



RESEARCH



Firefighter Injuries on the Fireground

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Key Findings

- United States firefighters experienced an average of 24,950 non-fatal injuries on the fireground each year from 2015 through 2019.
- Injuries involving exposure to a hazard (such as heat, smoke, or toxic agents) and overexertion or strain were 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 (39 percent) were report only and did not result in lost work time. Another one-fifth of the injuries (1 percent) required treatment by a physician, but no lost time, while 13 percent were classified as first aid only.
- Three in ten fireground injuries (29 percent) occurred outside at grade level, with a somewhat smaller share of injuries occurring while firefighters were inside a structure, but not the attic (27 percent).

Career Firefighters

- Career firefighters experienced an average of 20,650 fireground injuries each year from 2015 through 2019.
- Male firefighters accounted for 97 percent of the fireground injuries experienced by career firefighters.
- Career firefighter injuries most often occurred in structures, excluding attics (40 percent), or outside at grade (38 percent).
- More than two-fifths (44 percent) of the career firefighter injuries on the fireground were classified as report only and three in ten (29 percent) were lost time injuries of moderate severity.
- The leading primary symptoms of fireground injuries among career firefighters were strains or sprains (27 percent), smoke inhalation (18 percent), pain only (12 percent), thermal burns (7 percent), and cuts or lacerations (5 percent).

Volunteer Firefighters

- Volunteer firefighters experienced an annual average of 4,300 fireground injuries each year from 2015 through 2019.
- Male firefighters accounted for 93 percent of the fireground injuries experienced by volunteer firefighters.
- Two in five volunteer firefighter injuries on the fireground (38 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 (11 percent), cuts or lacerations (9 percent), thermal burns (9 percent), pain only (8 percent), and smoke inhalation (5 percent).
- Approximately one-half of the volunteer fireground injuries occurred outside at grade (49 percent), with just over one-quarter (27 percent) of the injuries occurring inside a structure.

Introduction

Firefighters are routinely exposed to an array of safety and health hazards at fire scenes. 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, a 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, the activities being performed at the time of injury, and other relevant information — is critical for identifying risk factors, developing prevention programs, and guiding resource decisions for firefighters, 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 2015 through 2019. The data is 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 related to injury incidents than is possible with the summary data collected by the NFPA survey alone. The data in this report represents estimates of firefighter injuries from fires reported to US municipal fire departments and so excludes injuries resulting from fires 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, both 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 the data presented in the body of the report represents only the results for the major response categories. More detailed information is available in the [accompanying tables](#).

The information in this report focuses on non-fatal injuries that occurred on the fireground 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*¹ and *United States Firefighter Injuries*.² The latter provides the latest estimates of all firefighter injuries, including injuries that occurred off the fireground and documented exposures to infectious diseases.

¹ See *Firefighter Fatalities in the United States – 2019* by Rita F. Fahy Jay Petrillo and Joseph L. Molis.

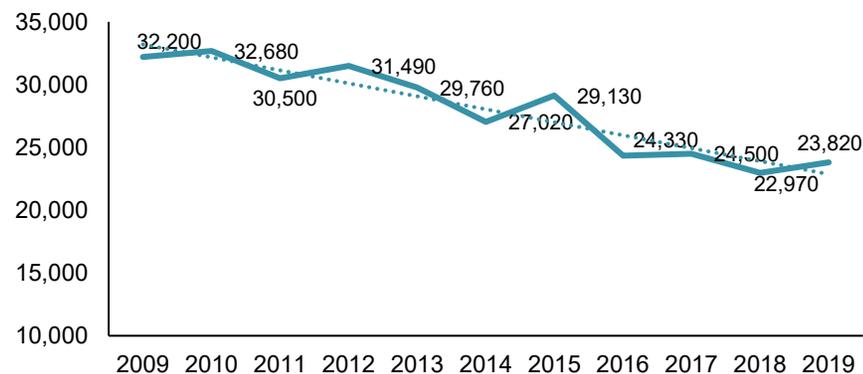
² See *United States Firefighter Injuries in 2019* by Richard Campbell and Ben Evarts.

Part 1. Patterns of Firefighter Injuries on the Fireground

NFPA estimates that firefighters sustained a total of 124,750 injuries on the fireground during the five-year period from 2015 to 2019, an average of 24,950 non-fatal injuries each year. While substantial, the number of injuries over the latest five-year period nevertheless represents a substantial decrease from the estimated total of 151,450 injuries experienced from 2010 through 2014, an average of 30,290 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 back to 2005 can be found in Table 1 of the tables accompanying this report. It should be noted that this encouraging decline in firefighter injuries has been a consistent trend documented in prior NFPA reports on fireground injuries. The estimated injury totals in 2018 and 2019 represent the lowest fireground injury counts over this time period.

Figure 1. Fireground Injuries by Year, 2009–2019 Annual Average

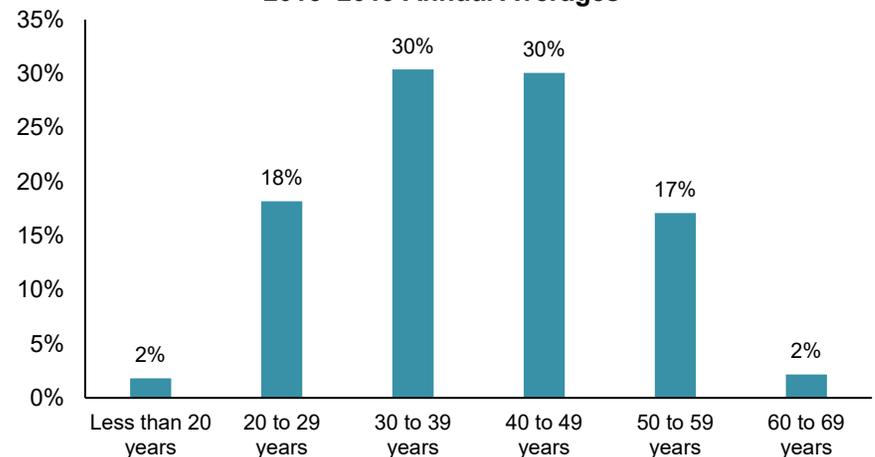


Age and Gender

The vast majority of fireground injuries were experienced by males, with females accounting for only 4 percent of the injuries. According to NFPA's recent report, *US Fire Department Profile*, women accounted for 8 percent of the firefighter workforce in 2018, which suggests that female firefighters may have experienced a disproportionately lower share of injuries relative to males. Part 2 of this report shows that the disparity is less apparent among volunteer firefighters. Additional research is needed to confirm the 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 30 to 39 and 40 to and 49 age groups accounted for the highest shares of injuries, each with 30 percent of the total. 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.

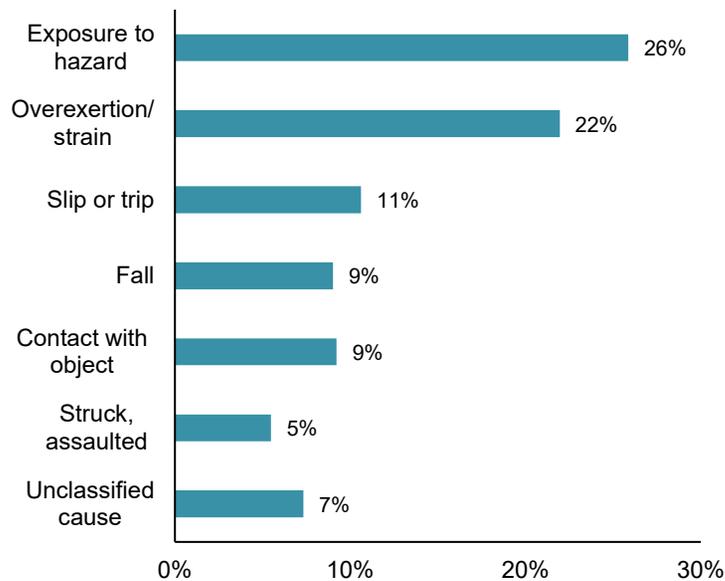
Figure 2. Fireground Injuries by Victim's Age, 2015–2019 Annual Averages



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 accounted for nearly half of the injuries (48 percent). Injuries involving overexertion or strain consistently ranked 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 slipping or tripping, contact with objects, falls, and being struck or assaulted by a person, animal, or moving object.

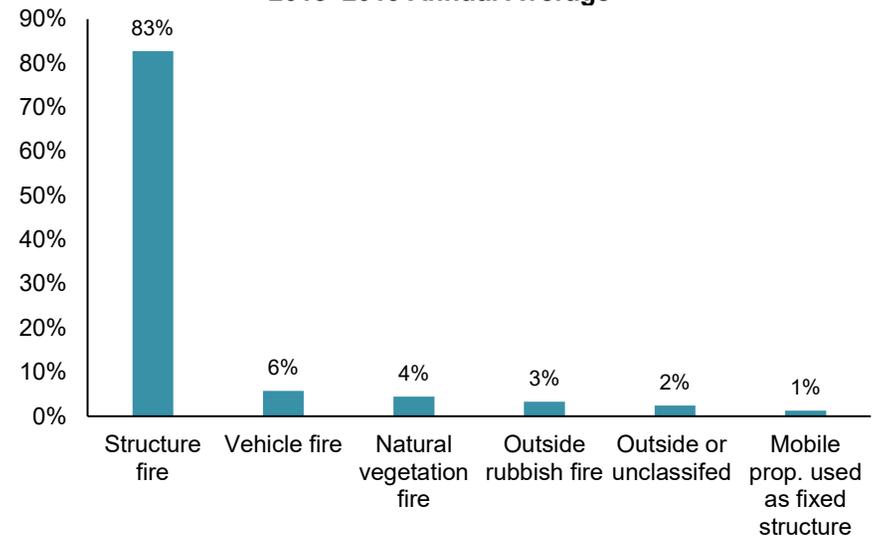
Figure 3. Fireground Injuries by Cause, 2015–2019 Annual Average



Injuries by Type of Fire Incident

Firefighters respond to different types of fire incidents. The vast majority (83 percent) of the fireground injuries 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.

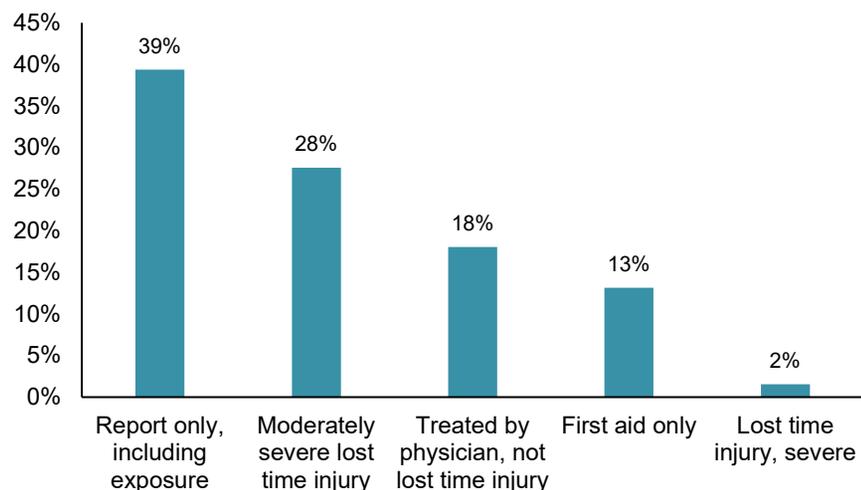
Figure 4. Fireground Injuries by Type of Incident, 2015–2019 Annual Average



Severity of Injury

These injuries are broken down by severity 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 (18 percent) of the injuries required treatment by a physician without 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, 2015–2019 Annual Average

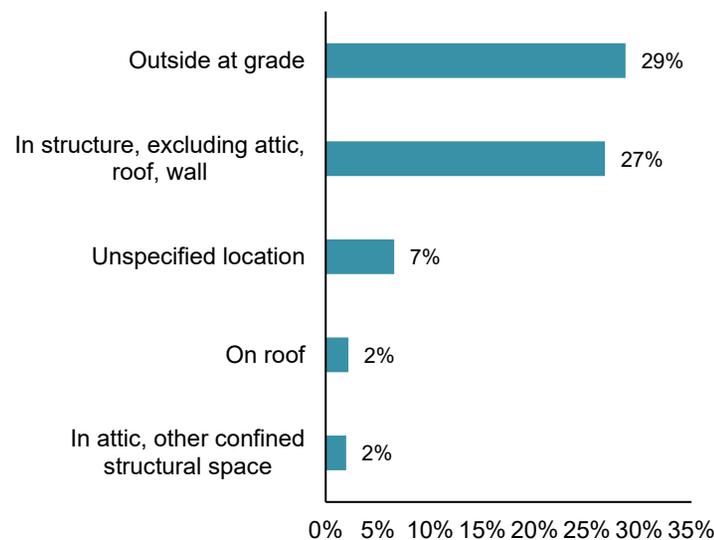


Injury Location

Almost three in ten fireground injuries either occurred outside at grade level (29 percent) or inside a structure, excluding the attic (27 percent), as shown in Figure 6. Smaller shares of injuries occurred while firefighters were on a roof, steep grade, or ground ladder.

Injury locations do not by themselves provide any indication of the relative chance of injury in specific locations, as they can 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 of structures on the fireground.

Figure 6. Fireground Injuries by Leading Injury Locations, 2015–2019 Annual Average



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 three in ten injuries, while another one-tenth of the injuries (9 percent) occurred during overhaul. Figure 7 shows the tasks 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 for equipment, or be used to inform purchasing decisions.

Figure 7. Fireground Injuries by Activity, 2015–2019 Annual Average

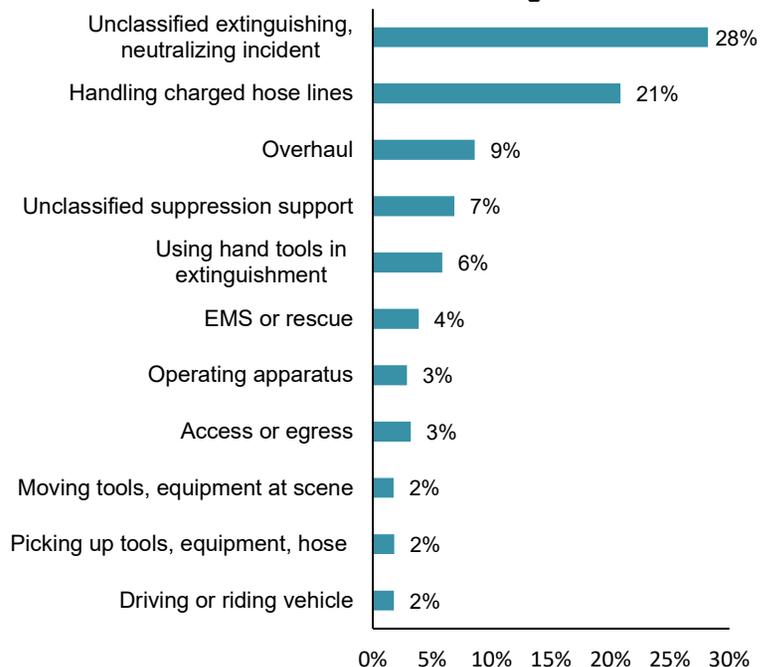
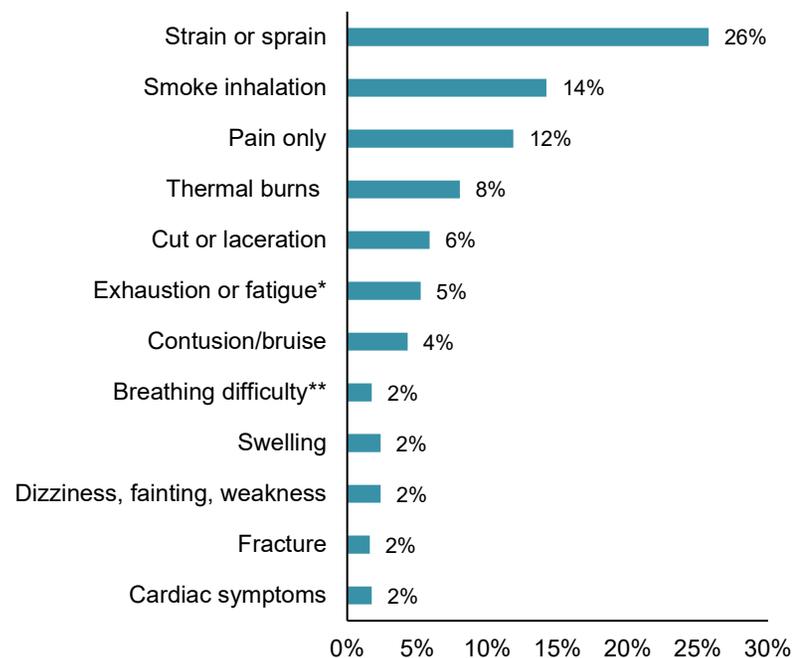


Figure 8. Fireground Injuries by Primary Symptom, 2015–2019 Annual Average



*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 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 smoke inhalation, cuts or lacerations, thermal burns, contusions or bruises, fractures, and swelling injuries. Firefighters also experienced a variety of symptoms influenced by the physical demands of their work tasks, the environmental conditions in which they were working, or 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. Injuries to lower (20 percent) and upper (18 percent) extremities together accounted for two in five injuries. Acute trauma may have caused some of these injuries, but they also involved 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, 2015–2019 Annual Average

Primary Body Part Injured	Percent
Lower extremities	20%
Knee	8%
Ankle	6%
Lower leg	3%
Upper extremities	18%
Hand and fingers	11%
Wrist	2%
Elbow	2%
Lower arm	2%
Internal	17%
Trachea and lungs	14%
Neck and shoulders	13%
Shoulder	8%
Neck	4%
Head	11%
Unclassified head	5%
Ear	3%
Eye	2%
Thorax	7%
Back, except spine	5%
Chest	2%
Multiple parts	7%
Spine	3%
Abdominal area	3%

Factors Contributing to Injuries

Injury reports sometimes include limited information on the factors that contributed to the fireground injuries. As shown in Table B, factors relating to fire development (such as smoke conditions or explosions) contributed to just over three in ten injuries, while slippery or uneven surfaces contributed to another one-fifth of injuries (19 percent). Collapses of structural elements or falling objects also contributed to a substantial share of injuries (10 percent). Holes or being lost, caught, trapped, or confined contributed to comparatively smaller shares of the injuries.

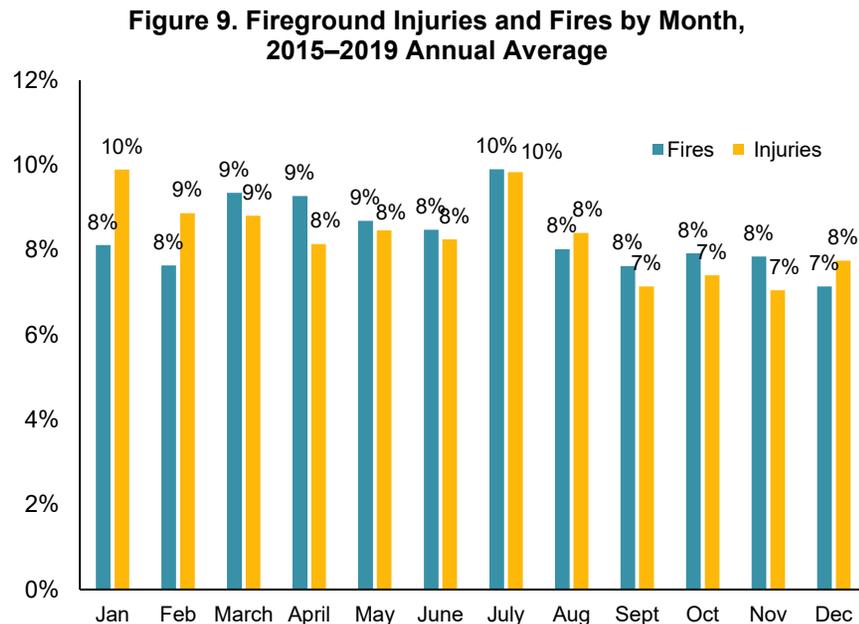
Table B. Factors Contributing to Injuries, 2015–2019 Annual Average

Injury Factor	Percent
Fire development	32%
Fire progress, including smoky conditions	27%
Slippery or uneven surfaces	19%
Uneven surface, including holes in the ground	6%
Icy surface	4%
Loose material on surface	2%
Wet surface	2%
Unclassified slippery or uneven surface	5%
Collapse or falling object	9%
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 the months of January and July, with 10 percent of the injuries occurring in each of those months. February and March each accounted for 9 percent of the injuries. Injuries were lowest in September, October, and November.

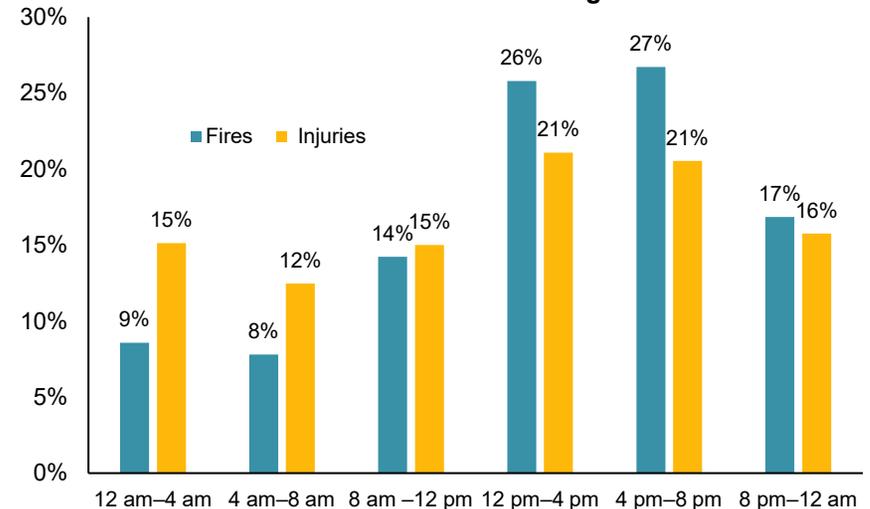
Since the incidence of fires by month can vary and thereby influence opportunities for injury on a monthly basis, Figure 9 shows the monthly distribution of fireground injuries and fire incidents. As the figure indicates, the monthly share of injuries was highest relative to the distribution of fires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



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 with the largest shares of 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, 2015–2019 Annual Average



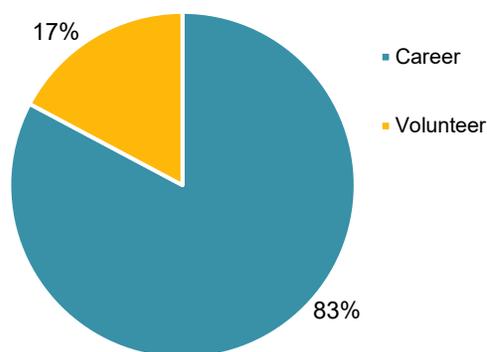
Part 2. Fireground Injuries by Firefighter Affiliation

It is useful to compare the fireground injury experience of career and volunteer firefighters as there are some important differences between firefighters in the two groups. Although volunteer firefighters are generally responsible for performing the same work as their career counterparts, they are more likely to do so 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 do not require annual or biannual fitness testing or health screenings and that the regular jobs of volunteers may not be physically demanding, leaving them with a disadvantage when performing arduous firefighting tasks.

As Figure 11 shows, the vast majority of fireground injuries were experienced by career firefighters (83 percent), with volunteer firefighters experiencing just one in six 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 that could have on the reported injury totals.

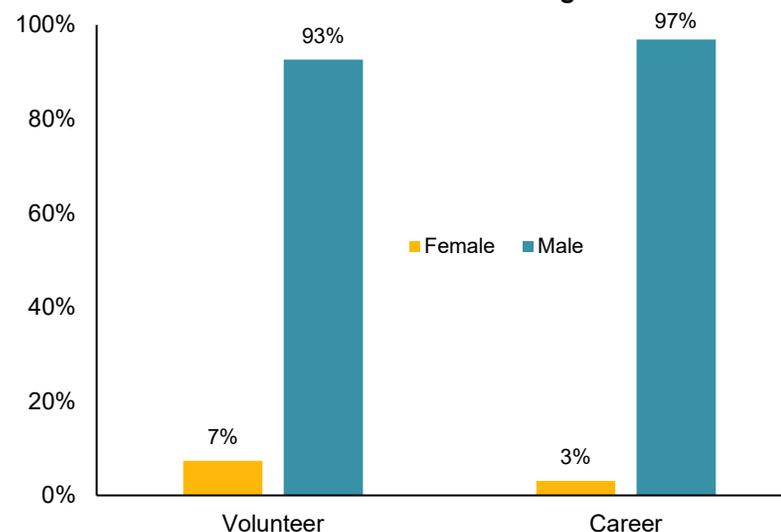
Figure 11. Fireground Injuries by Affiliation, 2015–2019 Annual Average



Injuries by Gender

The vast majority of fireground injuries (96 percent) were experienced by male firefighters. Although the share of injuries experienced by female firefighters was higher for volunteers than for career firefighters, females also comprised 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 breaks down fireground injuries by affiliation and gender.

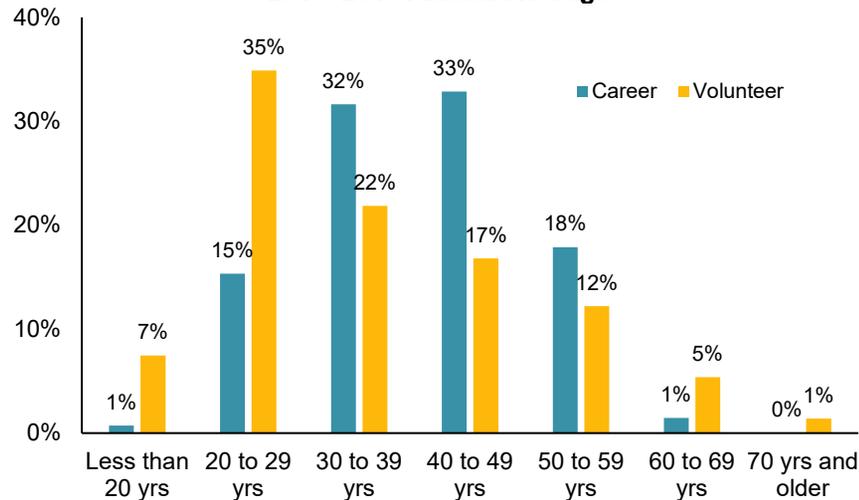
Figure 12. Fireground Injuries by Affiliation and Gender, 2015–2019 Annual Average



Injuries by Age

Fireground injuries are broken down by affiliation and age in Figure 13. As the figure indicates, more than two of every five volunteer injuries were experienced by those in the two youngest age groups, with over one-third of the 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 (32 percent) or 40 to 49 years (33 percent). Only 1 percent of the career firefighter injury victims were aged 60 or older, while 6 percent of the injured volunteers were in that 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.

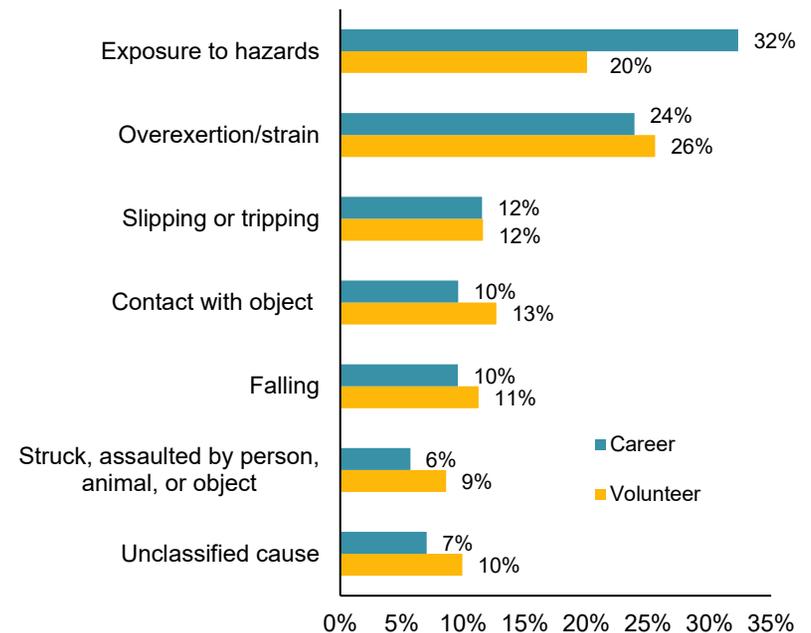
Figure 13. Fireground Injuries by Affiliation and Age, 2015–2019 Annual Average



Injuries by Cause

The leading cause of injury for career firefighters was exposure to hazards, which accounted for approximately one in three injuries (32 percent), followed by overexertion or strain (24 percent). An additional one-third of career firefighter injuries were collectively caused by slipping or tripping (12 percent), contact with objects (10 percent), and falling (10 percent). As Figure 14 shows, volunteer firefighters were less likely to experience injuries from exposure to hazards (20 percent) than career firefighters and slightly more likely to experience overexertion or strain injuries (26 percent) or injuries caused by being struck or assaulted (9 percent) than career firefighters.

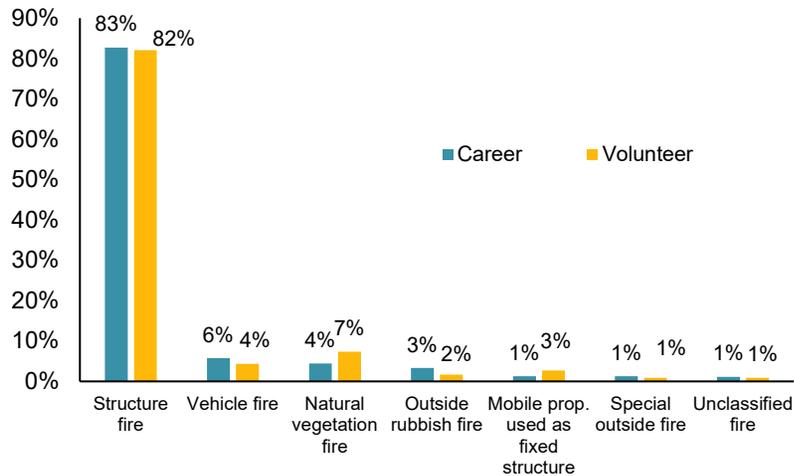
Figure 14. Fireground Injuries by Affiliation and Cause of Injury, 2015–2019 Annual Average



Injuries by Type of Fire Incident

As shown in Figure 15, the vast majority of fireground injuries for both volunteer and career firefighters occurred at structure fires. Career firefighters experienced a larger share of injuries at vehicle fires than volunteers, while volunteers experienced larger shares of injuries at natural vegetation fires and fires in mobile properties used as fixed structures, in all likelihood reflecting the predominance of volunteer firefighters in more rural areas.

Figure 15. Fireground Injuries by Affiliation and Type of Incident, 2015–2019 Annual Average

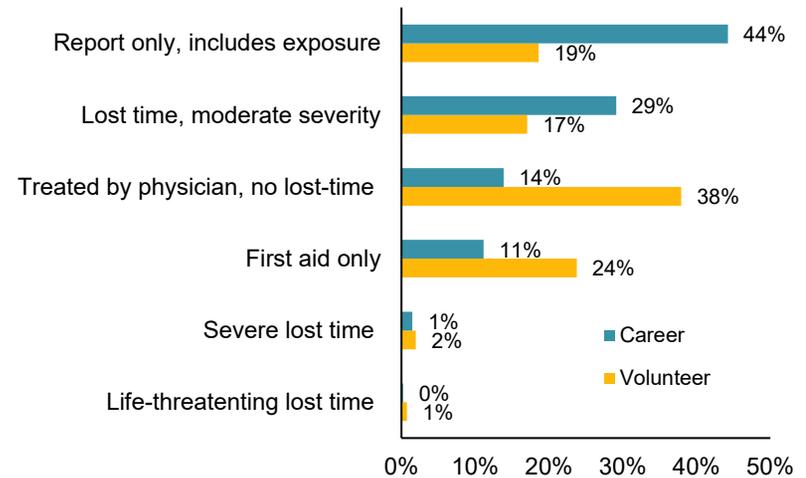


Severity of Injury

Injuries are broken down by severity 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 that

were first aid only. There were few severe lost time injuries in either group. One percent of the volunteer firefighter injuries and fewer than 1 percent of the career firefighter injuries were classified as life-threatening.

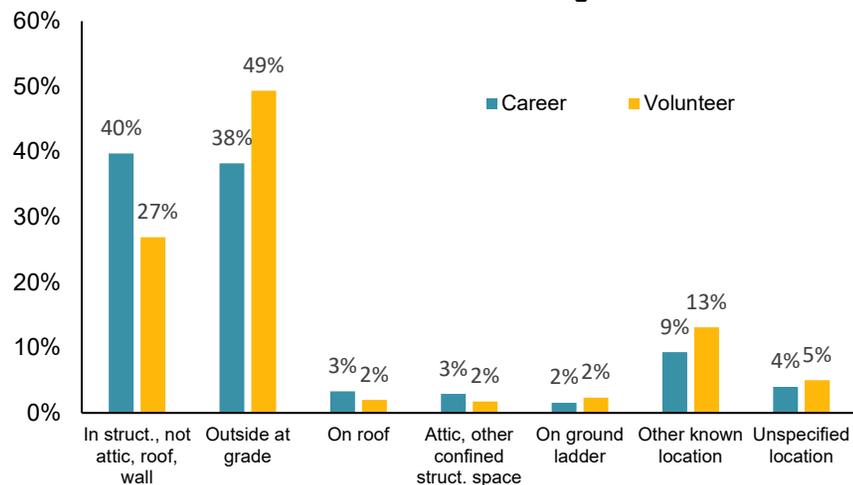
Figure 16. Fireground Injuries by Affiliation and Severity of Injury, 2015–2019 Annual Average



Injury Location

Figure 17 shows that almost four in five career firefighter injuries occurred inside a structure other than the attic (40 percent) or outside at grade level (38 percent). Half of the volunteer firefighter injuries occurred while outside at grade level, while more than one-quarter occurred inside a structure somewhere other than the attic. A possible explanation for these 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 smaller shares of the fireground injuries.

Figure 17. Fireground Injuries by Affiliation and Injury Location, 2015–2019 Annual Averages



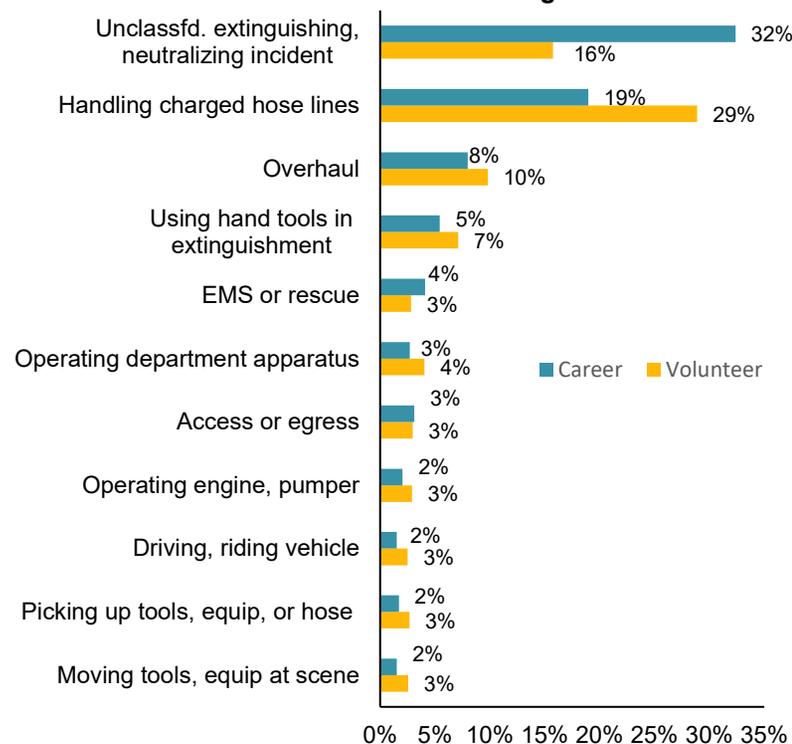
Activity When Injured

One-third of the career firefighter injuries (32 percent) occurred during unclassified extinguishing or neutralizing activities and another one-fifth occurred while handling charged hose lines. Volunteer firefighters were most likely to be injured while handling charged hose lines (29 percent). Injuries while engaged in unclassified extinguishing or neutralizing activities was the second leading injury activity for volunteers (16 percent), but it was less prevalent than with career firefighters. See Figure 18. One explanation for this could be that volunteers are more likely to be operating outside and moving charged, heavy hose lines, creating a greater likelihood 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.

Injuries that occurred during overhaul activities accounted for 8 percent of the career firefighter injuries and a slightly higher share of volunteer

injuries (10 percent). Other leading activities accounted for similar shares of volunteer and career firefighter injuries, including suppression support; using hand tools in extinguishment; moving or picking up hand tools, equipment, or hose on scene; operating apparatus; providing EMS or rescue support; accessing or egressing from a structure; or driving or riding in vehicles.

Figure 18. Fireground Injuries by Affiliation and Activity, 2015–2019 Annual Averages



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 the primary injury symptoms among career firefighters.

Strains and sprains were also the primary injury symptom of volunteer firefighter injuries, but volunteer firefighters were substantially less likely to sustain smoke inhalation injuries than career firefighters, potentially due to less engagement in interior firefighting. Also notable is that nearly a quarter (23 percent) of the volunteer injuries involved exhaustion and fatigue, dizziness, fainting or weakness, breathing difficulty, or cardiac symptoms, compared to just 9 percent of the career firefighter injuries. This disparity is likely due to fewer opportunities for volunteers to participate in physical fitness programs, as well as reduced access to nutrition and wellness programs.

Table C. Fireground Injuries by Affiliation and Primary Symptom, 2015–2019 Annual Averages

Primary Symptom of Injury	Career	Volunteer
Strain or sprain	(27%)	(15%)
Smoke inhalation	(18%)	(5%)
Pain only	(12%)	(8%)
Thermal burns	(7%)	(9%)
Cut or laceration	(4%)	(5%)
Contusion or bruise, minor trauma	(5%)	(4%)
Exhaustion, fatigue, including heat	(4%)	(11%)
Dizziness, fainting or weakness	(2%)	(5%)
Breathing difficulty, shortness of breath	(1%)	(4%)
Cardiac symptoms	(1%)	(4%)

Primary Body Part

Two in five career firefighter injuries were either internal injuries (21 percent) or involved the lower extremities (19 percent) as indicated in Table D. Career firefighter injuries also often involved the upper extremities, neck and shoulders, head, thorax, and multiple body parts. Volunteer firefighters were much less likely to experience internal injuries than career firefighters, but they were somewhat more likely to experience injuries to the upper extremities and the head.

Table D. Fireground Injuries by Affiliation and Primary Body Part, 2015–2019 Annual Averages

Primary Body Part	Career	Volunteer
Internal	(21%)	(10%)
Lower extremities	(19%)	(20%)
Upper extremities	(16%)	(22%)
Neck and shoulders	(13%)	(10%)
Head	(10%)	(15%)
Thorax	(7%)	(7%)
Multiple parts	(7%)	(11%)
Spine	(4%)	(2%)
Abdominal area	(3%)	(4%)

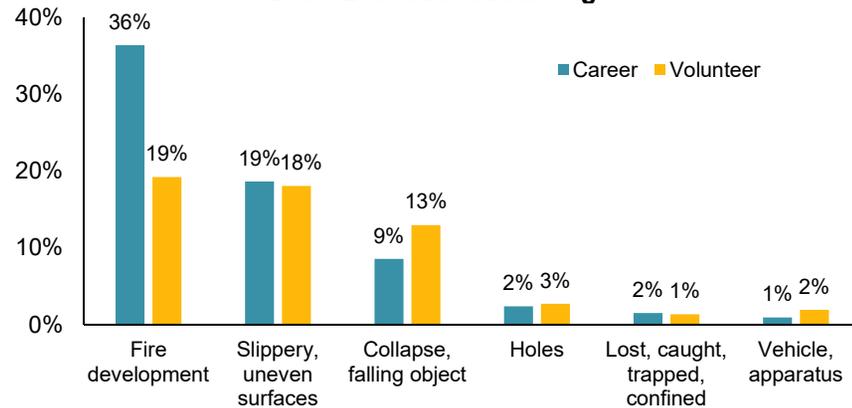
Injury Factor

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

Fire development accounted for much higher shares of injuries among career firefighters (36 percent) than among volunteers (19 percent). This difference may again reflect a reduced likelihood for volunteer firefighters to engage in interior 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 (13 percent) compared to career firefighters (9 percent), but the contributing factors were otherwise similar regardless of affiliation.

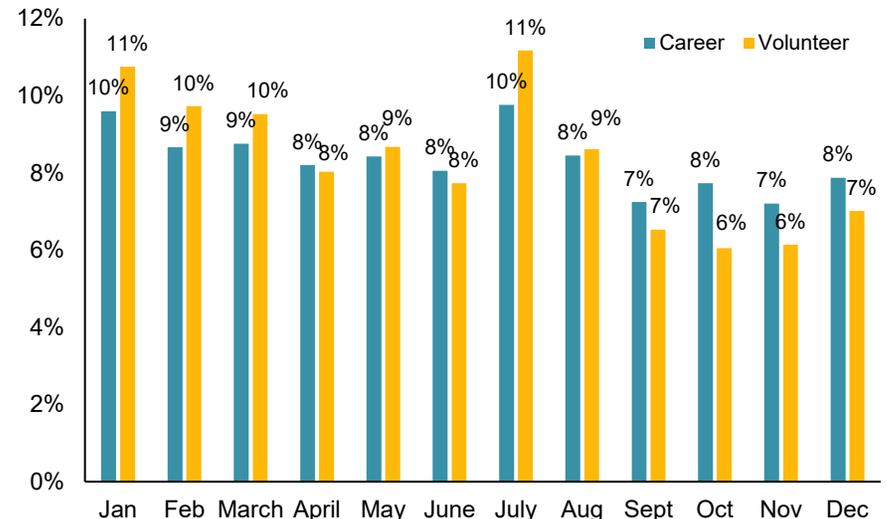
Figure 19. Fireground Injuries by Affiliation and Injury Factor, 2015–2019 Annual Average



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. Volunteer firefighters had a higher share of injuries in July, which could reflect the availability of volunteers for duty in July or a comparative deficit in physical fitness and the influence of hot weather. In general, the monthly distribution in injuries showed greater variation for volunteer firefighters.

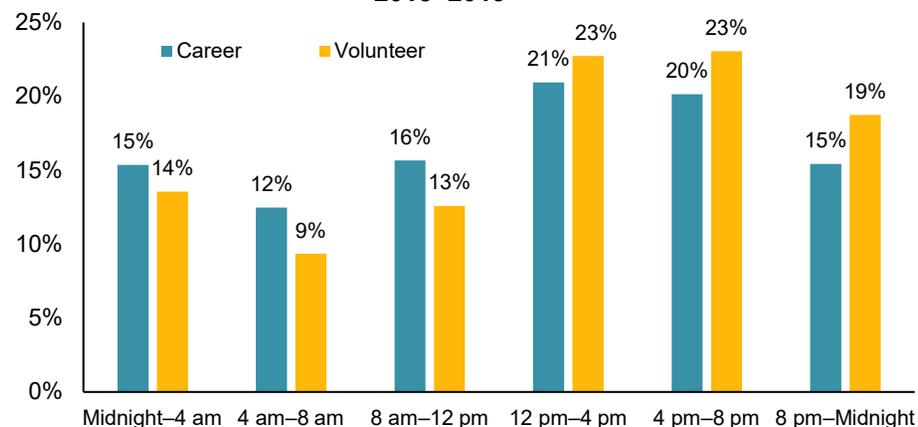
Figure 20. Fireground Injuries by Affiliation and Month of Injury, 2015–2019



Injuries by Time of Day

Fireground injuries for career and volunteer firefighters were highest during the hours between 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 noon to 8 p.m. period (41 percent), while career firefighter injuries were higher than those of volunteers between midnight and noon. See Figure 21. Additional research is needed to study these differences between the affiliations.

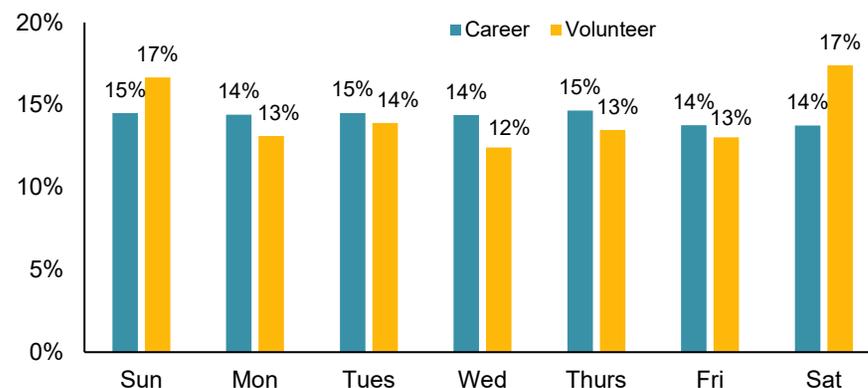
Figure 21. Fireground Injuries by Affiliation and Time of Injury, 2015–2019



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 and 15 percent. The share of injuries to volunteer firefighters by day varied from 12 percent to 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 weekends.

Figure 22. Fireground Injuries by Affiliation and Day of Injury, 2015–2019



Discussion

Firefighters are regularly at risk of injury due to work activities that involve exposure to fire and explosion hazards, carrying heavy equipment or injury 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 motions, inadequate fitness, and activities that compromise trunk stability.

While any number of routine firefighter tasks can 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 has also shown that programs that

enhance [core strength and functional movement performance](#) can reduce injuries due to awkward postures, while greater attention to [nutrition and fitness](#) has been identified as a way to reduce musculoskeletal injuries. Training and education on [safe lifting techniques and the use of ergonomically designed equipment](#) represent additional injury reduction interventions.

This research also indicates that in addition to sprain and strain or exhaustion-related injuries, volunteer firefighters experience 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, and such practices should begin at the pre-incident phase with the development of safety-related standard operating procedures and training programs for all firefighter activities. Since 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 prevailing equipment codes.

At the incident scene, it is critical for firefighters 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 a 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, 2015–2019

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 conditions 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 the 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 heavy fire on the front stairwell and front porches on 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 area, operating a hose stream and performing overhaul in the front-left quadrant of the third floor in a bedroom adjacent to the front stairwell 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 handling 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 with zero visibility and high heat.

As the engine company worked its way into the apartment, the captain tried to move by 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, multiple muscle sprains in his neck and upper back, and a sprained knee. He returned to light duty a month after the fire.

Structural Collapse

On a windy and wet afternoon, a 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 another firefighter 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. A nearby firefighter immediately trained his hose stream onto the burning material engulfing the victim as other firefighters and bystanders sought to pull the firefighter free.

The firefighter was pulled to safety after rescuers were able to lift enough 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 makes this analysis possible. Their contributions allow us to estimate the size of the fire problem.

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

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

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How National Estimate Statistics Are Calculated

The statistics in this analysis are estimates derived from the National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA) annual survey of US fire departments. NFIRS is a voluntary system by which participating fire departments 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 for 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 about NFIRS visit <http://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. It is impossible to tell the portion of each from the coded data.

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 fire department

experience on a larger scale. Surveys are sent to all 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 size of population protected 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 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 their part of the final estimate.

The survey includes 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, 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, which 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*. To download a free copy of the report, visit <http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf>.

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 correlated with frequency and severity of fires. This means NFIRS may 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 database — 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.

In this analysis, only data originally collected in NFIRS 5.0 is included in the calculations of the 2015-2019 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 2015 to 2019 period ranged from 97 percent to 100 percent.

This update for 2015–2019 includes injuries that occurred at all fires (incident type 110–171), at the fireground (where injury occurred codes 5 and 6), and severity of injury (1 to 5). Except where otherwise noted, all 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 distribution where the data was known. The “Other” category includes cases specifically coded as “other” and cases coded in specific categories but 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 percentages are rounded to the nearest whole percent. Totals in tables may not equal sums due to rounding.