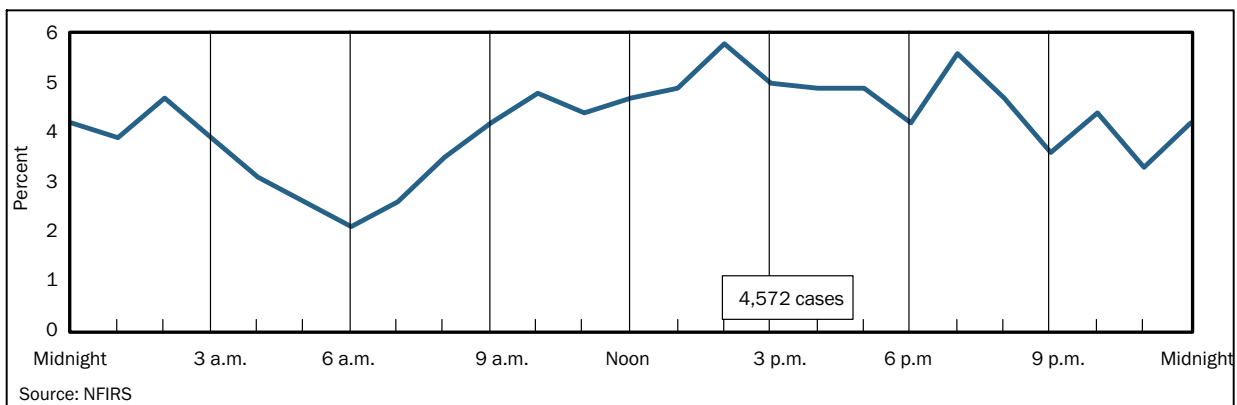


Figure 105. Firefighter Injuries by Time of Day (2001)

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.

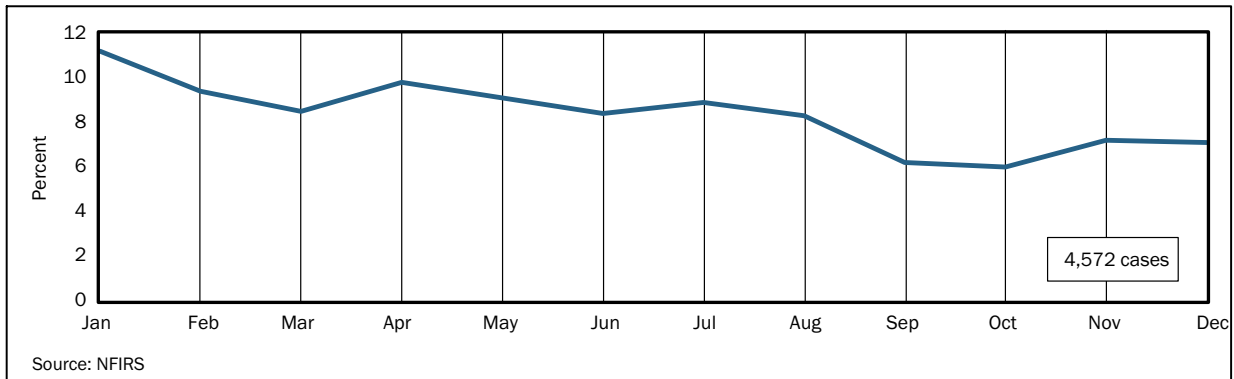


Figure 106. Firefighter Injuries by Month of Year (2001)

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.

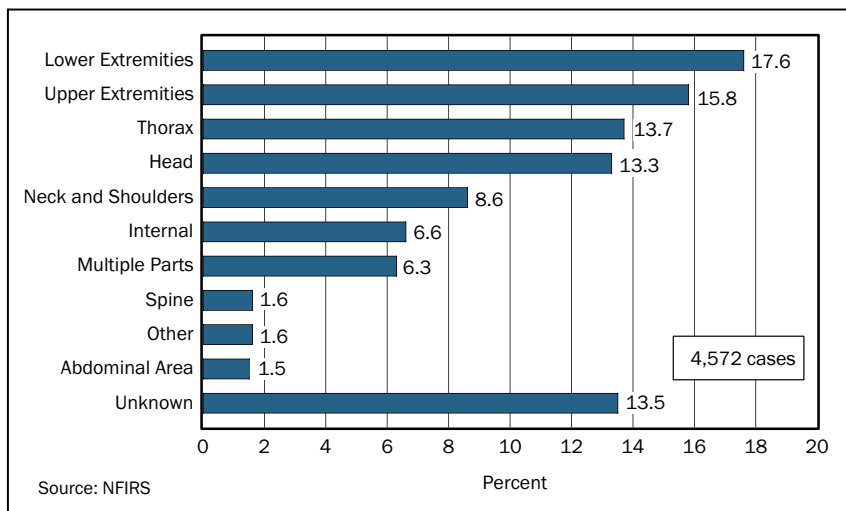


Figure 107. Firefighter Injuries by Part of Body Injured (2001)

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

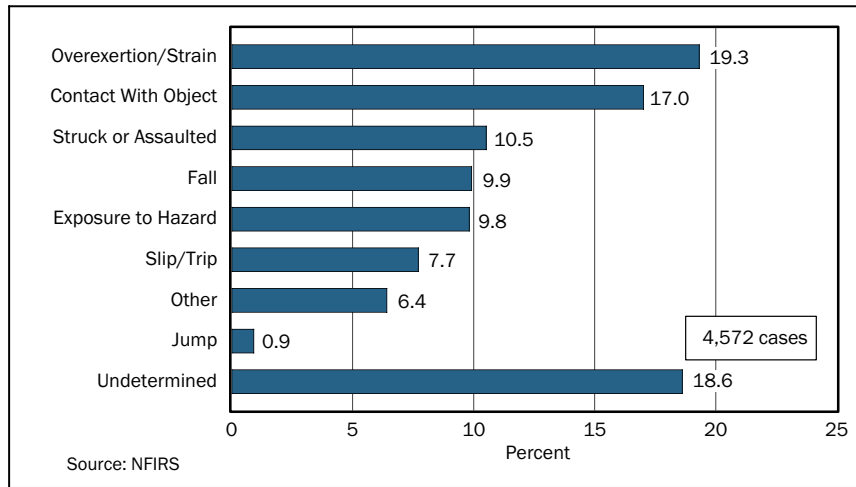


Figure 108. Firefighter Injuries by Cause (2001)

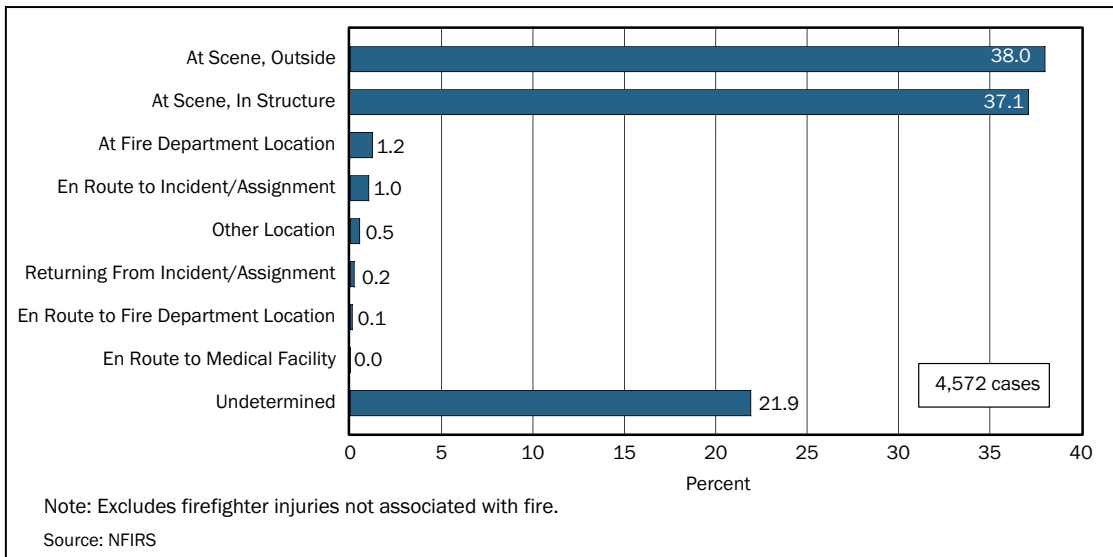


Figure 109. Firefighter Injuries by Where Injury Occurs (2001)

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).

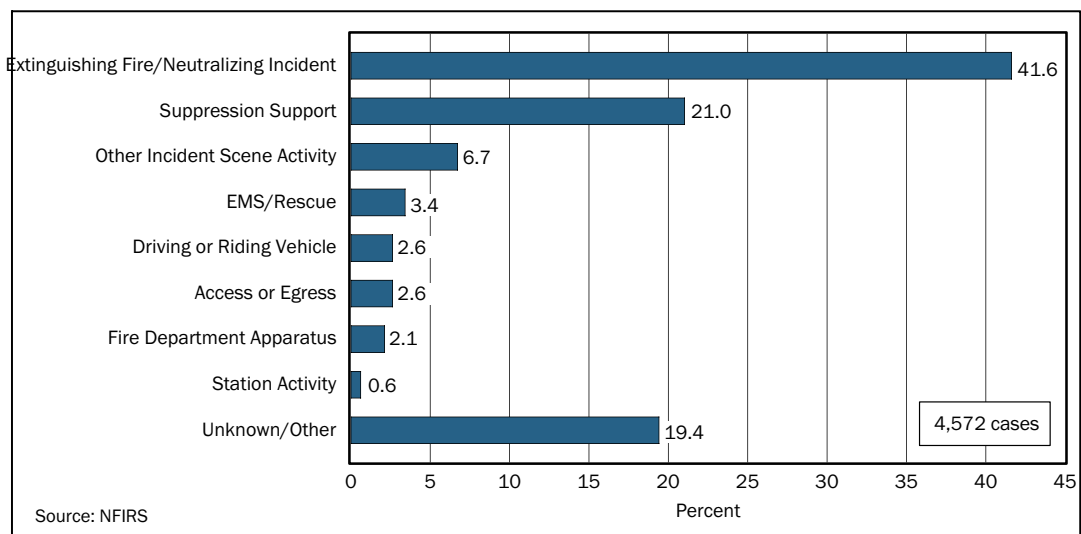


Figure 110. Firefighter Injuries by Type of Activity (2001)

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.

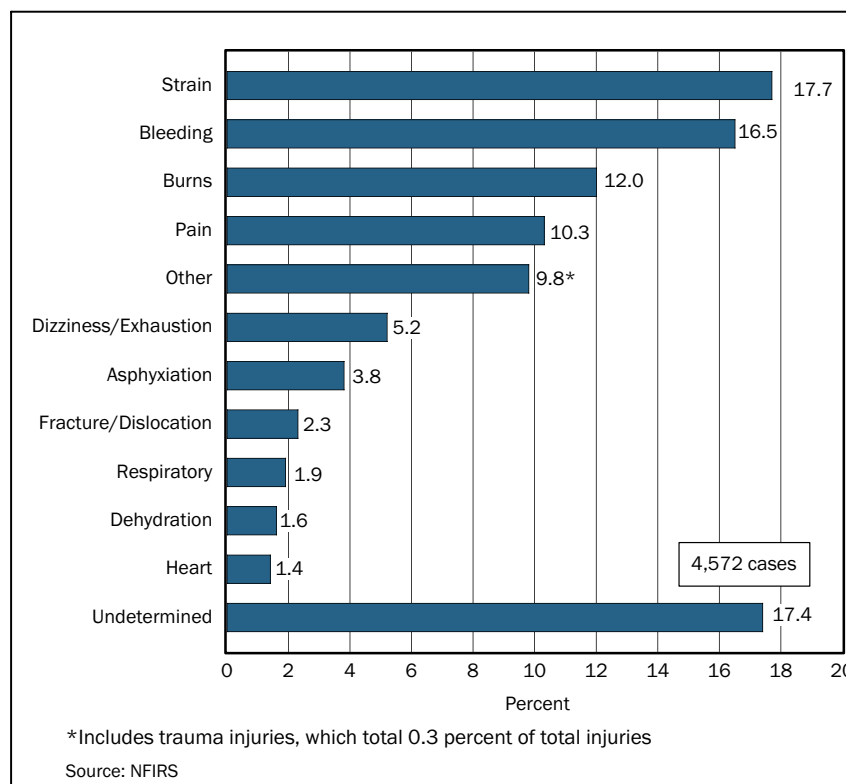


Figure 111. Firefighter Injuries by Nature of Injury (2001)

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.

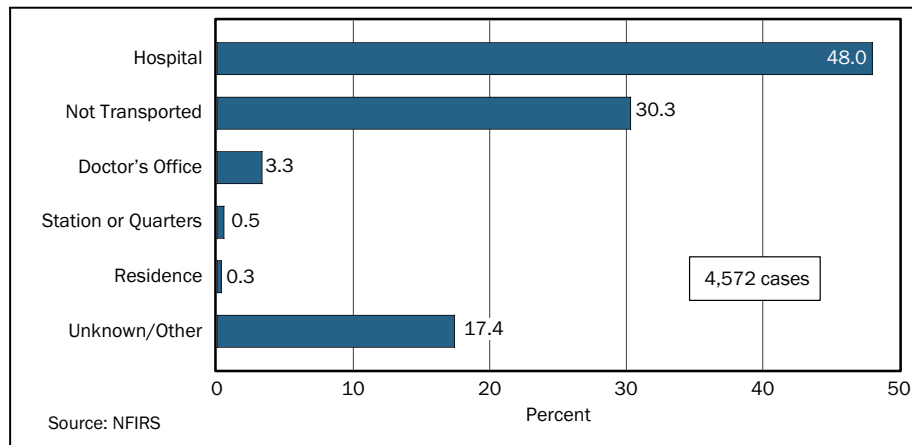


Figure 112. Firefighter Injuries by Where Treated (2001)

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; *Safe Operations 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 *Emergency Incident 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)*

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.