Firefighter Injuries and Fireground Operations

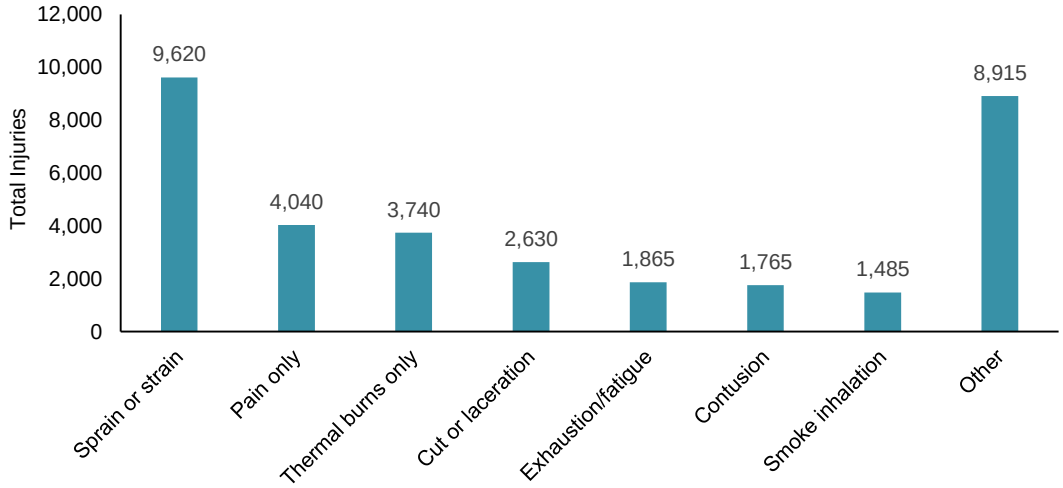
There were an estimated annual average of 34,065 injuries to firefighters during fireground operations in the U.S. for the 2007-2011 period.[1] An annual average of 23,885 of these injuries were classified as minor injuries, and 10,180 were classified as moderate or severe, as shown in Table 1.[2]

Table 1. Firefighter Fireground Injuries, Total and Severity 2007-2011 Annual Averages

Year	Total Injuries	Minor	Moderate and Severe
2008	36,595	25,825	10,770
2009	32,505	22,610	9,595
2010	32,675	22,400	10,275
2011	30,505	20,990	9,515
2007-11 Averages	34,065	23,885	10,180

Sprain and strain injuries were the most common type of injury experienced by firefighters on the fireground. As shown in Figure 1 below, injuries with the highest annual averages, as measured by primary apparent symptom, included sprain or strain (9,620 injuries, 28% of the total), pain only (4040 injuries, 12%), thermal burns only (3,740 injuries, 11%), exhaustion or fatigue, including heat exhaustion (1,865 injuries, 5%), contusion (1765 injuries, 5%), and smoke inhalation (1,485 injuries, 4%). The remaining 26% (average of 8,915 per year) were a variety of other injury types.

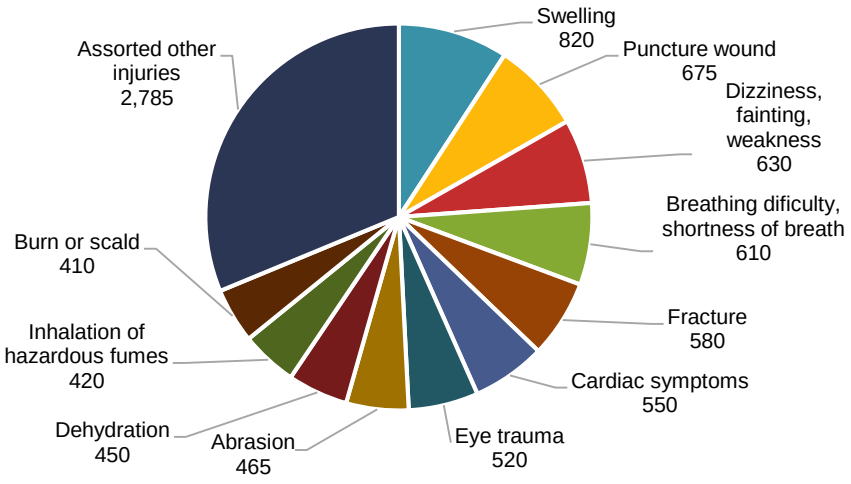
Figure 1: Fireground Injuries by Primary Apparent Symptom, 2007-2011 Annual Averages



[1] Data presented here are drawn from the NFPA report *Patterns of Fireground Firefighter Injuries - 2013* by Michael J. Karter.
[2] Minor injuries are injuries which generated only a report, were first aid only, or were treated by a physician but did not involve loss of worktime. Moderate injuries are lost-time injuries which had little danger of death or permanent disability, while severe injuries are those which involve lost worktime for a potentially life-threatening condition. Moderate and severe injuries are combined in this report due to the comparatively small number of severe injuries.

Figure 2 provides a breakdown of injuries in the "other" category in which there were annual averages of 400 or more injuries. As indicated, they include annual averages of 820 swelling injuries, 675 puncture wounds, 630 instances of dizziness, fainting, weakness, 610 instances of breathing difficulty/shortness of breath, 580 fractures, 550 instances of cardiac symptoms, 520 instances of eye trauma, 465 abrasions, 450 instances of dehydration, 420 instances involving inhalation of hazardous fumes, and 410 burn or scald injuries. These injuries provide further indication of the variety of occupational hazards faced by firefighters in fireground operations.

Figure 2. Other Fireground Primary Symptom Injuries, 2007-2011 Annual Averages



Figures 3 and 4 below show the annual average number of injuries for minor and moderate or severe fireground injuries with 5% or more of the injury total in the respective categories. As the results show, sprain or strain injuries were the leading injury type for both minor and moderate or severe injuries, but accounted for a higher share of moderate or severe injuries, 34% versus 26%. Not surprisingly, pain only injuries were more predominant among minor injuries (13%) than among moderate or severe injuries (9%), while fractures accounted for 5% of moderate/severe injuries, but were not a leading type of minor injury.

Figure 3. Leading Minor Fireground Injuries, 2007-2011 Annual Averages

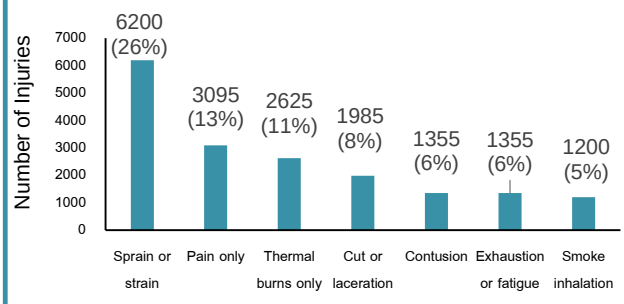
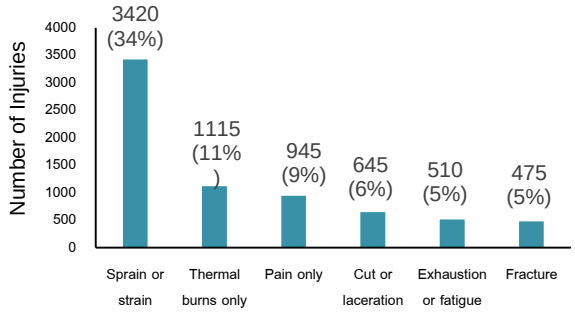


Figure 4. Leading Moderate or Severe Fireground Injuries, 2007-2011 Annual Averages



Moderate and severe injuries for obvious reasons pose the greatest concern for firefighting personnel and fire departments. Table 4 below shows the type of activity that was taking place for moderate and severe injuries at the time of injury occurrence.

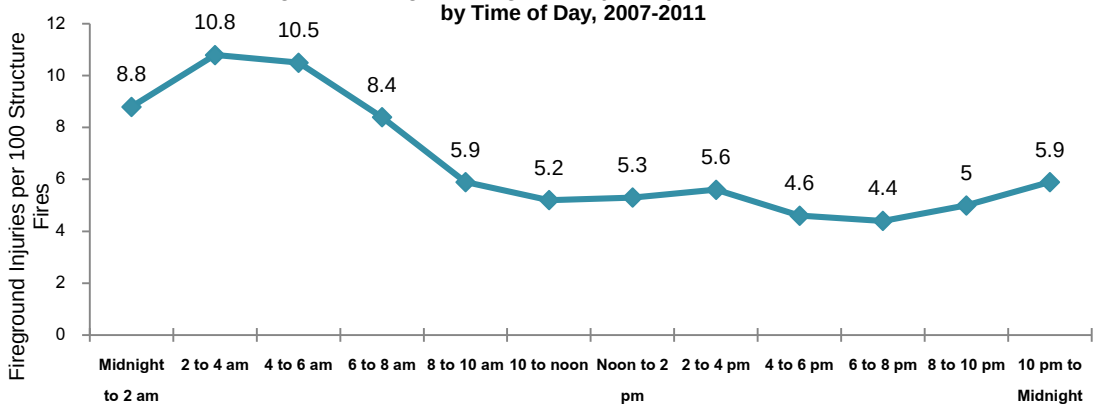
- 52% of all moderate or severe injuries took place during activities related to extinguishing a fire.
- Of these, 41% occurred while handling charged hose lines and 9% while using hand tools.
- 25% of moderate or severe injuries took place during suppression support activities.
- Key activities leading to injury during suppression support were overhaul (12%), ventilation with hand tools (6%), forcible entry (3%), and ventilation with power tools (3%).
- Other incident scene activity accounted for 9% of injuries, primarily activities while picking up tools, hose, or equipment.
- 6% of moderate or severe injuries occurred while operating an engine or pumper.
- Access or egress activities and EMS or rescue activities were each involved in 4% of moderate or severe injuries.

Table 2. Moderate/Severe Fireground Injuries by Activity at Time of Injury, 2007-2011 Annual Averages

Activity	Number of Moderate or Severe Injuries	Percentage of All Moderate or Severe Injuries
Extinguish fire or neutralize incident	5,255	52%
Handling charged hose line	*4,130*	*41%*
Using hand tool	*960*	*9%*
Suppression support	2,520	25%
Overhaul	*1,220*	*12%*
Ventilation with hand tools	*560*	*6%*
Forcible entry	*340*	*3%*
Ventilation with power tools	*260*	*3%*
Other incident scene activity	910	9%
Picking up tools, hose, equipment	*275*	*3%*
Operating engine or pumper	570	6%
Access or egress	400	4%
EMS or rescue	370	4%
Other	425	4%
Total	**10,180**	**100%**

Although the peak periods for structure fires are from noon to 6 p.m. (34%) and 6 p.m. to midnight (31%), the highest injury rates per 100 structure fires came in the midnight to 8 a.m. time frame, as illustrated in Figure 5. The injury rate drops from a high of 10.8 per 100 structure fires between 2 a.m. and 4 a.m. to lows of 4.6 per 100 structure fires between 4 p.m. and 6 p.m. and 4.4 between 6 p.m. and 8 p.m.

Figure 5. Firefighter Fireground Injuries per 100 Structure Fire by Time of Day, 2007-2011



Source: 2007-11 NFIRS, NFPA Survey

Focus on Strain and Sprain Injuries

The frequency of sprain and strain injuries from the fireground – minor as well as moderate or severe -- poses a substantial challenge for firefighter safety and health. Musculoskeletal disorders, which include sprains and strains, are considered one of the most common sources of severe long-term pain and disability among workplace injuries. The direct and indirect costs of low back pain alone in the United States have been estimated to range from $100 to $200 billion per year.[3]

- The causes of work-related musculoskeletal disorders include repetitive lifting of heavy objects, awkward postures, forceful and repetitive exertion, regular overhead work, and work with the neck in a chronically flexed or bent position.
- Musculoskeletal disorders are not the result of acute events, such as falls, but are due to chronic exposures over time. The risk of musculoskeletal disorder increases with the frequency, duration, and intensity of exposures.

Musculoskeletal disorders are injuries affecting muscles, nerves, tendons, joints, cartilage, and spinal discs. Once experienced, they may lead to recurring problems that require additional treatment, disability, and lost work time. Musculoskeletal orders can be aggravated or prolonged by work conditions or job tasks.

Firefighters engage in a number of physically demanding activities that place them at risk for musculoskeletal disorders. These include working and training with heavy equipment, undertaking forcible entries, rescuing victims or lifting and carrying patients, operating charged hose lines, cutting structures, performing overhaul, and other rigorous activities. Many common workplace interventions that target musculoskeletal disorders, such as redesigning workstations or reducing workload, are not practical for many tasks on the fireground. However, there are steps that firefighters and fire departments can take to limit sprain and strain injuries.

- Physical fitness and fatigue are important factors in determining vulnerability to musculoskeletal disorders. Firefighters should engage in exercise and functional movement enhancement programs to improve aerobic capacity and trunk stability.[4]
- For back disorders in particular, research indicates that firefighters can improve back extension endurance and related core muscles through injury prevention programs that emphasize long duration, high repetition, and low-intensity exercise.[5]
- For emergency medical service activities that require firefighters to lift and carry patients, musculoskeletal loads may be reduced through engineering changes that allow for lateral transfers, bed-to-chair transfers, and stair descent transport.[6]

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[3] Katz JN. Lumbar disc disorders and low-back pain: Socioeconomic factors and consequences. Journal of Bone and Joint Surgery. 2006;88 (suppl 2):21-24.
[4] Peate WF, et al., Core Strength: A New Model for Injury Prediction and Prevention. *Journal of Occupational Medicine and Toxicology*. 2007. Available at: *CoreStrength*.
[5] Verna J, et al., Study Involving Sand Diego Firefighters Examines Back Muscle Strength, Endurance, and Flexibility. *Fire Rescue Magazine.* November 10, 2010. Available at: *FirefighterBackInjuries*.
[6] Conrad KM, et al., Designing Ergonomic Interventions for EMS Workers: Concept Generation of Patient Handling Devices. *Applied Ergonomics* 39;2007:792-802.