

Firefighter Injuries in British Columbia:
An Examination of Frequency, Severity, Locational and Temporal aspects



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Executive Summary

When firefighter injuries occur, especially at the fire-ground, they tend to evoke heightened media attention as well as public concern and interest. While these concerns are understandable given the potential for injuries and casualties at the fire-ground or at other emergency incidents, such concerns must be placed into context. Firefighter injuries may potentially lead to severe or debilitating health outcomes, especially when incurred at the fire-ground. However, firefighter injuries in the province of British Columbia (BC) are infrequent; with few cases requiring hospitalization or extended medical leave.

The intent of this study is to examine the frequency, severity, locational and temporal aspects of firefighter injuries in BC, and propose recommendations to enhance the health and safety of personnel. Toward that end, the study assesses WorkSafeBC and Office of the Fire Commissioner (OFC) firefighter injury data at the provincial level. The study did not address occupational diseases such as cancer, a significant matter for firefighters. The injury datasets received did not contain data relating to firefighters and cancer, and this topic will be examined in a future study.

Approximately 88 percent of firefighter injuries reported in BC from 2009 to 2014 are classified as minor and light and are caused by overexertion, falls and smoke inhalation with few accidents leading to serious bodily injury or death. From 2009 to 2013 there were a total of 1283 firefighter injury claims in BC. According to WorkSafeBC, 258 firefighter injuries occurred provincially in 2013. This is a decrease of 10 percent from 2012, and two points below the five-year average of 256 injuries. Overall, 55 percent of all firefighter injuries reported in BC are classified as minor, that is: less than one day of hospitalization or off work. One-third of all reported firefighter injuries are classified as light, that is: 1-2 days of hospitalization and/or off work between 1-15 days. Slightly less than 6 percent of all reported firefighter injuries are classified as serious. Injuries in this category equate to three or more days of hospitalization and/or off work 15 or more days.

- An examination of WorkSafeBC data reveals that firefighter injuries in BC sustained while on the way to or from an incident are relatively low. These injuries account for 5 percent of all reported firefighter injuries in BC from 2009-2013, specifically: responding to incident (4.6 percent) and returning from incident (0.4 percent). This suggests that emergency vehicle operation in BC remains a safe and relatively accident-free endeavour, and is supported by the available research.
- Firefighter injuries at incident account for approximately 43.7 percent of all firefighter injuries in BC from 2009 to 2013. In 2012 there were 126 firefighters injured at incident, with an 11.1 percentage decrease from the previous year. Ongoing monitoring and evaluation of this metric is required.
- Firefighter injuries at station account for approximately 27.2 percent of all firefighter injury claims in BC from 2009 to 2013. With the exception of 2010 and 2013, all other reported years witnessed above average injuries in this category.

- From 2009 to 2014, approximately 50 percent of firefighter injuries in BC occurred in the months of January, April, July and December. Approximately one-quarter of all injuries took place in December/January suggesting that firefighter safety and injury prevention programs could be targeted for the winter months when injuries are seasonally at their highest across the province. Temporally, injuries are more likely to occur in the late evening hours and early morning period.
- One-quarter of firefighter injuries are incurred by members between the ages of 40 to 44, identifying an age cohort that faces more injury experiences on the fire-ground. This age cohort typically makes up between 22 to 25 percent of all fire suppression staff at most fire services in BC which partly explains the higher number of injuries reported in this category. The 40 to 44 age cohort is relatively the oldest cohort actively engaged in non-supervision firefighting roles. At approximately 45 years of age, most firefighters start spending acting time in an officer's role (i.e., Captains or Lieutenants). This could help to explain why the oldest firefighter only roles are at most risk for injury. Further analysis is required.
- Falls impact the 35 to 39 and 40 to 44 age cohorts equally at 8.5 percent, however, it appears the 40 to 44 age cohort suffers more injuries from object strikes (12.2 percent) and smoke inhalation (7.3 percent) relative to other age cohorts examined.
- When analyzing accident types at incident, overexertion accounts for 36.4 percent of firefighter injuries. This is followed by falls (18.3 percent) and exposure (16.3 percent) injuries. A review of accidents at station indicates that falls constitute the leading type of injury (30.6 percent) followed by object strikes (19.3 percent).

A healthy firefighter is an effective and safe firefighter. If injury prevention is achievable, more lives will be saved. It will also save on the fiscal bottom line for many BC municipalities, not to mention the financial burden an injury could place on the families of a member. Firefighters constantly face issues of overexertion and sprain while engaged in the performance of their duties. This is particularly true on the fire-ground when suppression crews are offensively engaged in firefighting activities, and exerting themselves for extended periods of time.

With firefighter overexertion, strains and sprains being a key finding of this study and accompanying literature review, it is recommended that fitness and injury prevention programs be considered. These initiatives can be fashioned to meet the needs of firefighters who may be prone to recurring injuries and/or musculoskeletal disorders, and may benefit from injury prevention programs, as well as health and wellness initiatives.

Introduction

Overview

Every occupation brings degrees of safety risk. Firefighting is no exception. At the fire-ground, on the way to or from a fire, or even while training, firefighters face the possibility of suffering an injury. Each year firefighters are injured while fighting fires, rescuing people, responding to emergency medical incidents, dealing with hazardous material incidents, or training for their job. While the majority of injuries are classified as minor, others have the potential to be debilitating and career-ending. Such injuries exact a considerable toll on the member, family and colleagues, and have profound operational implications for the organization. From the need to adjust staffing levels and rotations to accommodate injuries, to the focus of the fire service on injury prevention, firefighter injuries and their prevention are a priority concern. Firefighter occupational health and safety initiatives, proficiency training, and protective gear are several areas where time, energy and resources have been well-spent. Efforts in these crucial areas continue to grow and expand, and contribute to ensuring the overall safety of firefighters in BC. Despite these ongoing efforts and accomplishments, injuries can and do occur. A better understanding of how firefighter injuries occur in the province of BC can help to identify focussed injury prevention strategies that could further minimize the job's inherent risks.

Rationale

Firefighter roles and duties are diverse and involve a range of complex to straightforward activities from addressing high-risk emergency incidents to undertaking less hazardous activities such as handing out fire prevention material. Whether attending incidents at the fire-ground or speaking with residents about fire prevention at their homes, firefighter activities at these and other locations present unique occupational hazards and some risks being greater than others. In reality, the potential for firefighter injury exists at any location or incident, and could potentially lead to a range of injuries and negative health outcomes.

The majority of firefighter injuries reported in BC are classified as either minor or light and generally include falls and smoke inhalation with extremely few accidents leading to serious bodily injury or death. Some firefighter injuries lead to trips to the clinic, while others require a stay in hospital. In some cases, a period of alternate duties is required upon discharge from hospital. While firefighting is a dangerous profession with little, if any, room for error, injuries have declined in several categories over the past five years in BC. This is largely due to high levels of firefighter proficiency training and the rigorous application of occupational health and safety policies and procedures, as well as steady advancements in protective equipment and its proper usage. It is also a reflection of the genuine desire and ongoing commitment of firefighters in BC to keep colleagues and residents safe while executing their duties and protecting communities.

Discussion has recently centered on the perceived increase of firefighter injuries in BC, and it has been asserted that injuries will continue to rise in the foreseeable future. The intent of this study is to examine the frequency, severity, locational and temporal aspects of firefighter injuries in BC, and

make recommendations to enhance the health and safety of members while engaged in their duties. As a result, three specific questions are posed and frame this report:

1. Has there been an increase in the frequency and severity of firefighter injuries in the province of British Columbia?
2. At which location are firefighter injuries most pronounced? What are the leading types of firefighter injuries?
3. Which age cohort is more susceptible to injury? How can these injuries be prevented?

In order to answer these three questions, the scope of this research involved:

- Undertaking an analysis of relevant documentation including WorkSafeBC and Office of the Fire Commissioner data, as well as a literature review of existing academic publications and available firefighter injury studies.

Literature Review

There is a dearth of literature related to the scope, nature and impact of firefighter injuries. The available material is divided into three main categories: (1) governmental; (2) occupational health and safety; and (3) industry-related.

A study by LaTourette, Loughran and Seabury (2008) examined the frequency, cause and type of injuries, and fatalities suffered by public safety workers. The study focussed on fire services and identified health and safety hazards that may potentially result in the following negative health outcomes: (1) musculoskeletal disorders; (2) thermal injuries; (3) cardiovascular disease; (4) cancer; (5) and respiratory disorders. Physical injuries examined include physical stress and overexertion, vehicle crash injuries, burns, inhalation of smoke and toxins, asphyxiation, and blunt trauma, as well as more general occupational hazards, such as heavy lifting and slips and falls. These hazards lead to a wide variety of fatalities, injuries and illnesses. While emergency calls to structure fires consisted of approximately 30 percent of total calls for service in the cohort, the study found that the risk of heart attack deaths during fire suppression activities was 10 to 100 times higher than for non-emergency calls. When injuries at the fire-ground are combined with travel to and from the incident and non-fire emergencies, 75 percent of firefighter injuries occur during emergency operations. In sum, it found that firefighters are more likely to be hurt during emergency activities than during other types of work.

Each year, the National Fire Protection Association (NFPA) examines firefighter deaths and injuries to provide national statistics on their frequency, extent and characteristics. An NFPA study co-authored by Karter and Molis (2014) explored patterns of firefighter fire-ground injuries. The NFPA study estimated that 65,880 US firefighter injuries occurred in the line-of-duty in 2013, a 5.1 percent drop from 2012 and the lowest total since the association began tracking firefighter injuries in 1981. Based on survey data from fire departments, 45.2 percent of all injuries occurred during fire-ground operations, and the majority of those (55.3 percent) were strains and sprains.

Injuries at the fire-ground have plummeted from a high of 67,500 in 1981 to 29,760 in 2013, a decrease of 55.9 percent. The number of fires also has declined steadily since 1981, for an overall decrease of 57.1 percent. This suggests the fire-ground injury-rate risk has not changed much since 1981; however, additional research is needed. Of the major types of injuries that occur during fire-ground operations, sprains and strains accounted for 55.3 percent in 2013; wounds, cuts, bleeding and bruising accounted for 13.8 percent; and burns accounted for 5.1 percent. The leading causes of fire-ground injuries were overexertion and strain, which led to 26.5 percent of the injuries; and falls, jumps and slips, which led to 22.7 percent. The researchers reviewed emergency vehicle collisions and firefighter injuries with few conclusive findings. Karter and Molis concluded their study with recommendations to improve firefighter safety in accordance with NFPA standards.

There exist several useful studies relating to firefighter injuries arising from emergency vehicle collisions. One study by Donoughe, Whitestone and Gabler (2012) examined the injury and fatality risk of firefighters traveling in fire department vehicles. The study found that nearly two-thirds of fatal fire truck crashes involved either tripped or un-tripped rollovers. For details on fire truck crashes in BC, refer to Tyakoff, Garis and Thomas (2014) in *Emergency Motor Vehicle Crashes in British Columbia: Myth or Reality?* The study found that emergency vehicle crashes in BC represent an almost immeasurably or incalculably small fraction of non-emergency vehicle crashes reported in BC, and continue to decline in most regions across the province.

Scope of Research

Data Considerations

Firefighter injury data from 2009 to July 1, 2014 in British Columbia was obtained from WorkSafeBC, an independent agency governed by a Board of Directors appointed by BC government. In addition to administering claims for work-related injury, illness and disease, the agency is also responsible for injury prevention. The *Workers Compensation Act* assigns the authority to enforce the Occupational Health and Safety (OHS) Regulation of British Columbia to WorkSafeBC, which also carries out workplace inspections and investigations of work-related injuries and fatalities. The mandate of WorkSafeBC, in concert with workers and employers, is to:

- Promote the prevention of workplace injury, illness and disease
- Rehabilitate those who are injured and provide timely return to work
- Provide fair compensation to replace workers' loss of wages while recovering from injuries
- Ensure sound financial management for a viable workers' compensation system

The OHS contains legal requirements that must be met by all workplaces under the inspection jurisdiction of WorkSafeBC. Many sections of the OHS have industry-specific guidelines and policies, and Part 31 refers to health and safety expectations of firefighters and their employers in BC. WorkSafeBC also compiles injury statistics across a range of BC industries, including fire services.

In terms of data holdings, the type of duty firefighters were performing when injured was reported in the following six categories: (1) responding to incidents; (2) at incident; (3) returning from incident; (4) at station; (5) training; and (6) physical activity (N=1359). The dataset did not include information about occupational disease such as cancer. Other and unknown categories were included. Data categories 1, 2 and 3 relate to firefighter injuries sustained while addressing emergency incidents, that is: on the way to or from an incident or while on scene. WorkSafeBC data did not specify the nature of the emergency call, that is: whether suppression crews were travelling lights and siren to an incident when a firefighter injury occurred. Moreover, it failed to make a distinction between whether the firefighter injury took place at a structure fire or a medical call. It is assumed that the first three data categories relate to firefighter injuries sustained by fire suppression crews, and preclude fire prevention staff and non-emergency personnel. Fire prevention officers and non-emergency staff rarely, if ever, attend emergency incidents. However, the remaining data categories, namely: 4, 5 and 6 may apply to both fire suppression crews and fire prevention staff. This is particularly true for categories 4 and 6. It is unclear whether firefighter injuries reported in the physical activity category occurred while members were exercising on-duty or off-duty at the gym prior to or after shift. The other category relates to firefighter injuries sustained at charitable events, open house forums, cooking contests, etc.

Firefighter injury data covering a six-year period of activity in BC was obtained from the provincial OFC. While OFC data represents a much smaller sample size compared to WorkSafeBC data, it provided greater specificity on the cause and nature of firefighter injuries. The OFC distributes safety information bulletins and product hazard announcements to BC fire services and related agencies. The OFC facilitates the implementation of fire service operational guidelines that provide for firefighter safety and risk management objectives. In addition, a variety of related statistics are collected. Data fields included the fire service of where the injury occurred, date and time of injury, firefighter age at injury, gender, and ignition injury, cause of injury and nature of injury. The dataset did not include information about occupational disease such as cancer.

Figure 1: OFC Nature of Injury Classification

Nature of Injury	Hospitalization and/or days off work
Minor injury	Less than one day hospital or off work
Light injury	Hosp. 1-2 days and/or off work 1-15 days
Serious injury	Hosp. 3+ days and/or off work 15+ days
Death	

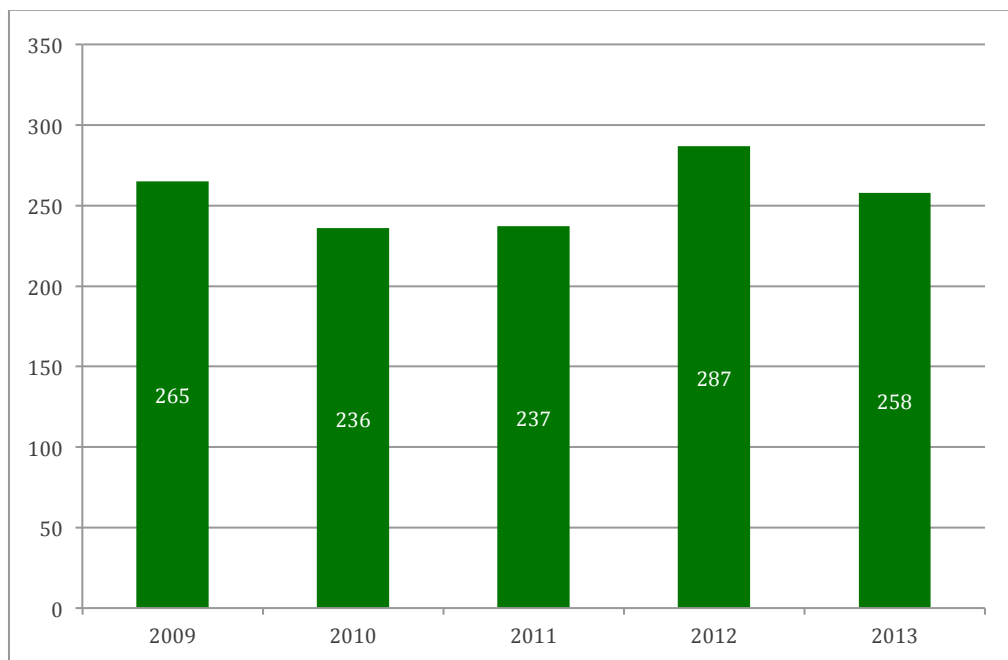
OFC Firefighter Injuries, 2009-2014

Nature of injury was classified into four severity categories: (1) minor injury; (2) light injury; (3) serious injury; and (4) death. Injuries listed in categories 1, 2 and 3 were categorized by the amount of time loss from work and/or hospitalization due to severity of injuries.

Data Analysis

From 2009 to 2013 there were a total of 1283 firefighter injuries in BC. According to WorkSafeBC data, 258 firefighter injuries occurred in the line-of-duty in 2013. This is a decrease of 10 percent from 2012, and two points below the five-year average of 256 firefighter injuries. Data reveals that 2012 was an abnormally high year in terms of firefighter injuries in BC. In nine incidents that year, two or more firefighters were injured at each scene. For the most part, these were multiple firefighter injuries suffered at multiple single events in Metro Vancouver.

Figure 2: Total Firefighter Injury Claims in BC, 2009-2013



WorkSafeBC, BC Firefighters Location/Activity of Injury
(n=1283)

Figure 3 below shows the frequency of firefighter injuries by location in BC. Data is reported by WorkSafeBC in the following six locational categories: (1) responding to incident; (2) at incident; (3) returning from incident; (4) at station; (5) training; and (6) physical activity. Other and unknown categories were excluded in the table below.

Figure 3: Total Firefighter Injury Claims by Location in BC, 2009-2013*

Location	2009	2010	2011	2012	2013
Responding to Incident	9	11	22.2%	12	9.09%
At Incident	132	94	28.7%	97	3.2%
Returning From Incident	0	0	0	2	0
At Station	72	65	-9.72%	72	10.7%
Training	30	50	66.6%	41	-18%
Physical Activity	12	14	16.6%	10	-28.5%
Total:	255	234	-8.2%	234	0

WorkSafeBC, BC Firefighters Location/Activity of Injury

*Excludes 2014 (partial year data) & other and unknown categories

(n=1257)

An examination of WorkSafeBC data shows that firefighter injuries sustained while on the way to or from an incident are relatively low. When combined they account for 5 percent of all reported firefighter injuries in BC from 2009-2013: responding to incident (4.6 percent) and returning from incident (0.4 percent). Despite claims to the contrary, this suggests that emergency vehicle operation in the province of BC remains a safe and relatively accident-free endeavour. This is consistent with the author's previous findings in the study titled *Emergency Motor Vehicle Crashes in British Columbia* (2014) stating that "accidents involving emergency vehicles in BC are infrequent; most are of a minor nature and incur property damage only." Statistically, accidents involving fire trucks are expected to decrease and, therefore, firefighter injuries occurring while in transit is expected to decrease commensurately.

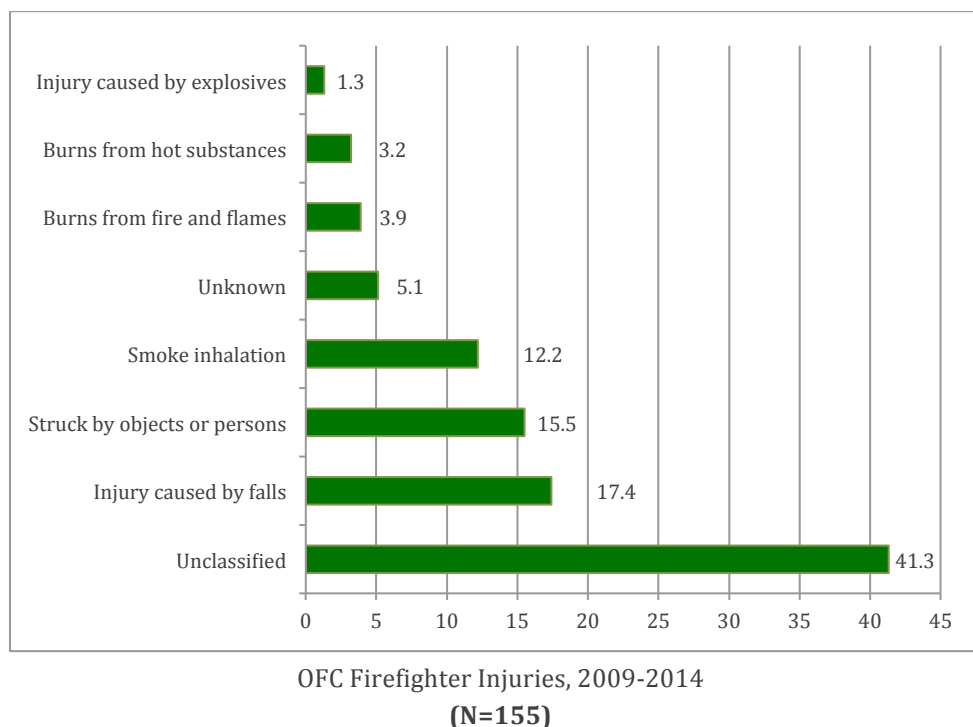
From 2009 to 2013, firefighter injuries at incident account for approximately 43.7 percent of all reported firefighter injuries in BC. WorkSafeBC do not report firefighter injuries on the fire-ground separately from medical calls, nor do they distinguish a career firefighter from a paid-on-call firefighter (volunteer firefighter) in the dataset. In 2012 there were 126 firefighters injured at incident, with an 11.1 percentage decrease in 2013. Ongoing monitoring and assessment of this metric is required to determine if firefighter injuries sustained at incident will continue to decline. Having said this, firefighter injury prevention initiatives could be targetted to addressing health and safety concerns at this location, and are listed at the conclusion of the report.

Firefighter injuries at station accounted for approximately 27.2 percent of all firefighter-related injuries in BC from 2009 to 2013. With the exception of 2010 and 2013, all other reported years posted slight increases above the five-year average (69.8 percent) for this location. Other firefighter injuries when combined account for approximately 22 percent of all reported firefighter injuries in BC from 2009 to 2013, specifically: training (16 percent) and physical activity (6 percent).

According to the OFC dataset, approximately 17 percent of all reported firefighter injuries in BC were caused by falls (N=155). The next two leading causes combined account for 27.7 percent of firefighter injuries in BC: struck by objects or persons (15.5 percent) and smoke inhalation (12.2 percent). Approximately 41 percent of firefighter injuries reported by the OFC fall into the unclassified category and were excluded from analysis.

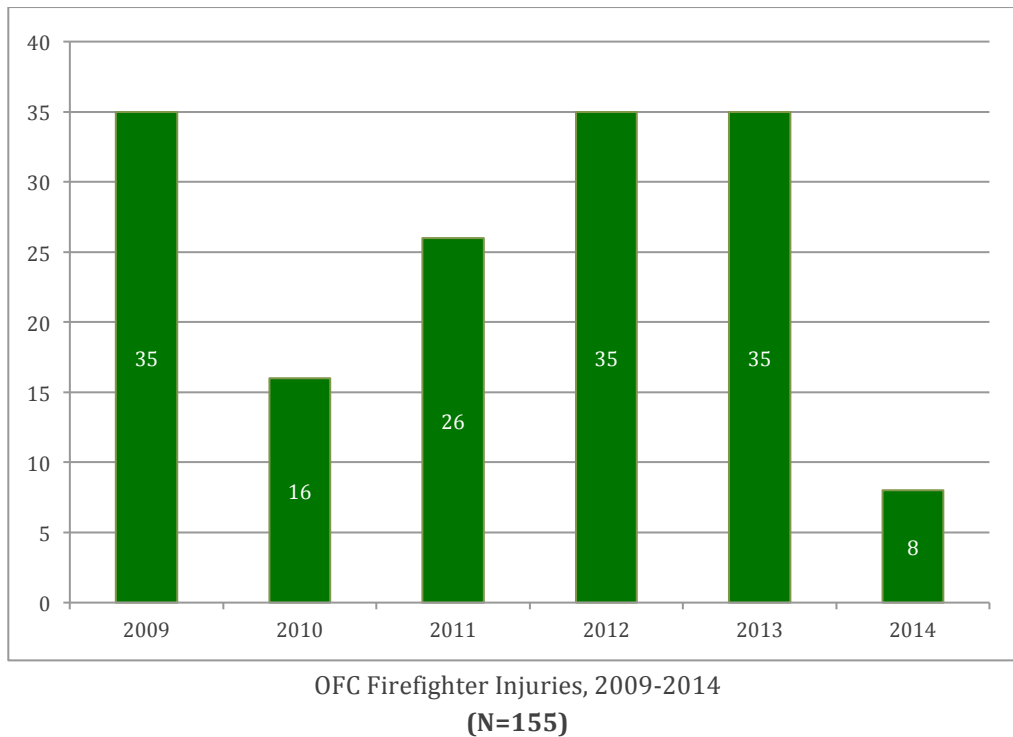
Data reveals the underlying importance of member safety at the fire-ground especially when combatting structure fires. Given the prevalence of falls, object strikes and smoke inhalation-related firefighter injuries, it is vital to ensure continued situational awareness at scene along with the vigilant use and proper functioning of personal protective gear and self-contained breathing apparatus, or SCBA.

Figure 4: Percent of Fire-Related Firefighter Injuries by Cause of Injury in BC, 2009-2014



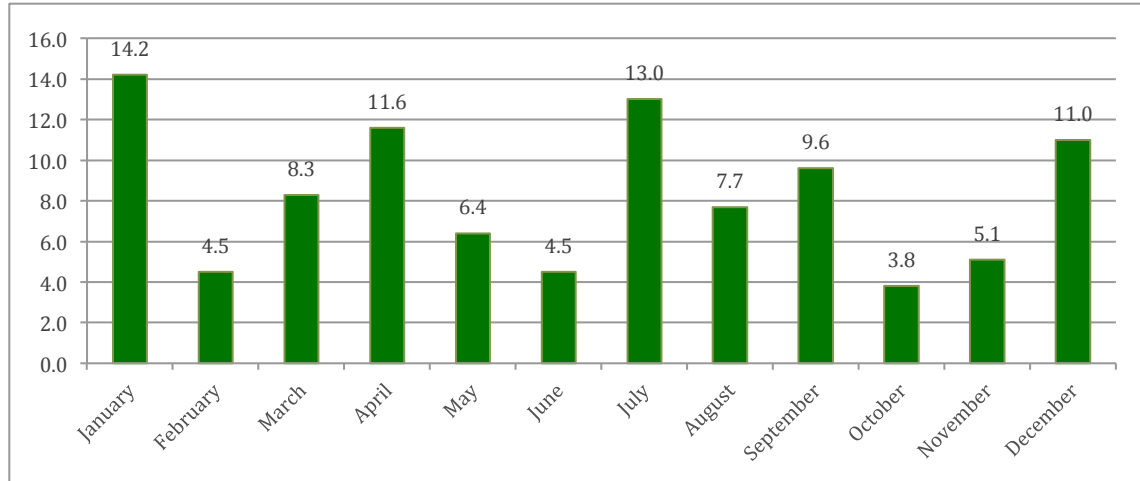
According to OFC data, there were 155 fire-related firefighter injuries reported in BC from 2009 to 2014. Of these, one injury resulted in death. When examining firefighter injuries in BC between 2009 to 2013, the five-year injury average is 29.4 percent (n=147). Aside from markedly fewer firefighter injuries reported in 2010 and 2011, all other years consistently reflect injuries slightly above the average.

Figure 5: Fire-Related Firefighter Injuries in BC, 2009-2014



When examining all WorkSafeBC accident types at incident, overexertion accounts for 36.4 percent of firefighter injury claims in BC. This is followed by falls (18.3 percent) and exposure (16.3 percent) (n=1331). A review of firefighter accidents at station indicates that falls constitute the leading type of injury (30.6 percent) closely followed by overexertion (29.5 percent). When examining accident types at training, overexertion makes up almost one-half (48.5 per cent) of all injuries reported. Other incidents include other bodily motion (16.3 percent) and falls (15.4 percent). It appears that overexertion and falls at incident and training constitute the majority of injuries reported. From 2009 to 2014, approximately 50 percent of firefighter injuries in BC occurred in the months of January, April, July and December. Approximately one-quarter of all injuries took place in December/January and suggests that firefighter safety and injury prevention programs while a year-round endeavour, could be targeted for the winter months when injuries are seasonally at their highest level across the province. However, care should be exercised when interpreting these findings as each fire service is unique and, therefore, independent or localized studies should be conducted.

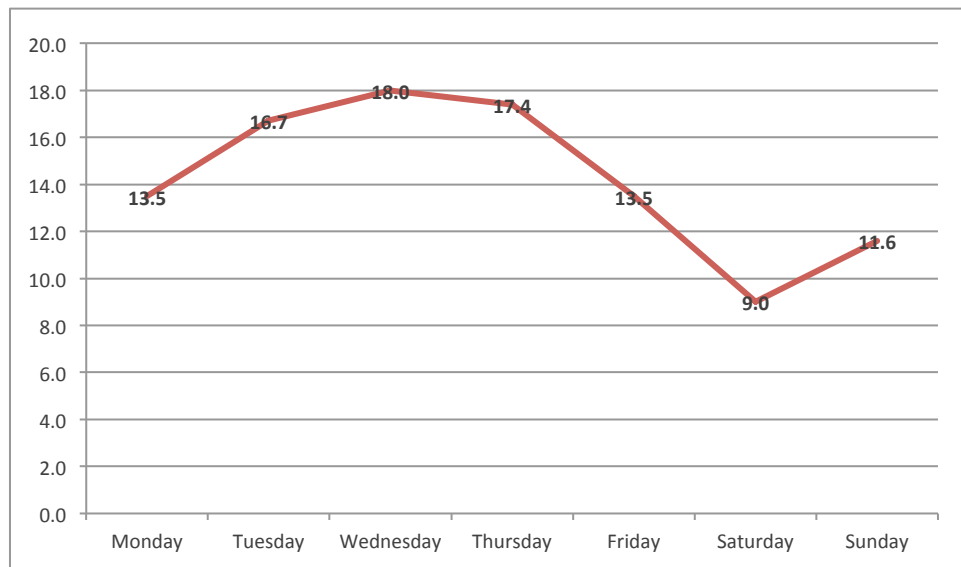
Figure 6: Percent of Fire-Related Firefighter Injuries by Month in BC, 2009-2014



OFC Firefighter Injuries, 2009-2014
(N=155)

In terms of day of week, over 50 percent of firefighter injuries in BC occurred mid-week from Tuesday to Thursday, and declined by Friday and Saturday with an increase on Sunday. A likely explanation is that more training that takes place during week days and weather may have a bearing on injury types. Temporally, injuries are more likely to occur in the late evening and early morning hours. Because of the physicality of the job, and periods of downturn marked by sudden and intense bouts of activity late at night, firefighters are at heightened risk of injury during this period.

Figure 7: Percent of Fire-Related Firefighter Injuries by Day of Week in BC, 2009-2014



OFC Firefighter Injuries, 2009-2014
Total may not add up to 100% due to rounding
(N=155)

Figure 8: Fire-Related Firefighter Injuries by Incident Hour in BC, 2009-2014

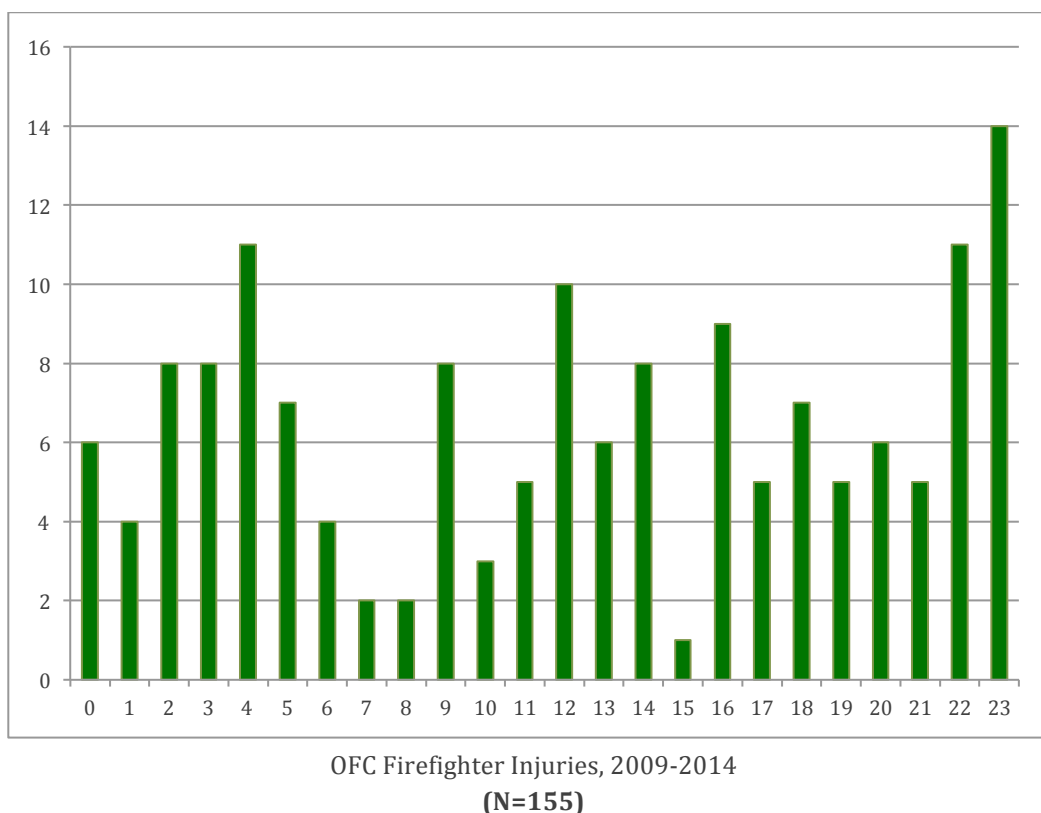
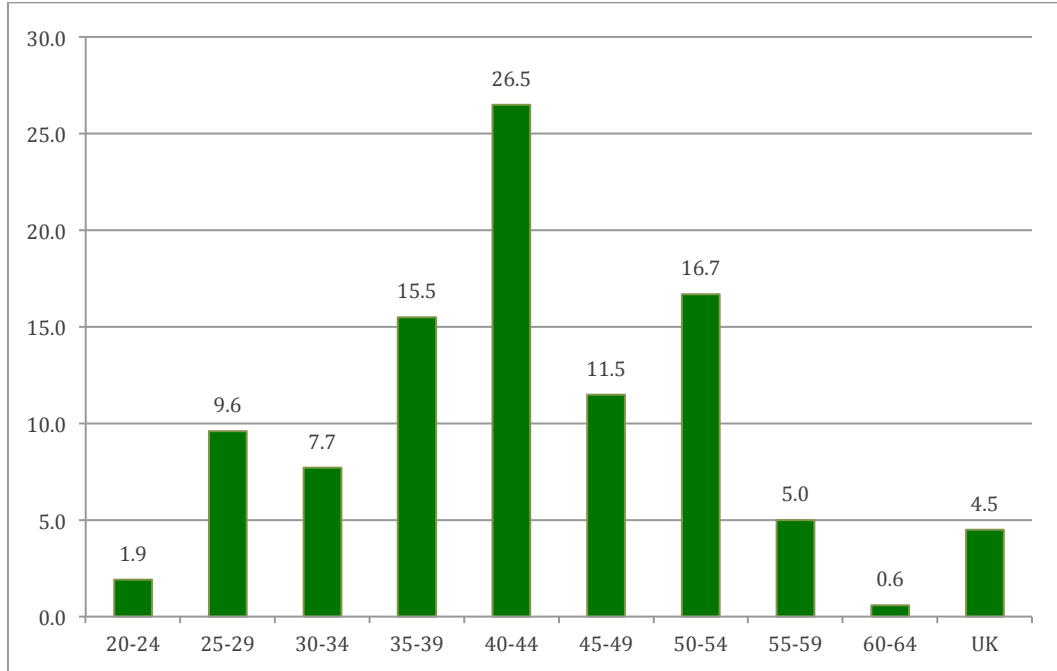


Figure 9 below indicates that over one-quarter of firefighter injuries reported in BC from 2009 to 2014 are incurred by members between the ages of 40 to 44. This cohort typically makes up anywhere between 22 to 25 percent of all fire suppression staff at most fire services in BC. The 40 to 44 age cohort is the oldest cohort actively engaged in non-supervision roles. At approximately 45 years of age, most firefighters start spending acting time in an officer's role (i.e., Captains or Lieutenants). This could help to explain why the oldest firefighter only roles are at most risk for injury. Further analysis is required to understand why the 40 to 44 age cohort is most at-risk. The available data suggests that overexertion/fall prevention programs in BC could be ideally targeted to members between the ages of 40 to 44 for optimal results.

Figure 9: Percent of Fire-Related Firefighter Injuries by Age Cohort in BC, 2009-2014



OFC Firefighter Injuries, 2009-2014
 Total may not add up to 100% due to rounding
 (N=155)

Figure 10 indicates that approximately 55 percent of firefighter injuries reported in BC from 2009 to 2014 are classified as minor, that is: less than one day of hospitalization or off work. One-third of all firefighter injuries reported in the OFC dataset are classified as light, that is: 1-2 days of hospitalization and/or off work 1-15 days. Slightly less than 6 percent of all firefighter injuries in the period under review are serious. When isolating the 40 to 44 age cohort, 14.2 percent of injuries fall into the minor injury category. Eleven percent of injuries are categorized as light.

Cross-tabulation of nature of casualty by cause of injury reveals that the priority causes of firefighter injuries in BC, namely: falls, object strikes and smoke inhalation are largely classified as minor. With unknown and unclassified cases excluded (n=82), the following breakdown is revealed: falls (57 percent); struck by objects/persons (54 per cent); and smoke inhalation (63 percent).

Figure 10: Percent of Fire-Related Firefighter Injuries by Age Cohort and Nature of Casualty in BC, 2009-2014

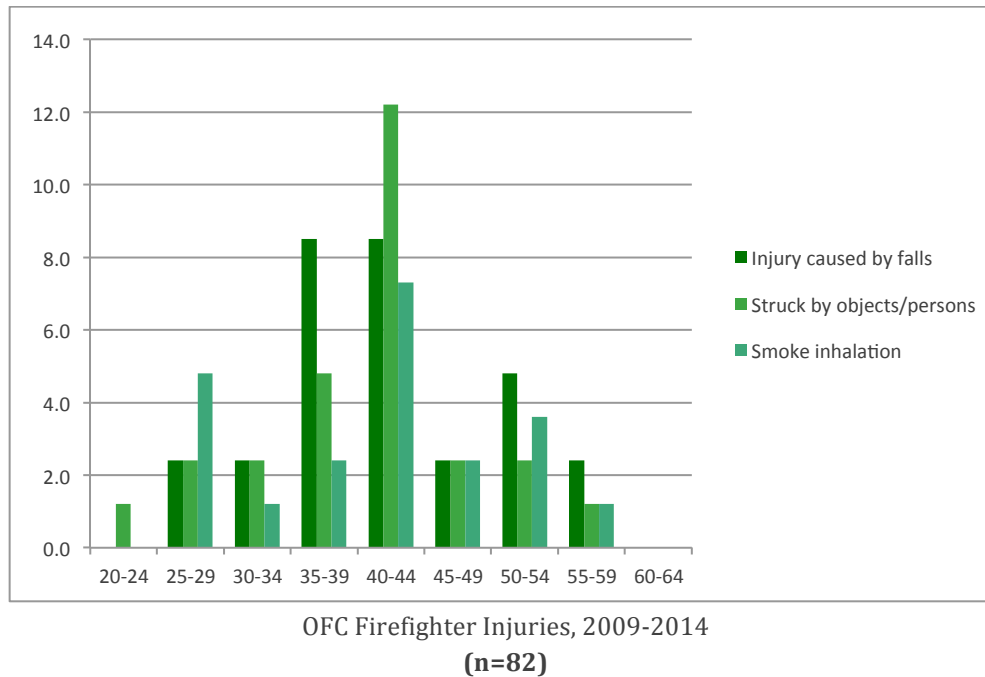
Age Cohort	Minor	Light	Serious	Death
20-24	1.3	0.6	0.0	0.0
25-29	5.8	3.2	0.0	0.6
30-34	5.1	1.3	1.3	0.0
35-39	7.7	5.8	2.0	0.0
40-44	14.2	11.0	1.3	0.0
45-49	7.7	3.2	0.6	0.0
50-54	11.0	5.1	0.6	0.0
55-59	2.5	2.5	0.0	0.0
60-64	0.0	0.6	0.0	0.0
Total:	55.3%	33.3%	5.8%	0.6%

OFC Firefighter Injuries, 2009-2014

Total may not add up to 100% due to rounding and exclusion of 4.5% unknown category
(N=155)

An examination of OFC data indicates that the three leading causes of firefighter injuries in BC, namely: falls; struck by objects or persons; and smoke inhalation reveals that falls constitute over one-third of all injuries during the period under review (31.4 percent). Struck by objects make up 29 percent of firefighter injuries followed by smoke inhalation (22.9 percent). Falls affect the 35 to 39 and 40 to 44 age cohorts equally at 8.5 percent, however, the 40 to 44 age cohort suffers more injuries from object strikes (12.2 percent) and smoke inhalation (7.3 percent) compared to all age cohorts in the dataset. Burns from fire and flames (7.2 percent); burns from hot substances (6 percent); and injury from explosives (2.4 percent) constitute the remaining categories.

Figure 11: Percent of Fire-Related Firefighter Injuries by Age Cohort and Cause of Injury in BC, 2009-2014



Conclusions

Firefighters work in varied and complex environments that increase their risk of on-the-job injury. Given the kind of work performed and the hazards involved, it is unlikely that all firefighter injuries can be eliminated. Firefighters are trained to exacting professional standards and take every reasonable precaution to avoid on-the-job injuries. Nevertheless, the very act of responding to emergency calls contains inherent risks and while every sensible measure can be taken to avoid injuries, it is impossible to guarantee zero risk. Injuries will inevitably occur. A risk management system and rigorous and ongoing firefighter safety education and training, however, can lessen the inherent risks. In conclusion, with respect to the three main research questions posed, the following can be summarized:

1. From 2009 to 2013 there were a total of 1283 firefighter injury claims in BC. According to WorkSafeBC, 258 firefighter injuries occurred in the line-of-duty in 2013. This is a decrease of 10 percent from 2012, and two points below the five-year average of 256 firefighter injuries. Approximately 88 percent of firefighter injuries reported in BC from 2009 to 2014 are classified as minor and light and are caused by overexertion, falls and smoke inhalation with few accidents leading to serious bodily injury or death. Fifty-five percent of all firefighter injuries reported in BC are classified as minor, that is: less than one day of hospitalization or off work.

2. Firefighter injuries sustained at incident account for approximately 43.7 percent of all injuries from 2009 to 2013 in BC. This is followed by injuries at station (27.2 percent). When examining all accident types at incident, overexertion accounts for 36.4 percent of firefighter injury claims in BC. This is followed by falls (18.3 percent) and exposure (16.3 percent) (n=1331).
3. One-quarter of firefighter injuries in BC during the period under review are incurred by members between the ages of 40 to 44, identifying an age cohort that faces relatively more on-the-job injury experiences. This cohort typically makes up anywhere between 22 to 25 percent of all fire suppression staff in BC which partly explains the higher number of injuries in this category. The 40 to 44 age cohort is the oldest cohort actively engaged in non-supervision roles. At approximately 45 years of age, most firefighters start spending acting time in an officer's role (i.e., Captains or Lieutenants). This could help to explain why the oldest firefighter only roles are at most risk for injury. More in-depth study is required.

Firefighter injuries may potentially lead to severe or debilitating health outcomes, especially when incurred at the fire-ground. However, firefighter injuries in BC are infrequent; with few cases requiring hospitalization or extended medical leave.

Recommendations

Overarching firefighter health and safety initiatives should include the provision of training, equipment, policies and systems to prevent accidents and to protect employees from job-related injuries and illness. A firefighter injury and illness prevention program may consist of the following main elements:

- Continued regular inspections of equipment and facilities for health and safety hazards (i.e., SCBA mask fit-testing and proper PPE usage);
- Training and instruction of personnel in the use and hazards of equipment, facilities and safety hazards for employees' functional job assignments;
- Training of personnel when responding to incidents at high-speed roadways and high-crash locations with guidelines on when and how to engage police and other resources in securing these places;
- Ensuring that firefighters use their seat belts while on the way to or from an incident or a community event;
- A system of communicating with employees on health and safety matters;
- A method for employees to report safety and health hazards;
- An occupational health and safety committee to study causes of on-the-job accidents and safety complaints and to make recommendations for corrective action; and
- Tailored and age-appropriate physical fitness, health and wellness programs.

The NFPA 1583 standard outlines a complete health-related fitness program for members of fire departments involved in emergency operations to enhance their ability to perform occupational activities and reduce the risk of injury, disease and premature death. The fire-ground and other

emergency scenes may be the most difficult areas in which to prevent injuries. Critical fire-ground factors, such as threats to exposures, victims trapped, water supply issues, etc., frequently challenge the incident action plan as well as the firefighters executing that plan. Firefighters constantly face issues of strain and overexertion. In order to lessen the risk of injuries and increase firefighter effectiveness at incident, most members exercise, and do so frequently. However, sometimes the workouts intended to help firefighters decrease injuries can be the very trigger that causes the injuries in the first place. A sensible and properly-tailored fitness and injury prevention regimen will greatly reduce the frequency and severity of injuries incurred by firefighters.

It is recommended that a fitness and injury prevention regimen be offered to firefighters, and tailored to meet the age-appropriate needs of members who may be prone to recurring injuries and/or musculoskeletal disorders. Strength and conditioning coaches could be identified for this purpose, coordinating medical and fitness assessments; developing recruit fitness training, pre-employment medical and fitness evaluations; and mentoring certified peer fitness trainers. This may be accomplished through the implementation of training methods that place emphasis on the way an individual is moving and activating their muscles, rather than simply becoming physically fit. Too often, measures of fitness, such as strength or muscular endurance are used to identify occupational readiness, with disregard for how the tasks are performed. Interestingly, firefighters appearing to be the most physically fit or prepared could, in fact, move their bodies in ways that predispose them to a higher risk of injury. (The University of Waterloo and the Andrews Institute for Orthopedics & Sports Medicine refers). These prevention initiatives could help to lessen or mitigate issues of strain and overexertion faced by BC firefighters in the line-of-duty.

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Disclaimer

WorkSafeBC information referenced in this report was created with the sole purpose of assisting the City of Surrey in its efforts to identify and reduce workplace injuries. Some of that information is based upon assumptions and interpretations of data. Consequently the WorkSafeBC data referenced in this paper should not be relied upon as statistically accurate.

Appendix – Notes Provided from Original Data

The “BC Firefighters Location/Activity of Injury” dataset contains WorkSafeBC information relating to injuries incurred by BC firefighters 2009 to July 1, 2014. Data is collected in the following eight categories:

Responding to Incidents:

- Indications that injury occurred between dispatch and arrival at emergency incident. Includes dismounting apparatus at scene.

At Incident:

- Indication that injury occurred between arrival and clearing of emergency incident including: disease; hearing loss and mental disorder claims.

Returning from Incident:

- Indications that injury occurred between clearing emergency incident and arrival back at station.

At Station:

- Indication injury that arose out of non-emergency, non-training routine work including: station maintenance, vehicle maintenance, cooking, inspections, hose testing and hose loading.

Training:

- Indication injury arose out of training exercises including, driver training, RIT training and auto extrication.

Physical Activity:

- Indication injury arose out of physical fitness activities including: weight training, jogging, floor hockey and football.

Other:

- Indication injury arose out of employer approved charitable or PR functions such as open house or cooking contest.

Unknown:

- Not enough information available to make determination.

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