



**RESEARCH**

# Firefighter Injuries on the Fireground

Richard Campbell and Joseph L. Molis  
November 2020

## Key Findings

- US firefighters experienced an average of 25,590 non-fatal injuries on the fireground each year from 2014 through 2018.
- Injuries involving exposure to a hazard (such as heat, smoke, or toxic agents) and overexertion or strain are the most common injuries experienced by firefighters on the fireground.
- Three in ten fireground injuries (30 percent) resulted in lost work time, while just under two in five injuries (37 percent) were report only and did not result in lost work time. Another one-fifth of the injuries (19 percent) required treatment by a physician, but no lost time, while 13 percent were classified as first aid only.
- Two in five fireground injuries (40 percent) occurred outside at grade level, with a somewhat smaller share of injuries occurring while firefighters were inside a structure (37 percent).

## Career Firefighters

- Career firefighters experienced an average of 20,890 fireground injuries each year from 2014 through 2018.
- Male firefighters accounted for 97 percent of the fireground injuries experienced by career firefighters.
- Career firefighter injuries were evenly divided between those occurring in a structure or outside at grade, each accounting for 39 percent of the total fireground injuries.
- Two-fifths (41 percent) of career firefighter injuries on the fireground were classified as report only and three in ten (30 percent) were lost time injuries of moderate severity.
- The leading primary symptoms of fireground injuries among career firefighters were strains or sprains (29 percent), smoke inhalation (14 percent), pain only (13 percent), thermal burns (8 percent), and cuts or lacerations (5 percent).

## Volunteer Firefighters

- Volunteer firefighters experienced an annual average of 4,700 fireground injuries each year from 2014 through 2018.
- Male firefighters accounted for 93 percent of the fireground injuries experienced by volunteer firefighters.
- Two in five volunteer firefighter injuries on the fireground (39 percent) required treatment by a physician but did not result in lost work time
- The most common injury symptoms experienced by volunteer firefighters included sprains or strains (15 percent), exhaustion or fatigue (10 percent), cuts or lacerations (9 percent), thermal burns (9 percent), pain only (8 percent), and smoke inhalation (6 percent).
- Approximately one-half of the volunteer fireground injuries occurred outside at grade (49 percent), with just over one-quarter of the injuries occurring inside a structure.

## Introduction

Firefighters are routinely exposed to an array of safety and health hazards at the scene of a fire. In addition to working in the presence of fire or explosive materials, firefighters must contend with weather-related temperature extremes, physical demands involving awkward postures or heavy loads, work environments that include slippery surfaces or the presence of sharp objects, exposure to chemical and biological agents, potential lack of adequate oxygen, fall hazards and falling objects, and any number of additional health and safety threats.

Information about firefighter injuries — how and where they occur, activity at the time of injury, and other relevant information — is critical for identifying risk factors, developing prevention programs, and guiding resource decisions, as well as informing other areas of intervention.

This report reviews injuries experienced by US firefighters on the fireground for the five-year period from 2014 through 2018. The data are derived from the US Fire Administration’s National Fire Incident Reporting System (NFIRS) in conjunction with the annual fire experience survey administered by the National Fire Protection Association. The use of NFIRS data allows for a more detailed examination of the factors relating to injury incidents than data produced by the more limited NFPA survey alone. The data in this report are estimates of firefighter injuries from fires reported to US municipal fire departments and so exclude firefighter injuries reported only to state or federal agencies or industrial fire brigades.

The report is divided into two sections. The first section consists of data and analysis of fireground injuries for all municipal firefighters, career and volunteer. This section is most useful for audiences interested in the general injury experience of firefighters on the fireground. The second section reviews the same data elements, but the results are disaggregated by career and volunteer firefighter affiliation for users who may be interested in the injury experience of the different affiliations.

In the tables and figures, firefighter injuries are rounded to the nearest ten. Note that data presented in the body of the report represent only results for major response categories. More detailed information is available in the accompanying tables.

The information in this report focuses on non-fatal injuries occurring on the fireground which is available through the National Fire Incident Reporting System. NFPA also publishes two reports that examine aspects of firefighter injuries not covered here: *Firefighter Fatalities in the United States*<sup>1</sup> and *Firefighter Injuries in the United States*.<sup>2</sup> The latter provides the latest estimates of all firefighter injuries, including injuries occurring off the fireground, as well as documented exposures to infectious disease.

---

<sup>1</sup> Fahy, Rita F, et al. *Firefighter Fatalities in the United States — 2019*. Quincy, MA: National Fire Protection Association, 2019.

<sup>2</sup> Campbell, R., et al. *Firefighter Injuries in the United States in 2018*. Quincy, MA: National Fire Protection Association, 2019.

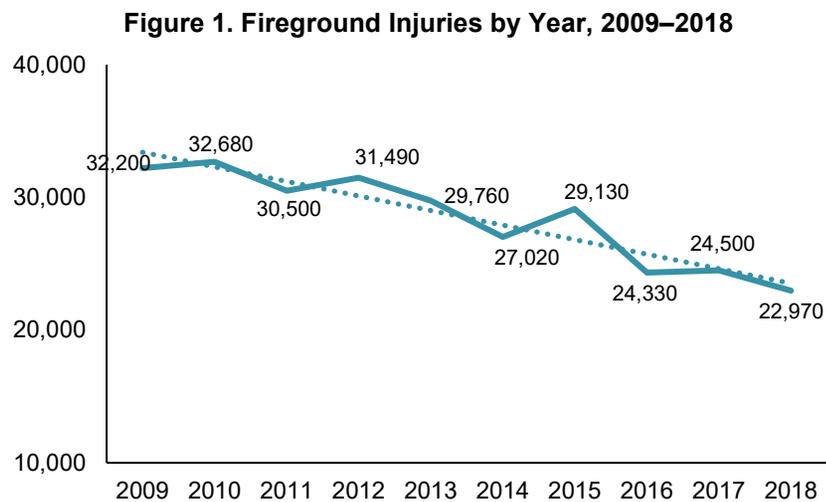
## Part 1. Patterns of Firefighter Injuries on the Fireground

NFPA estimates that firefighters sustained a total of 127,950 injuries on the fireground during the five-year period from 2014 to 2018, an average of 25,590 non-fatal injuries each year.

While substantial, the injuries over the latest five-year period represent a substantial decrease from the estimated total of 156,630 injuries experienced from 2009 through 2013, an average of 31,330 injuries each year.

Figure 1 provides a visual representation of the fireground injury trend from 2009 through 2018. The figure shows a clear downward trend, with a sizeable increase in 2015 representing the most significant interruption of the decline.

Estimates of the annual number of fireground injuries dating to 2005 can be found in Table 1. It should be noted that the encouraging decline in firefighter injuries continues a trend that has been consistently documented in earlier NFPA reports on fireground injuries. The estimated total of 22,970 injuries in 2018 represents the lowest fireground injury count over this period.

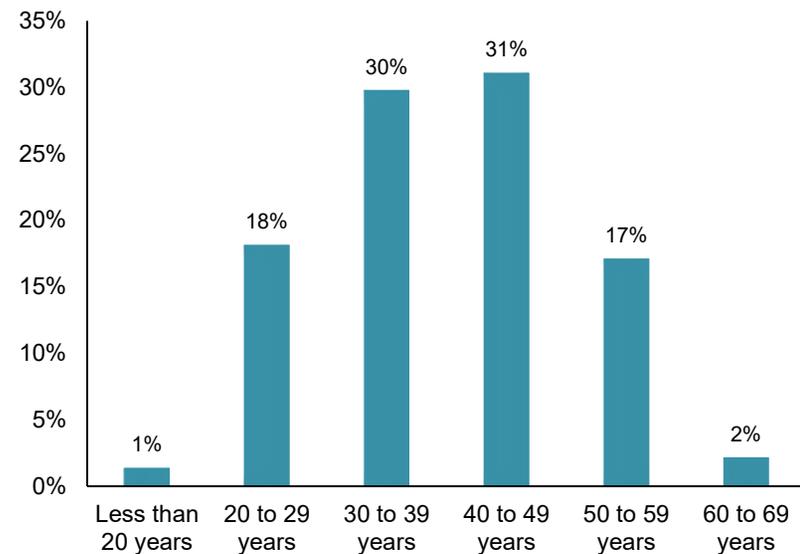


## Age and Gender

The vast majority of fireground injuries were experienced by males, with females accounting for only 4 percent of the injuries. According to NFPA's most recent *US Fire Department Profile*, women accounted for 8 percent of the firefighter workforce in 2018, suggesting that female firefighters may have experienced a disproportionately lower share of injuries relative to males. Part 2 of the report shows that the disparity is less apparent among volunteer firefighters. Additional research is needed to confirm differences in the injury burden between male and female firefighters.

Fireground injuries by age are shown in Figure 2. As the figure indicates, those in the 40 to 49 age group (31 percent) and 30 to 39 age group (30 percent) accounted for the highest shares of injuries. The 20 to 29 age group (18 percent) and 50 to 59 age group (17 percent) accounted for the majority of the remaining fireground injuries.

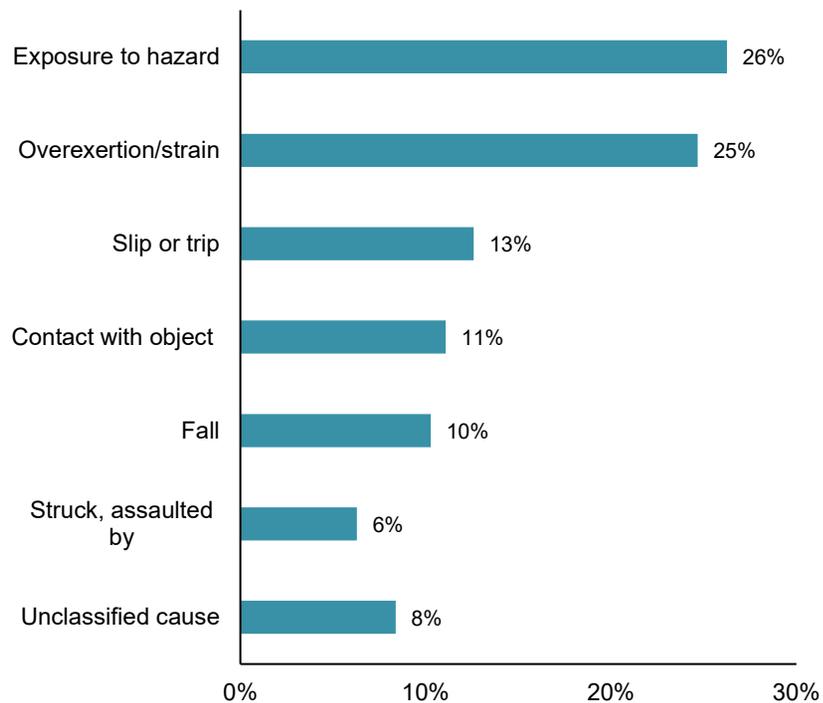
**Figure 2. Fireground Injuries by Victim's Age, 2014–2018**



## Leading Causes of Injury

Figure 3 shows the leading causes of fireground injuries. As indicated, the two leading causes of injury, exposure to hazards and overexertion or strain, together account for over half of the injuries (51 percent). Injuries involving overexertion or strain consistently rank among the most common injuries experienced by firefighters (volunteer and career) on the fireground. Exposure to hazards includes exposure to fire products, such as heat or smoke. Firefighters were also injured on the fireground due to slips or trips, coming into contact with objects, falls, and being struck or assaulted by a person, animal, or moving object.

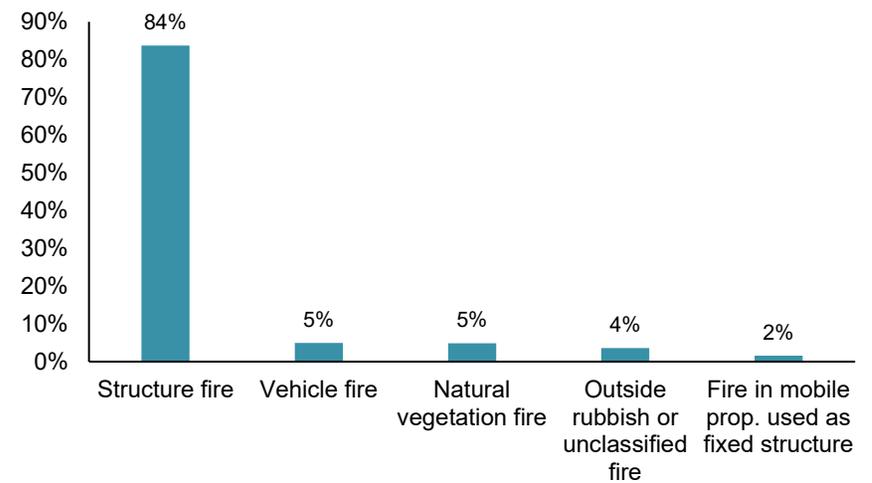
**Figure 3. Fireground Injuries by Cause, 2014–2018**



## Injuries by Type of Fire Incident

Firefighters respond to different types of fire incidents. The vast majority of fireground injuries (84 percent) occurred at structure fires. Much smaller shares of injuries occurred at vehicle fires, natural vegetation fires, outside rubbish or unclassified fires, or fires in mobile properties used as fixed structures, as shown in Figure 4.

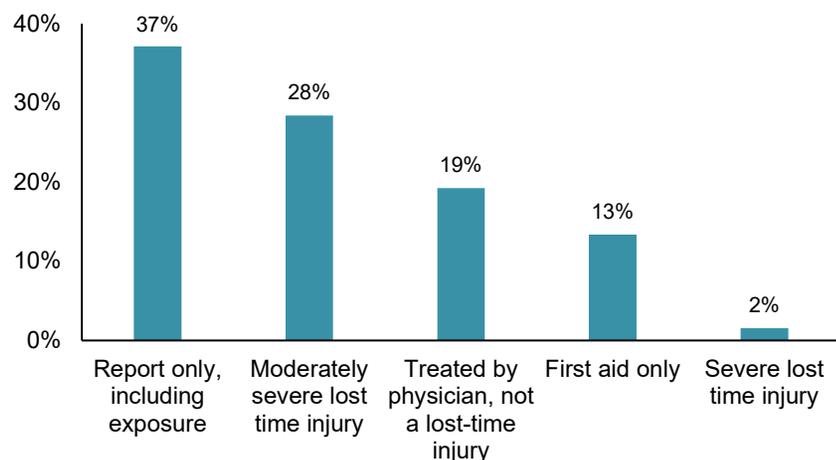
**Figure 4. Fireground Injuries by Type of Incident, 2014–2018**



## Severity of Injury

Injuries by severity are shown in Figure 5. Nearly two in five injuries were classified as report only. Injuries resulting in lost work time accounted for three in ten injuries, most of which were injuries of moderate severity. Another one-fifth of the injuries (19 percent) required treatment by a physician without a loss of work time. It should be noted that the report only injuries included exposure to toxic substances or other harmful agents and that any health effects from such exposures might only be realized after repeated exposure or a prolonged latency period.

**Figure 5. Fireground Injuries by Severity of Injury, 2014–2018**

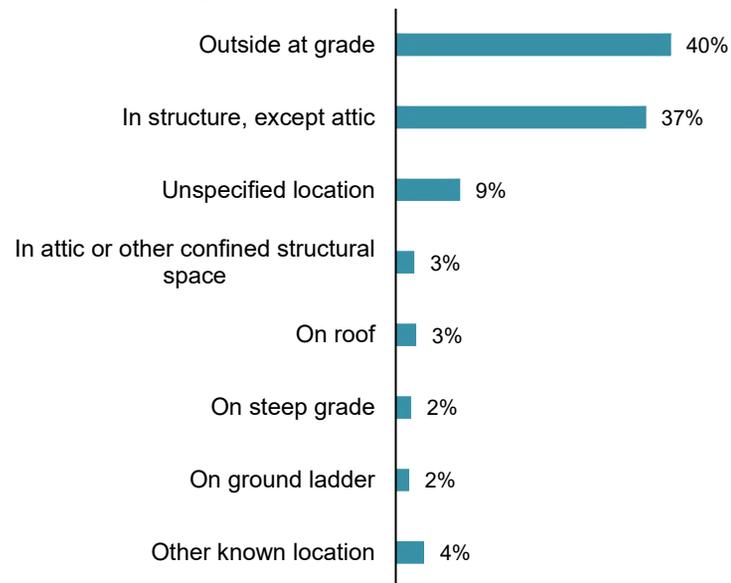


### **Injury Location**

Almost four in five fireground injuries occurred either outside at grade level (40 percent) or while firefighters were inside a structure except in an attic (37 percent), as shown in Figure 6. A smaller share of injuries occurred while firefighters were on a roof, on a steep grade, or on a ground ladder.

Injury locations do not by themselves provide any indication of the relative chance of injury in specific locations, as these also reflect the number of firefighters or the amount of time spent in one location versus another. Hence, the higher share of injuries occurring outside may reflect a greater number of firefighters or greater person hours in outside locations. They do, nevertheless, indicate that firefighters are exposed to hazards inside and outside structures on the fireground.

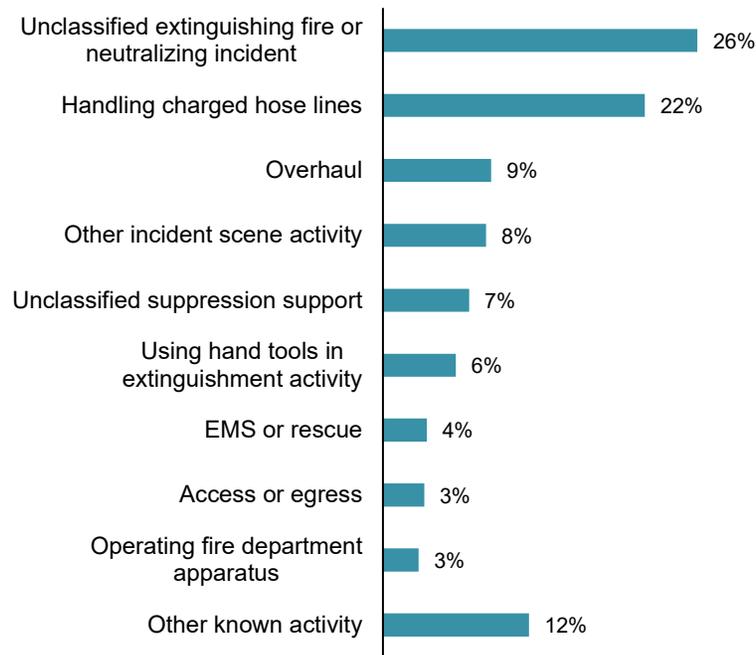
**Figure 6. Fireground Injuries by Injury Location, 2014–2018**



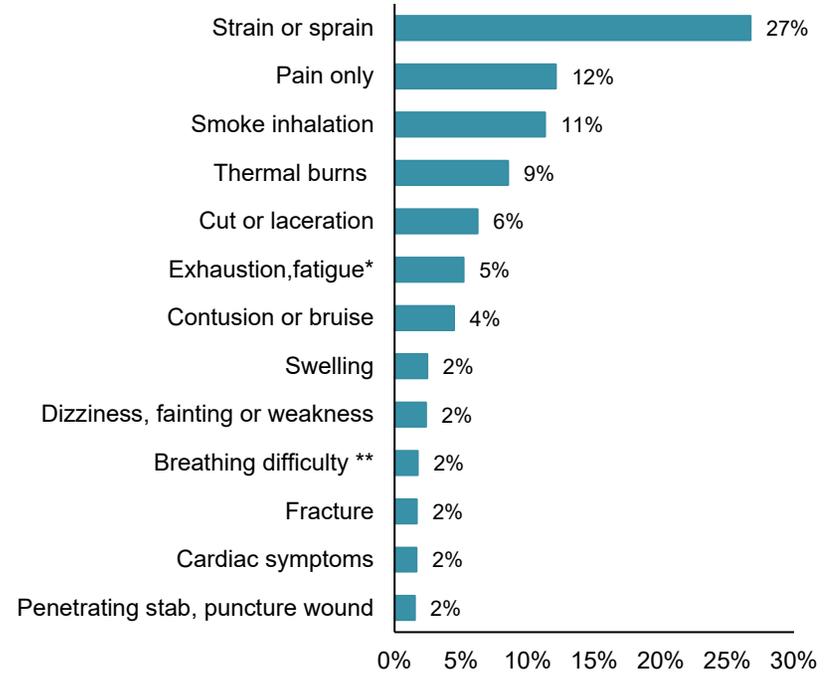
### **Activity When Injured**

The specific activity most often associated with fireground injuries was handling charged hose lines, which accounted for just over one in five injuries. Unclassified extinguishment incidents accounted for approximately one-quarter of the injuries, while another one-tenth of the injuries occurred during overhaul (9 percent). Figure 7 shows the tasks that were being performed by firefighters at the time of injury. Additional research into how firefighters are injured while handling charged hose lines, engaging in overhaul, or using hand tools could be used in training programs, contribute to ergonomic design improvements in equipment, and inform purchasing decisions.

**Figure 7. Fireground Injuries by Activity, 2014–2018**



**Figure 8. Fireground Injuries by Primary Symptom, 2014–2018**



\*Includes heat exhaustion

\*\*Includes shortness of breath

### Primary Symptom of Injury

Sprains or strains were the most common injury symptom experienced by firefighters, accounting for more than one-quarter of the fireground injuries. The prevalence of sprain or strain injuries is consistent with prior research findings. As shown in Figure 8, firefighters experienced different forms of physical trauma, such as cuts or lacerations, thermal burns, smoke inhalation, contusions or bruises, fractures, and penetrating stab or puncture wounds. Firefighters also experienced a variety of symptoms influenced by the physical demands of their work tasks, the environmental conditions in which they work, and their own personal conditioning, such as exhaustion or fatigue, dizziness, fainting or weakness, breathing difficulties, or cardiac symptoms.

## Primary Body Part Injured

Fireground injuries most often involved the extremities, as shown in Table A. Acute trauma may have caused some of these injuries, but they also involve parts of the body that may be injured as a result of repetitive or acute strain. Internal injuries most often involved the trachea and lungs.

**Table A. Fireground Injuries by Body Part, 2014–2018**

Primary Body Part Injured	Percent
Upper extremities	21%
Hand and fingers	14%
Lower extremities	19%
Knee	7%
Ankle	6%
Lower leg	3%
Foot and toes	3%
Head	15%
Eye	3%
Unclassified head	8%
Multiple parts	11%
Multiple body parts — whole body	9%
Neck and shoulders	10%
Shoulder	6%
Internal	10%
Trachea and lungs	6%
Thorax	7%
Chest	4%
Back, except spine	3%
Spine	2%

## Factors Contributing to Injuries

Injury reports sometimes include limited information on the factors contributing to fireground injuries. As shown in Table B, factors relating to fire development (such as smoke conditions or explosions) contributed to three in ten injuries, while slippery or uneven surfaces contributed to another one-fifth of injuries (20 percent). Collapses of structural elements or falling objects also contributed to a substantial share of the injuries (10 percent). Holes or being lost, caught, trapped, or confined contributed to comparatively small shares of injuries.

**Table B. Factors Contributing to Injuries, 2014–2018**

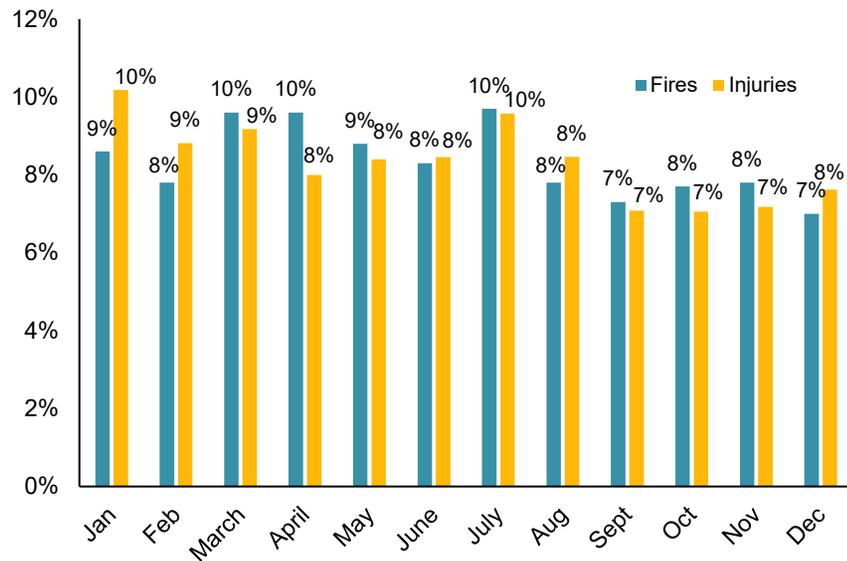
Injury Factor	Percent
Fire development	30%
Fire progress, including smoky conditions	24%
Slippery or uneven surfaces	20%
Uneven surface, including holes in the ground	6%
Icy surface	5%
Loose material on surface	2%
Wet surface	2%
Unclassified slippery or uneven surfaces	4%
Collapse or falling object	10%
Falling objects	3%
Ceiling collapse	2%
Holes	3%
Lost, caught, trapped, or confined	2%
Unclassified factor	12%
None	22%

## Injuries by Month

Fireground injuries were highest in January and July, with 10 percent of the injuries occurring in each of these months. February and March each accounted for 9 percent of injuries. Injuries were lowest in September, October, and November.

Since the incidence of fires by month can vary and thereby influence opportunities for injury on a monthly basis, Figure 9 shows the monthly distribution of fireground injuries and fire incidents. As the figure indicates, the monthly share of injuries was highest relative to the distribution of fires in January and February, potentially reflecting the influence of working in cold weather. The monthly share of injuries otherwise generally matched the distribution of fire incidents by month.

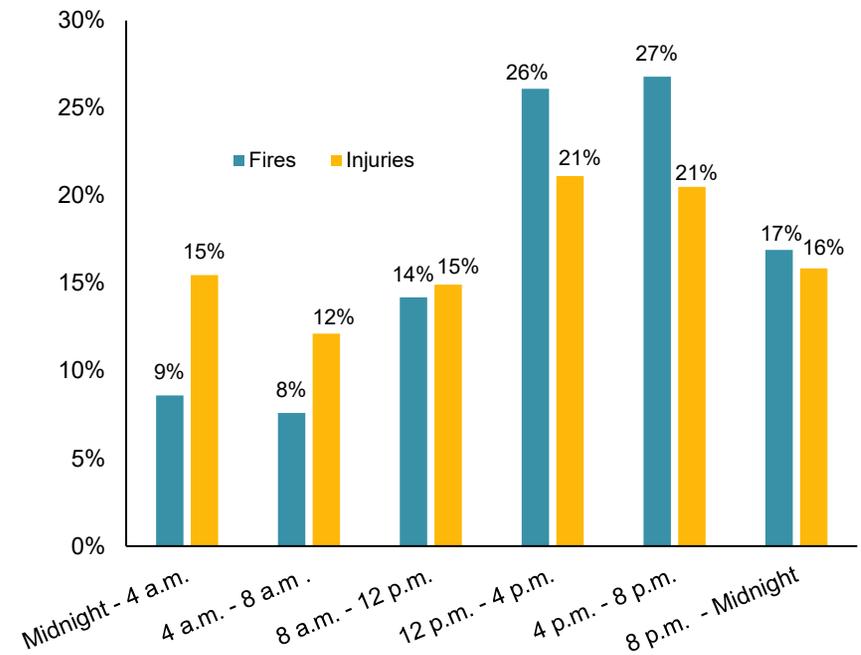
**Figure 9. Fireground Injuries and Fires by Month, 2014–2018**



## Injuries by Time of Day

Slightly more than two of five fireground injuries occurred in fires that took place between 12 p.m. and 8 p.m., but these were the hours that also recorded the largest shares of structure fires, as shown in Figure 10. As the figure indicates, injuries were low relative to fires in the period from 12 p.m. to 8 p.m. Although there were fewer fires between midnight and 8 a.m., injuries were higher relative to the share of fires at these hours. Such factors as working in dark environments or sleep disturbance may play a role in this injury pattern.

**Figure 10. Fireground Injuries and Fires by Time of Day, 2014–2018**

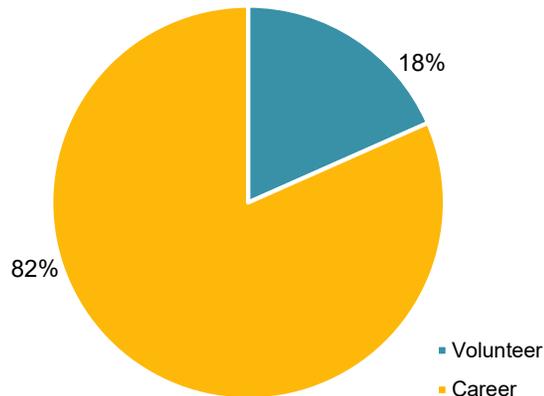


## Part 2. Fireground Injuries by Firefighter Affiliation

It is useful to compare the fireground injury experience of career and volunteer firefighters, as there are some important differences between the two groups. Although volunteer firefighters perform the same work as their career counterparts, they are more likely to do all this without some of the resources and benefits available to fire departments in larger communities. In addition, the National Volunteer Fire Council has pointed out that many volunteer fire departments don't require annual or biannual fitness testing or health screenings and that the regular jobs of volunteers may not be physically demanding, potentially leaving them at a disadvantage for arduous firefighting tasks.

As Figure 11 shows, the vast majority of fireground injuries were experienced by career firefighters (82 percent), with volunteer firefighters experiencing just under one-fifth of the fireground injuries each year. For a number of reasons, it is difficult to draw conclusions about the respective distribution of fireground injuries between volunteer and career firefighters. Although volunteer firefighters comprise nearly 70 percent of the US fire service, they perform their duties on a part-time basis, limiting their exposure relative to their career counterparts. It should also be noted that firefighters have been found to underreport injuries, but it is not clear whether underreporting differs between volunteer and career firefighters and any respective impact on reported injury totals.

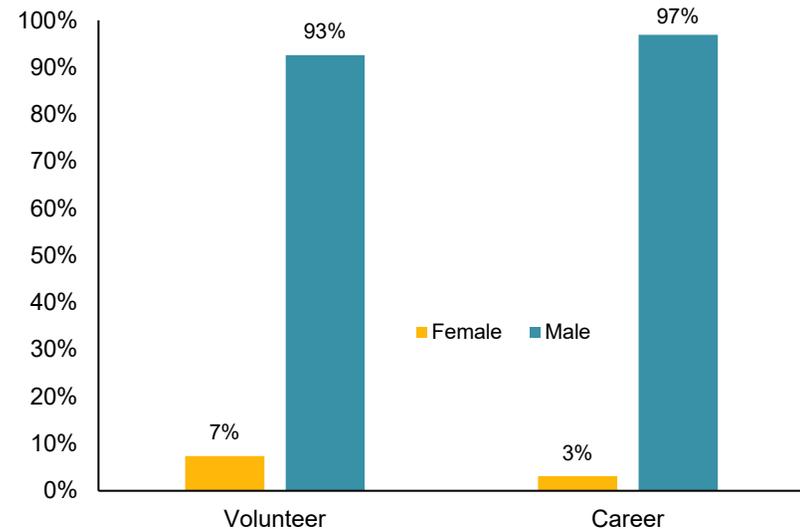
Figure 11. Fireground Injuries by Affiliation, 2014–2018



## Injuries by Gender

The vast majority of fireground injuries are experienced by male firefighters, as indicated in Figure 12. Although the share of injuries experienced by female firefighters is higher for volunteers than for career firefighters, females also comprise a higher share of the volunteer firefighter workforce. NFPA estimated in its [profile of US fire departments for 2018](#) that females comprised 4 percent of career firefighters and 11 percent of volunteers, which would suggest that female volunteer firefighters experience a lower share of injuries relative to their share of the workforce. However, due to low numbers and statistical uncertainty, caution is needed when interpreting these results.

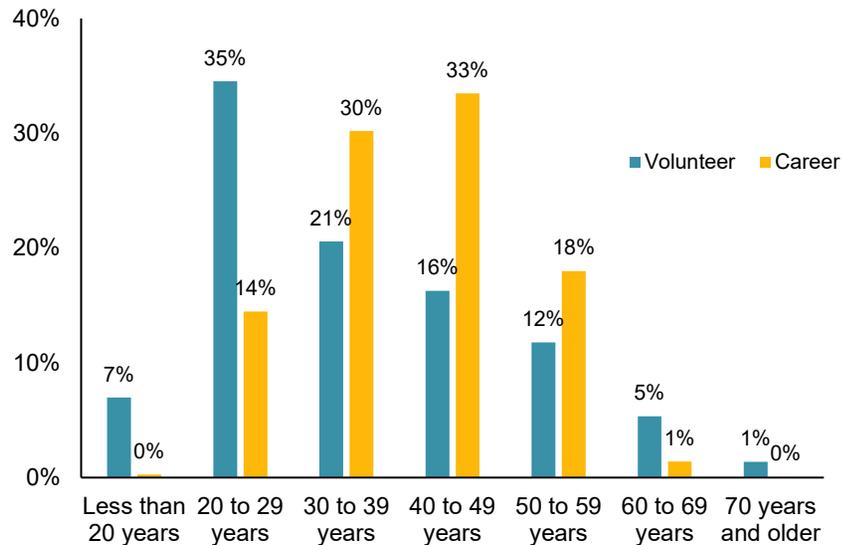
Figure 12. Fireground Injuries by Affiliation and Gender, 2014–2018



## Injuries by Age

Fireground injuries by affiliation and age are shown in Figure 13. As the figure indicates, more than two out of five volunteer injuries were experienced by those in the two youngest age groups, with over one-third of injured volunteers being 20 to 29 years old (35 percent) and 7 percent being less than 20 years old. Career firefighter injuries were most often experienced by those aged 30 to 39 years (30 percent) or 40 to 49 years (33 percent). Only 1 percent of career firefighter injury victims were aged 60 or older, while 6 percent of the injured volunteers were in this age group. One explanation for the larger share of volunteer injuries in the youngest age groups may be the influence of limited experience among part-time firefighters. Career firefighters, because they are full-time, accumulate hands-on experience much more quickly than volunteers. The low number of injuries among career firefighters in the older age groups almost certainly reflects the general absence of career firefighters aged 60 or over.

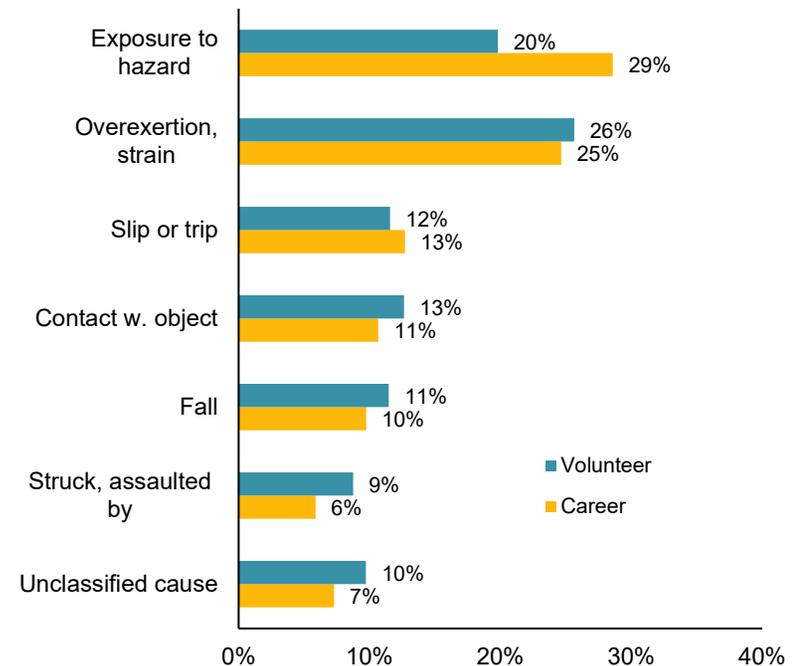
**Figure 13. Fireground Injuries by Affiliation and Age, 2014–2018**



## Injuries by Cause

The leading cause of injury for career firefighters was exposure to hazards, which accounted for approximately three in ten injuries (29 percent), followed by overexertion or strain (25 percent). An additional one-third of the career firefighter injuries were collectively caused by slips or trips (13 percent), contact with objects (11 percent), and falls (10 percent). As Figure 14 shows, the leading causes of volunteer injuries were generally similar to those of career firefighters, with the exception of a smaller share of injuries being due to exposure to hazards (20 percent).

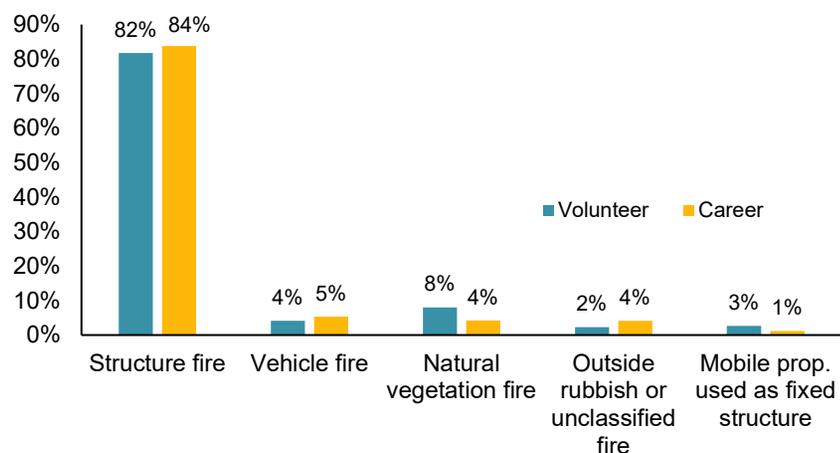
**Figure 14. Fireground Injuries by Affiliation and Cause of Injury, 2014–2018**



## Injuries by Type of Fire Incident

As shown in Figure 15, the vast majority of fireground injuries occurred at structure fires for both volunteer and career firefighters. Similar shares of injuries also occurred at vehicle fires for volunteer and career firefighters. Natural vegetation fires accounted for a larger share of volunteer injuries than was the case for career firefighters, in all likelihood reflecting the predominance of volunteer firefighters in more rural areas.

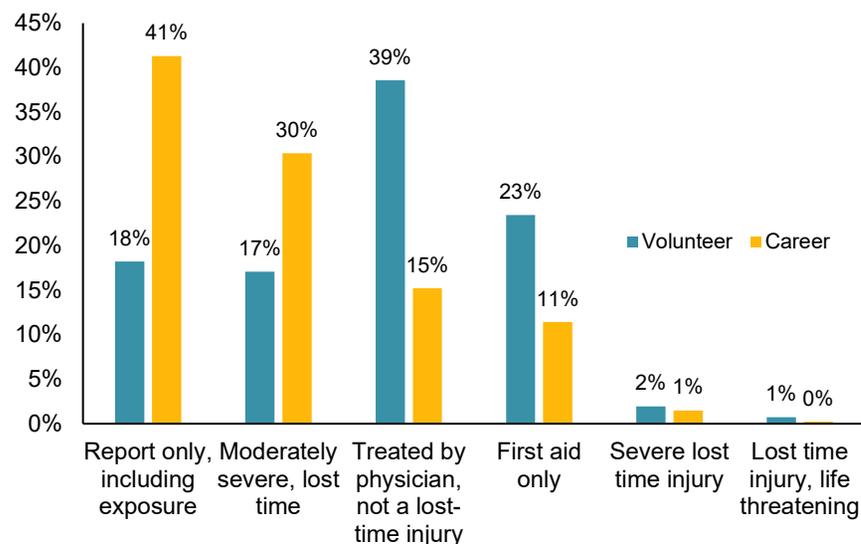
**Figure 15. Fireground Injuries by Affiliation and Type of Incident, 2014–2018**



## Severity of Injury

Injuries by severity are shown in Figure 16. As indicated, career firefighters were much more likely than volunteer firefighters to experience fireground injuries that were report only or moderately severe, while volunteer firefighters were more likely to experience injuries that either required treatment by a physician without lost work time or were first aid only. There were few severe lost-time injuries in either group. One percent of the volunteer injuries and fewer than 1 percent of the career firefighter injuries were classified as life-threatening.

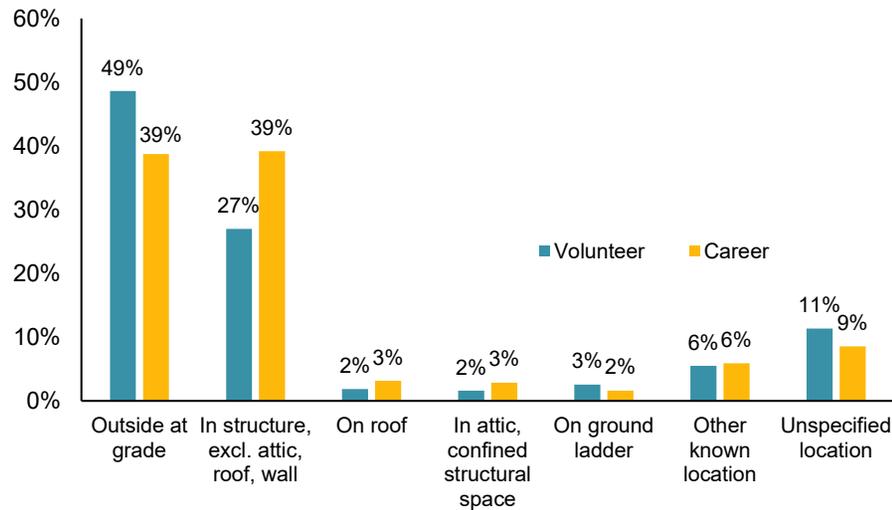
**Figure 16. Fireground Injuries by Affiliation and Severity of Injury, 2014–2018**



## Injury Location

Figure 17 shows that almost four in five of the career firefighter injuries occurred outside at grade level (39 percent) or inside a structure other than an attic (39 percent). Nearly half of the volunteer firefighter injuries occurred while outside at grade level, while more than one-quarter occurred inside a structure somewhere other than an attic. A possible explanation for the differences in injury location is that volunteer firefighters may be more likely to fight fires from the exterior due to longer response times in rural locations or delays in having sufficient crew members on-scene to observe two-in, two-out policies. Injuries occurring on a roof, in an attic or other confined structural space, or on a ground ladder accounted for small shares of the fireground injuries.

**Figure 17. Fireground Injuries by Affiliation and Injury Location, 2014–2018**



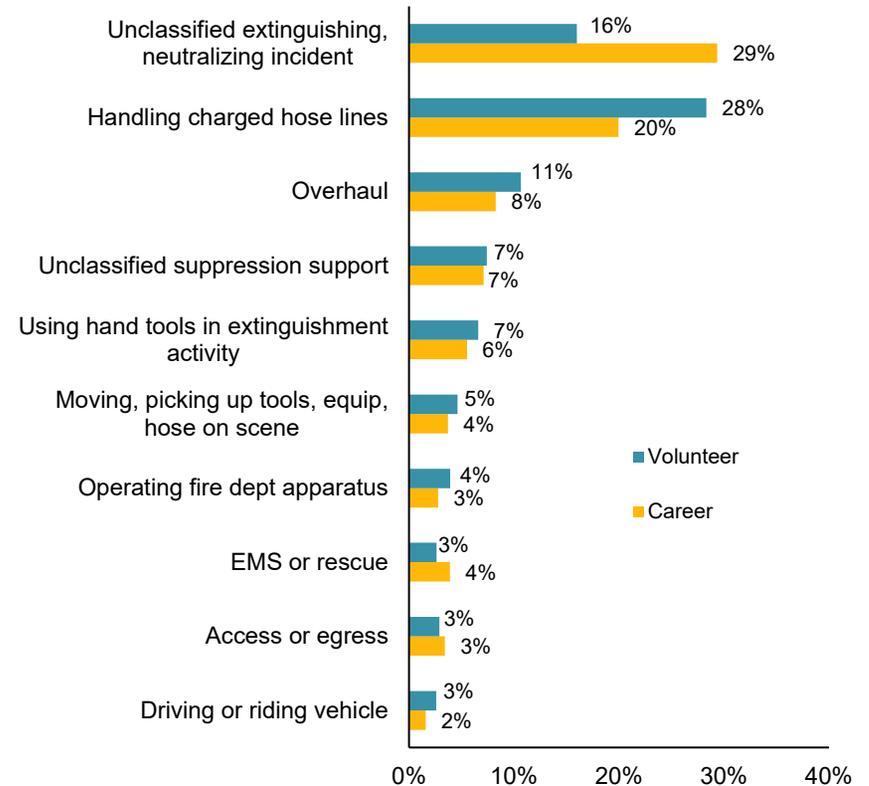
### Activity When Injured

Firefighters were most often handling charged hose lines at the time of injury, though this was more prevalent among volunteers than career firefighters (see Figure 18). One explanation for this could be that volunteers are more likely to be operating outside and are moving charged, heavy hose lines, which can increase their risk of injury. Career firefighters operating inside are more likely to stretch hoses before they are charged, reducing the weight burden until the hose becomes charged closer to the fire.

Almost three in ten career firefighter injuries occurred during unclassified extinguishing or neutralizing activities, compared to fewer than one in five for volunteers. Just over one in ten volunteer injuries occurred during overhaul activities, slightly more than career firefighters (8 percent). Other leading activities accounting for similar shares of

volunteer and career firefighter injuries include suppression support, using hand tools in extinguishment, moving or picking up hand tools, using equipment or hose on scene, operating apparatus, EMS or rescue, access or egress, or driving or riding in vehicles.

**Figure 18. Fireground Injuries by Affiliation and Activity, 2014–2018**



## Primary Symptom

Table C shows that almost three in ten career firefighter injuries on the fireground were strain or sprain injuries, with smoke inhalation, pain-only injuries, and thermal burns also acting as leading primary symptoms of injury. Cuts or lacerations, contusions or bruises, and exhaustion or fatigue accounted for smaller shares of primary injury symptoms among career firefighters.

Strains and sprains were also the primary injury symptom of volunteer firefighter injuries, followed by exhaustion or fatigue, cuts or lacerations, thermal burns, and pain-only symptoms. Dizziness, fainting, or weakness and breathing difficulties were more prevalent symptoms among volunteer than career firefighters.

Volunteer firefighters were substantially less likely to sustain smoke inhalation injuries than career firefighters, potentially reflecting the greater likelihood of volunteers to engage with a fire from outside a structure. In addition, a higher prevalence of exhaustion and fatigue injuries among volunteer firefighters may reflect fewer opportunities to participate in physical fitness programs, as well as reduced access to nutrition and wellness programs.

The disparity of strain and sprain injuries between career and volunteer firefighters may merit further investigation.

Table C. Fireground Injuries by Affiliation and Primary Symptom, 2014–2018

Primary Symptom of Injury	Volunteer	Career
Strain or sprain	(15%)	(29%)
Smoke inhalation	(6%)	(14%)
Pain-only	(8%)	(13%)
Thermal burns	(9%)	(8%)
Cut or laceration	(9%)	(5%)
Contusion or bruise, minor trauma	(5%)	(4%)
Exhaustion, fatigue (including heat exhaustion)	(10%)	(4%)
Dizziness, fainting, or weakness	(5%)	(2%)
Breathing difficulty, shortness of breath	(4%)	(1%)

## Primary Body Part

Nearly two in five injuries among career and volunteer firefighters involved either the lower or upper extremities, as indicated in Table D. Internal injuries were more prevalent among career firefighters than volunteers. Head injuries accounted for slightly more than one in ten career firefighter injuries and 15 percent of volunteer injuries. Injuries to the neck and shoulders accounted for one in ten volunteer injuries and 13 percent of career injuries.

**Table D. Fireground Injuries by Affiliation and Primary Body Part, 2014–2018**

Primary Body Part	Volunteer	Career
Lower extremities	(19%)	(20%)
Upper extremities	(21%)	(17%)
Internal	(10%)	(17%)
Head	(15%)	(11%)
Neck and shoulders	(10%)	(13%)
Thorax	(7%)	(7%)
Multiple parts	(11%)	(7%)
Spine	(2%)	(4%)
Abdominal area	(3%)	(3%)

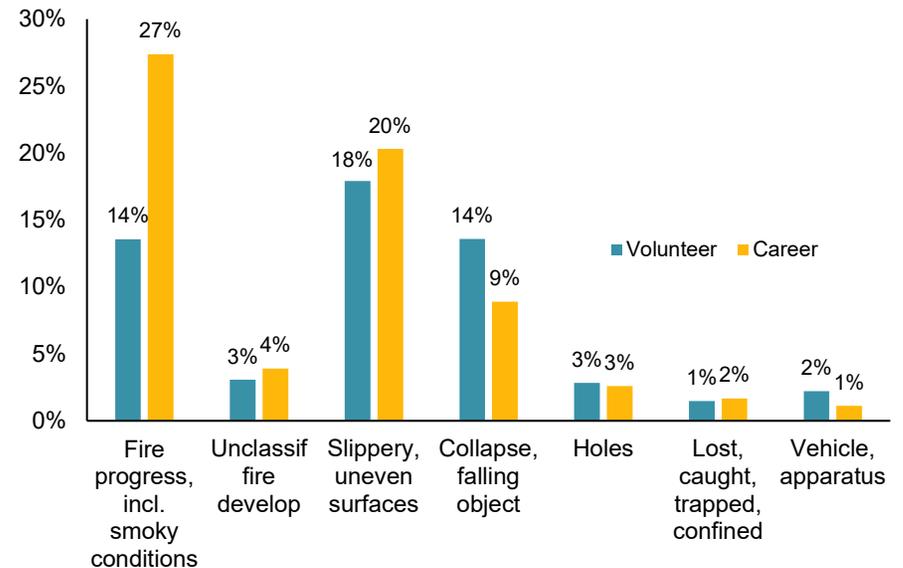
### Injury Factor

The leading factors contributing to injuries were fire progress, slippery or uneven surfaces, and collapse or falling objects (see Figure 19). Smaller shares of injuries involved holes, vehicles or apparatus, or firefighters being lost, caught, trapped, or confined.

Fire progress contributed to nearly three in ten career firefighter injuries (27 percent), nearly double that of volunteer injuries (14 percent). This difference may again reflect a greater likelihood for volunteer firefighters to engage in exterior firefighting, either due to crew limitations or because fires are more fully developed upon arrival due to slower response times.

Volunteer firefighter injuries were somewhat more likely to involve a collapse or falling object (14 percent) compared to career firefighter injuries (9 percent), but contributing factors were otherwise similar regardless of affiliation.

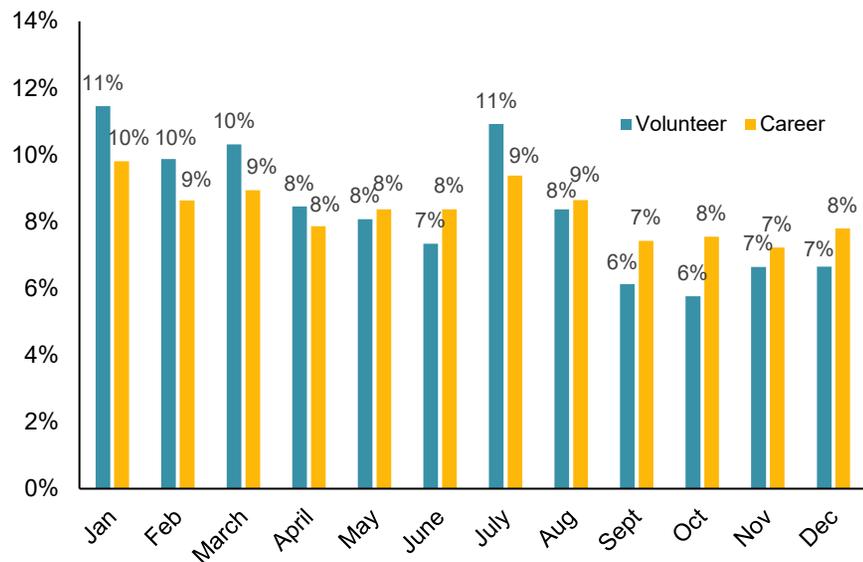
**Figure 19. Fireground Injuries by Affiliation and Injury Factor, 2014–2018**



### Injuries by Month

Fireground injuries were highest in the cold weather months of January, February, and March and hot weather months of July and August for firefighters of both affiliations, as shown in Figure 20. Because volunteer firefighters have less access to physical conditioning programs, the larger share of volunteer injuries in July relative to career firefighters may reflect comparative deficits in physical fitness and the influence of hot weather. In general, the monthly distribution of injuries showed greater variation for volunteer firefighters.

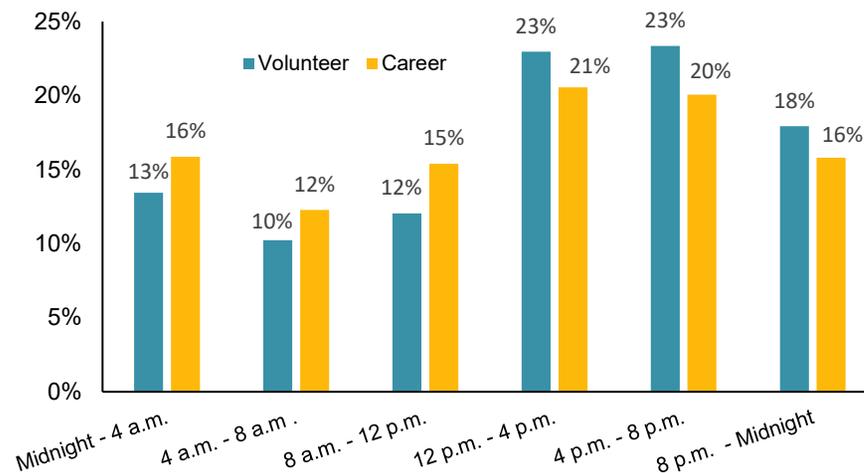
**Figure 20. Fireground Injuries by Affiliation and Month of Injury, 2014–2018**



### Injuries by Time of Day

Fireground injuries for career and volunteer firefighters were highest between the hours of 12 p.m. and 8 p.m. and lowest between midnight and 8 a.m. The share of volunteer injuries (46 percent) was somewhat higher than for career fighters in the 12 p.m. to 8 p.m. period (41 percent), while career firefighter injuries were higher than those of volunteers between midnight and 12 p.m. (see Figure 21). Additional research is needed to confirm differences in time of injury between affiliations.

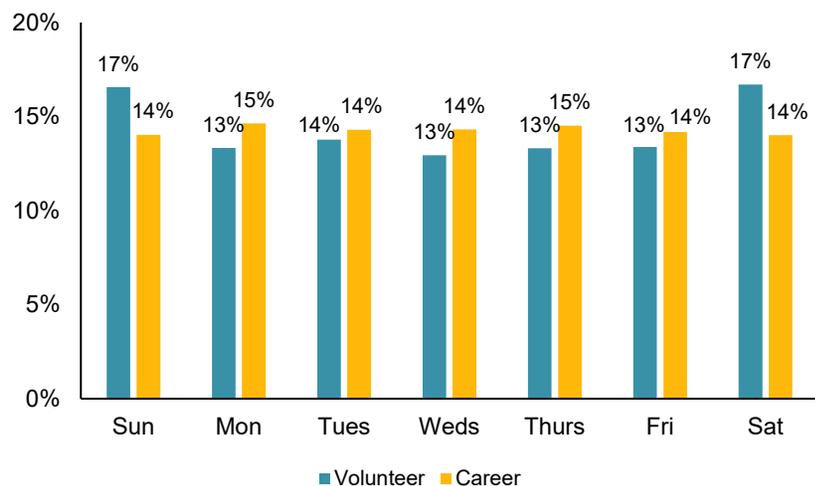
**Figure 21. Fireground Injuries by Affiliation and Time of Injury, 2014–2018**



### Injuries by Day of Week

As shown in Figure 22, fireground injuries for career firefighters were fairly evenly distributed across the days of the week, varying only between 14 percent to 15 percent. The share of volunteer firefighters by day of injury varied between 13 percent and 14 percent during the week and rose to 17 percent on Saturdays and Sundays, likely reflecting the greater availability of volunteer firefighters to respond to calls on the weekend.

**Figure 22. Fireground Injuries by Affiliation and Day of Injury, 2014–2018**



## Discussion

Firefighters are regularly at risk of injury due to work activities that involve exposure to fire and explosion hazards, carrying heavy equipment or victims, contending with hot or cold weather conditions, working on slippery or uneven surfaces, assuming awkward body postures, and contending with multiple other hazards.

Sprain or strain and overexertion injuries have been identified as prevalent forms of firefighter injury in [other research](#). Factors that contribute to these injuries include repetitive motion, inadequate fitness, and activities that compromise trunk stability.

While any number of routine firefighter tasks will pose limits for injury intervention efforts, research has nevertheless identified potential opportunities for reducing the risk of sprain, strain, and overexertion injuries. For instance, better [aerobic fitness](#) has been found to be associated with a lower risk of sprain and strain injuries among

firefighters, a finding which underscores the importance of structured fitness programs, particularly for volunteers who don't work in physically demanding jobs. Research also suggests that programs to enhance [core strength and functional movement performance](#) as a means to reduce injuries due to awkward postures and greater attention to [nutrition and fitness](#) can help reduce musculoskeletal injuries. Training and education on [safe lifting techniques and the use of ergonomically designed equipment](#) can be used as additional injury reduction interventions.

This research indicates that in addition to sprain and strain or exhaustion-related injuries, volunteer firefighters also experienced an array of traumatic injuries, including cuts and lacerations, burns, smoke inhalation, bruises, and fractures. Although the fireground is an inherently hazardous environment, good health and safety practices can reduce the risk of injury, beginning at the pre-incident phase with the development of safety-related standard operating procedures and training programs for all firefighter activities. Because personal protective equipment is an essential safeguard against firefighter injury, pre-incident safety preparations must also ensure that personal protective equipment is properly maintained and meets the prevailing equipment codes.

At the incident scene, it is critical to follow standard operating procedures before undertaking interior firefighting. This includes 360-degree size-up, determination of whether the situation justifies entry, identifying points of egress, and ensuring the use of personal protective equipment. The assignment of trained safety officers to the fire scene can help ensure the identification of hazards and curtail any inclinations of crew members to assume unnecessary risks by engaging in a quick response. In addition, the occurrence of a substantial share of injuries during overhaul indicates that hazards are not restricted to extinguishment activities and that appropriate safety practices are needed throughout the response.

## Select US Firefighter Injuries on the Fireground, 2014–2018

### Fall Through Ceiling

A company officer fractured his leg while checking for fire extension in an exposed building while operating at a brush fire. The brush fire was unintentionally ignited by a caretaker using a propane-fueled weed burner. The fire spread into a large brush pile and then extended to a church.

Bystanders used several garden hoses to extinguish approximately 90 percent of the fire by the time the fire department arrived. But the remaining fire was against the church. The officer of the engine company requested assistance for a building fire, as there was some minor damage and slight smoke condition near the eaves. Firefighters raised a ground ladder to the eave line and pulled off the fascia board to check for extension. After visually checking for extension and utilizing a thermal imaging camera, they concluded there was no fire extension, but mechanical ventilation was needed for the smoke in the attic.

A crew with an officer and two firefighters located access to the attic and the three entered the space to place a ventilation fan. Seven minutes later, a mayday was called by one of the firefighters in the attic. The officer fell through a ceiling, landing in the baptismal font below.

The 52-year-old captain fractured his leg in the fall and has not been cleared to resume firefighting activities.

\*\*\*

### Ceiling Collapse

Firefighters responding to a structure fire encountered fire heavy fire in the front stairwell and on the front porches of all three floors of a vacant multifamily residence. The first arriving engine company requested additional resources. The building was heavily secured, with screwed-in plywood covering all the doors and windows in the structure.

While companies removed plywood from the doors and windows, crews used a handline and tower ladder master streams to knock down the fire in the loft area. Approximately 15 minutes later, crews entered the structure to completely extinguish hidden fire in the voids.

Approximately 12 firefighters were in the front-left quadrant of the third floor in a bedroom adjacent to the front stairwell operating a hose stream and performing overhaul when a section of the ceiling collapsed.

Eight of the firefighters were struck by the large heavy ceiling, burying three of them under the heavy, water-soaked collapsed debris. The ceiling was comprised of plastered sheetrock, a second layer of plaster and wire lathes, and furring strips of blown-in insulation.

The sector officer issued a mayday call and a rapid intervention team was deployed. Several firefighters in the immediate vicinity helped extricate the buried firefighters.

All eight firefighters were transported to the emergency room, treated for their injuries, and released.

\*\*\*

## **Fall from Ladder**

Firefighters responding to a fire at an auto body repair shop arrived to find multiple vehicles on fire inside one of the seven garage bays. The fire was rapidly extending to the adjacent bays and through the roof.

During suppression efforts, a firefighter using a handline on a ground ladder fell approximately 20 feet (6.1 meters) to the ground after losing control of the nozzle. A rapid intervention team staffed with three firefighters quickly deployed and removed the victim from the front of the burning structure.

The 41-year-old firefighter was wearing a complete protective ensemble when he fell from the ladder and suffered contusions, sprains, and minor trauma. He was able to return to firefighting activities several weeks after the incident.

\*\*\*

## **Fall Down Stairs**

Firefighters responding to reports of a building fire with possible entrapment arrived to find venting from windows on the second floor of a two-family home. Crews were informed by a police officer and family member that an elderly occupant was possibly still on the second floor.

An engine company stretched a hose line up the front stairs while the ladder company began roof operations and two members of the heavy rescue followed the engine company to assist with forcible entry and to search the fire floor.

The captain and a firefighter ascended the rear stairs and met up with the engine company in a narrow hallway in zero visibility and high heat.

As the engine company worked its way into the apartment, the captain tried to move by in order to search the apartment. The captain ordered his partner to stand at the bottom of the stairs to ensure that another handline was not brought up until the first line could get into the apartment. Not realizing how close he was to the stairs, the captain took

a step backward while trying to stand and fell down the steep stairs headfirst, landing on his SCBA cylinder.

His partner and firefighters from the engine company at the bottom of the stairs assisted him to the backyard where he was treated by an advanced life support ambulance.

The 46-year-old captain suffered a concussion and multiple muscle sprains in his neck and upper back, as well as a sprained knee. He returned to light duty a month after the fire.

\*\*\*

## **Structural Collapse**

On a windy and wet afternoon, the fire department received calls reporting a fire at a gas station with a convenience store and fast-food restaurant. On arrival, crews found a large body of fire consuming the building.

Firefighters immediately deployed a ground-level master stream and also deployed a handline to the front of the building. The roof of the structure collapsed several minutes after arrival as the engine company was establishing the water supply.

Soon after the roof collapse, a firefighter attacking the fire through the front windows was struck and trapped by a falling sheet metal façade. The collapse of nearly the entire front façade buried the firefighter under the debris. Another firefighter immediately trained his hose stream onto the burning material engulfing the victim as firefighters and bystanders sought to pull the firefighter free.

The firefighter was pulled to safety after rescuers were able to lift some of the material off him. He was treated by the crew of an on-scene ambulance and transported to the hospital with first- and second-degree burns to his arms and legs. He was wearing a full protective ensemble, including SCBA.

\*\*\*

## Second Degree Burns in Home Fire

Firefighters responding to a late afternoon fire arrived to find fire venting from several bedroom windows in a single-family home.

The chief was first to arrive and was informed that everyone was out of the house. Crews from an engine company initiated an aggressive interior attack by advancing a hose line through the attached garage into the living room. Once they were near the kitchen, they charged their hose line and began advancing down the hallway.

With a 27-year-old firefighter leading the hose line down the dark hallway, the engine company could see that the bedroom had already flashed over and flames were beginning to roll over their heads.

While applying water onto the flames and darkening the fire down, the nozzle firefighter reported to an engine company officer that he thought he had been burned. Shortly afterward, the two abandoned their handline and exited the building after crews arrived with an additional handline to help knock down the main body of the fire.

The nozzle firefighter suffered second-degree burns to his ears and neck. The chief requested an ambulance and the burned firefighter was transported to the closest emergency room.

The injured firefighter was treated at the burn clinic and returned to firefighting activities nearly two months after the incident.

## Acknowledgments

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem.

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

To learn more about research at NFPA visit [nfpa.org/research](https://www.nfpa.org/research)

E-mail: [research@nfpa.org](mailto:research@nfpa.org)

NFPA No. USS02

**Table 1. Firefighter Fireground Injuries by Year, 2005–2018**

<b>Year</b>	<b>Number of Injuries</b>
2005	41,950
2006	44,210
2007	38,340
2008	36,590
2009	32,200
2010	32,680
2011	30,500
2012	31,490
2013	29,760
2014	27,020
2015	29,130
2016	24,330
2017	24,500
2018	22,970

Note: These are national estimates of firefighter injuries reported to US municipal fire departments and so exclude firefighter injuries reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to NFPA in its annual fire experience survey. Detailed firefighter casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fireground injuries are rounded to the nearest ten.

Source: NFIRS and NFPA fire experience survey.

**Table 2. Firefighter Fireground Injuries by Gender, 2014–2018**

Gender	Firefighter Injuries
Male	24,590 (96%)
Female	1,000 (4%)
Total	25,590 (100%)

Note: These are national estimates of firefighter injuries reported to US municipal fire departments and so exclude firefighter injuries reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to NFPA in its annual fire experience survey. Detailed firefighter casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fireground injuries are rounded to the nearest ten.

Totals might not equal sums because of rounding.

Source: NFIRS and NFPA fire experience survey.

**Table 3. Firefighter Fireground Injuries by Victim’s Age, 2014–2018**

Age	Firefighter Injuries
Less than 20 years	360 (1%)
20 to 29 years	4,650 (18%)
30 to 39 years	7,620 (30%)
40 to 49 years	7,950 (31%)
50 to 59 years	4,380 (17%)
60 to 69 years	560 (2%)
70 years and older	60 (0%)
Total	25,590 (100%)

Totals may not equal sums because of rounding.

Source: NFIRS and NFPA fire experience survey.

## How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the US Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of US fire departments. NFIRS is a voluntary system through which participating fire departments can report detailed factors about the fires to which they respond. Roughly two-thirds of US fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns of fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread and automatic detection and suppression equipment. For more information on NFIRS, visit <https://www.nfirs.fema.gov/>.

NFIRS has a wide variety of data elements and code choices. The NFIRS database contains coded information. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas, or wheel areas. However, the coded data cannot designate how much of each area was involved.

### **NFPA's fire department experience survey provides estimates of the big picture.**

Each year, NFPA conducts an annual survey of fire departments, which enables us to capture a summary of the fire department

experience on a larger scale. Surveys are sent to all the municipal departments protecting populations of 5,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten US municipal fire departments and about one-third of the US population.

The survey is stratified by the size of the population protected by a fire department to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond to confirm that those that did respond are truly representative of fire departments of their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total US population that it makes sense to survey all of them. Most respond, resulting in excellent precision for the final estimate.

The survey requests the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars) for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries and illnesses, by type of duty and nature of illness; (3) the number and nature of non-fire incidents; and (4) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected. The population size is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report [Fire Loss in the United States](#).

## **Projecting NFIRS to National Estimates**

As noted, NFIRS is a voluntary reporting system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors that correlate with the frequency and severity of fires. This means NFIRS could be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second source — the NFPA survey — is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

Only data originally collected in NFIRS 5.0 is included in the calculations of the 2014–2018 national estimates for firefighter injuries in structure fires. The portion of fires and firefighter injuries originally collected in NFIRS 5.0 compared to the earlier NFIRS 4.1 version has increased steadily over time. The percent of fires coded in version 5.0 for the 2014 to 2018 period ranged from 97 percent to 100 percent.

This update for 2014–2018 includes injuries that occurred at all fires (incident type 110–171) and at the fireground (where injury occurred codes 5 and 6), as well as the severity of injuries (1 to 5). Except where otherwise noted, all the tables are based on fireground injuries that occurred at all fires. The national annual estimates of firefighter injuries were weighted for the individual years using total fireground injuries from the annual NFPA fire experience survey.

In this report, unknown data was assumed to have the same proportional distribution as the known data. The Other category includes cases specifically coded as Other and cases coded in specific categories with very low frequency. Note that in the accompanying tables for this report, the number of firefighter injuries has been rounded to the nearest ten and the percentages have been rounded to the nearest whole percent. Totals in tables might not equal sums due to rounding.