

Canadian Firefighter Fatality and Injury

Trend Analysis of Association of Workers Compensation Boards of Canada
Fatality and Injury Claims 2006 – 2018



Larry Thomas, Len Garis, and Chris Biantoro

July 2020

Executive Summary

- The purpose of the study is to determine the trends for time-loss injury and fatality claims among firefighters due to industrial diseases by generating and comparing time-series data of Association of Worker's Compensation Boards of Canada (AWCBC) in 10-year periods. For that purpose, three Cohorts have been created and compared: Cohort 1 (2006 -2015), Cohort 2 (2008 - 2017), and Cohort 3 (2009 - 2018)
- The previous study, an analysis on the time-loss injury and fatality claims among firefighters, has been conducted using the 2006 - 2015 claims data
- The result of the study shows a further increase of fatality claims while a deceleration of the increases has been present over the last two years. The study also demonstrates a decrease in the time-loss injury claims over the recent years.
- Furthermore, it has shown a consistent trend with the previous study where Cancer, and Traumatic Injury are the leading causes of Canadian firefighter fatalities. While Traumatic injury and Mental Disorder are contributing the most to time-loss injury claims among Canadian firefighters.
- Nearly 90% of firefighter fatality claims are caused by Cancer which is an increasing trend over the previous years. Nevertheless, the evidence demonstrates a slowing down in the increase of these fatalities. Ontario as the province with the most claims, has seen a declining trend over the last 2 years. The data also shows an increasing trend of those in the older age groups (55+) to have claimed Cancer-related fatalities (around 80% of total claims).
- Traumatic Injury has seen a decline over the years in both of its fatality and time-loss injury claims. Young firefighters (49 years and younger) consistently dominated the injury claims with nearly 80% of total claims. However, the older age groups have seen an increasing trend in fatality claims.
- Mental Disorder contributes to 1% or less of total fatality claims, a significant increase of over 5 times have been seen in fatality claims compared to the first cohort. The same increasing trend also occurred in the time-loss injury claims for this nature over the last three years of 2016, 2017, and 2018 which places Mental Disorder as the second contributor of time-loss injury claims among Canadian firefighters (over 3% of total claims). The evidence also demonstrates a shift to more claims reported by the older age groups in the recent years. This shift depicts how Mental Disorder affects equally on firefighters across various age groups.

Purpose of this Research

As indicated in many studies, firefighters carry relatively high risk to exposures, work-related injuries and diseases attached to their occupation. The previous studies provide more understanding on the causes of injury, disease, and fatality among Canadian firefighters [1], [2]. The study conducted in 2018 on the Association Worker's Compensation Boards of Canada (AWCBC) data presents a detail analysis of injury claims from 2006 to 2015 for professional and volunteer firefighters so that priorities can be defined for targeted health promotion and injury prevention interventions [2].

The recent AWCBC data shows the firefighter fatalities and time-loss claims by various diseases and/or injuries from the period of 2006 to 2018. The purpose of this research is to provide 10-year comparisons between the previous data analyses from 2006 to 2015, 2008 to 2017, and the analysis using the data from 2009 to 2018. The comparisons should offer trends of fatalities and time-loss claims for certain diseases and should aim to give understanding on the trajectory of diseases among Canadian firefighters.

Background

An initial analysis on the AWCBC claims data offers a picture on the causes of injury, disease, and fatality among firefighters in Canadian context [2]. The analysis on the claims data from 2006 to 2015 revealed five principle causes of injury and fatality among Canadian firefighters: Cancer, Traumatic Injury, Cardiovascular Disease, Respiratory Disease, and Mental Health problems. The analysis provides evidence for increase mortality from cancer among firefighters in comparison to the general population, suggesting that the healthy worker effect, unfortunately does not play a preventive role in relation to cancer mortality. Furthermore, the stressful work environments that are faced by firefighters leads to increasing risk for traumatic injury and mental health issues. Therefore, the results of this study suggest that cancer, traumatic injury, and mental health should be priority issues for researchers, employers, and policymakers in improving health and safety of people working in this occupation. This study also provides further evidence of the need for a national firefighter injury surveillance model. The analysis uses claims data, and depicts, and assesses the injury status of those who submitted claims. However, not all injuries have claims submitted, so the analysis does not represent the entire profession.

Since 2010, researchers from the National Institute for Occupational Safety and Health (NIOSH) have conducted a multi-year study to assess job related risk of cancer for firefighters. The study included almost 30,000 career firefighters from multiple cities in North America between 1950 and 2009. It found that relative to the general population, the firefighters in this study had a modest increase of 9% and 14% in cancer diagnoses and cancer-related fatality respectively [3]. Despite the modest increases, they must be considered in the context of the baseline cancer risk faced by general North American population. For example, if in 2019, the average Canadian has a 44% risk of developing cancer over their lifetime, the number increases to 53% for Canadian firefighters. If the average Canadian has a 30% of risk dying of Cancer, the mortality rate increases to 44% for a person with a career in firefighting [4].

Furthermore, the study conducted by M. Dow, et. al provides an extensive list of literature across jurisdictions regarding the incidence, prevalence, and mortality rates of cancer in the population of firefighters in comparison to the general population [1]. The study also highlights the challenges and opportunities in mitigating cancer risk within the fire service. It shows the importance of personal accountability in conjunction with organizational leadership that could shift individual and department behaviours that contribute to resistance in prevention orientations whether in relation to safety gear/method, or health and wellness initiatives.

Methodology

For simplicity, three cohorts have been created for this study:

- Cohort 1 represents the analysis on the AWCBC data from 2006 to 2015
- Cohort 2 represents the analysis on the data from 2008 to 2017
- Cohort 3 represents the analysis on the data from 2009 to 2018

Comparisons among Cohorts have been performed to determine the trends of fatalities/injuries by diseases among Canadian firefighters.

The AWCBC provided national data on accepted time-loss claims due to injury and fatality claims. It should be noted that not all workplace injuries are included in the dataset, only accepted claims that have been submitted are presented in this analysis. This certainly becomes one of the limitations for this analysis. Data is submitted to AWCBC by the twelve provincial and territorial Canadian Workers' Compensation Boards and Commissions with the Northwest Territories and Nunavut combined. Each provincial and territorial WCB organization codes their own data which may vary among provinces/territories and leads to another limitation of the analysis. According to AWCBC, a time-loss injury has been defined as, an injury for which a worker is compensated for a loss of wages following a work-related incident (or exposure to a noxious chemical) or receives compensation for a permanent disability with or without time lost in his/her employment [5].

The data was provided in a series of five tables describing categories of analyses: nature of injury, body part injured, cause of injury, event, and occupation status by age group, gender, year of claim, and reporting province. Nonetheless, for this analysis, only the nature of injury has become the focus.

The original data has been limited to show only the aggregate number of fatalities and/or time-loss claims for more than 3 to protect the confidentiality of the individuals who submitted the claims. Random allocation has been applied to the suppressed numbers. For that reason, the numbers presented in the analysis here may not reflect the true numbers from the original data as well as the numbers presented in the previous analysis.

Appendix 'A' contains information related to the number of fire departments/firefighters included in the claim related data. Appendix 'B' provides a breakdown of the years included by Province. Appendix 'C' provides the claim grouping based on the AWCBC coding for nature of injury.

FIREFIGHTER FATALITIES

Overall, there is an increase of 51 fatalities (7.4% increase) between the Cohort 2 (687 fatalities) and Cohort 3 (738 fatalities). This percentage increase is significantly less relative to the percentage increase from the previous cohort comparison (21%). This translates to an increase of 5.2 fatalities per 100,000 firefighters annually over the previous 10-year period. The current cohort fatality rate per 100,000 firefighters is improved relative to the increase from the previous 10-year period (12.1 fatalities per 100,000 firefighters).

The highest contributor to the increase is from Cancer. Cancer is still the leading cause of fatalities among firefighters in Canada. In Cohort 1, Cancer contributes to around 85% of total firefighter fatalities whereas in Cohort 2 and Cohort 3, the percentage is increased to 88% and 90% respectively. The second contributor of total fatalities is Traumatic Injury with approximately 4.9% in Cohort 3 which represents a 6% increase compared to Cohort 2 (4.6% of total fatalities). Circulatory System Diseases with 3.9% of the fatalities in Cohort 3 is down 14% relative to Cohort 2. Although Mental Disorder contributes to a small proportion of total fatality claims (1.2% in Cohort 3), it represents a significant increase of 5 times relative to the first Cohort. See Table 1 below for the fatality by nature of injury, (Cohort 1: 2006-2015) vs (Cohort 2: 2008-2017) vs (Cohort 3: 2009-2018).

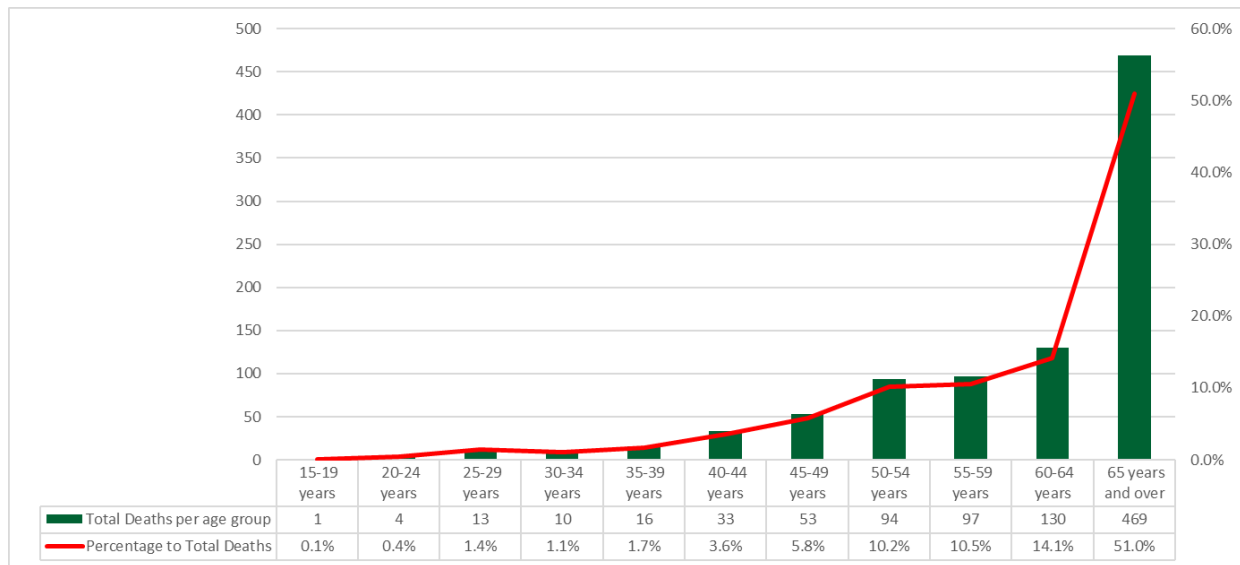
TABLE 1: CANADIAN FIREFIGHTER FATALITY CLAIMS BY NATURE OF INJURY

| Nature of Injury | Percentage of Total Fatalities | | | | | Annual Fatalities per 100,000 FF* | | | | |
|---------------------------|--------------------------------|----------|----------|-----------------|-----------------|-----------------------------------|----------|----------|----------------|----------------|
| | Cohort 1 | Cohort 2 | Cohort 3 | Pct. Diff (2-1) | Pct. Diff (3-2) | Cohort 1 | Cohort 2 | Cohort 3 | Pct Diff (2-1) | Pct Diff (3-2) |
| Cancer | 85.4% | 87.9% | 89.7% | 3.4% | 2% | 49.5 | 61.5 | 62.4 | 24% | 1.4% |
| Traumatic Injury | 6% | 4.6% | 4.9% | (23.3%) | 6% | 3.5 | 3.3 | 3.0 | (8.6%) | (9%) |
| Circulatory System | 4.9% | 4.2% | 3.9% | (14%) | (7%) | 2.8 | 2.9 | 2.7 | 3.6% | (6.9%) |
| Respiratory System | 1.7% | 1.6% | 2.0% | (6%) | 25% | 1.0 | 1.1 | 1.6 | 10% | 45% |
| Mental Disorder | 0.2% | 0.6% | 1.2% | 253% | 100% | 0.1 | 0.4 | 0.8 | 300% | 100% |

Note: random allocation of suppressed numbers was performed; therefore, the numbers represented here may not reflect the true numbers from the raw data. *only includes AB, BC, MB, NB, NS, ON, QC, SK, YT.

With respect to age breakdown, the data shows that nearly 80% of fatalities are those in the 55 years of age or over (see Graph 1).

GRAPH 1: CANADIAN FIREFIGHTER FATALITY CLAIMS BY AGE GROUP FOR ALL COHORTS (2006 – 2018)



The comparisons among different Cohorts demonstrate an increasing trend of older age groups dominating the proportions of firefighter fatalities. Cohort 1 shows nearly 71% of fatalities from those in the 55 years of age or over, the percentage is increased to nearly 76% in Cohort 2 and over 79% in Cohort 3 (see Table 2).

TABLE 2: CANADIAN FIREFIGHTER FATALITY CLAIMS BY AGE GROUP OVER COHORTS

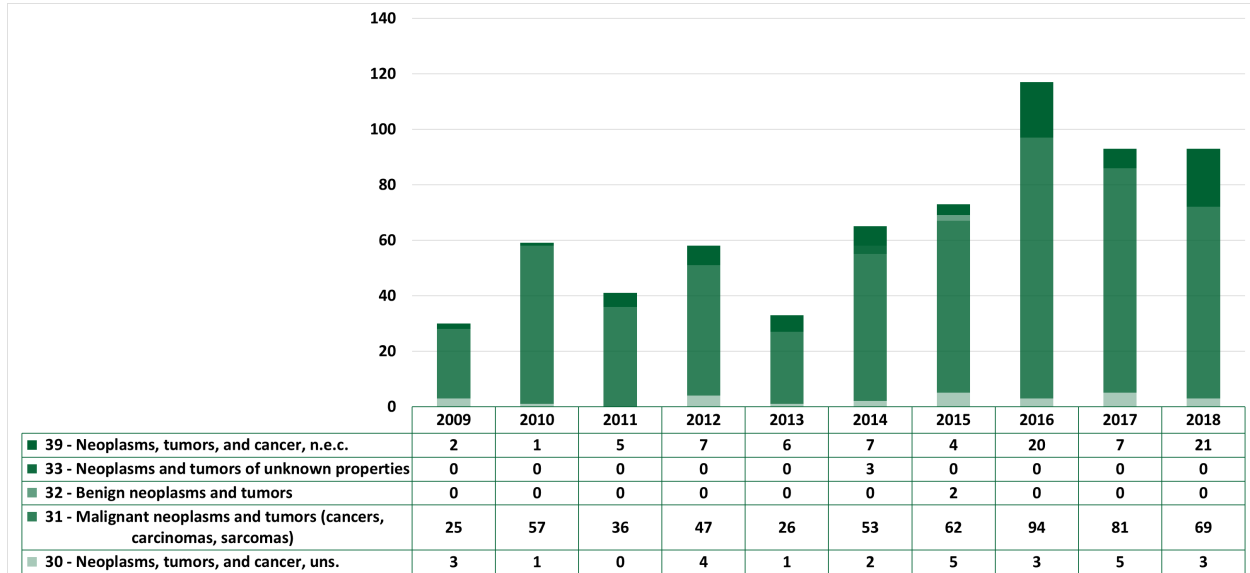
| Age Group | Cohort 1 | Cohort 2 | Cohort 3 |
|-------------------|----------|----------|----------|
| 15-19 years | 0.2% | 0.1% | 0.0% |
| 20-24 years | 0.7% | 0.1% | 0.1% |
| 25-29 years | 1.7% | 1.4% | 1.3% |
| 30-34 years | 1.4% | 1.1% | 0.9% |
| 35-39 years | 2.7% | 1.6% | 1.2% |
| 40-44 years | 3.9% | 4.0% | 3.3% |
| 45-49 years | 6.5% | 5.2% | 4.8% |
| 50-54 years | 11.9% | 10.5% | 9.0% |
| 55-59 years | 11.7% | 10.9% | 9.9% |
| 60-64 years | 15.8% | 13.5% | 13.1% |
| 65 years and over | 43.5% | 51.5% | 56.2% |

Cancer (Fatality)

Of the 738 firefighter fatalities reported in Canada between 2009 and 2018 by the AWCBC, approximately 74.5% of deaths (550) were caused by malignant neoplasms and tumors (cancers, carcinomas, sarcomas). When adding 94 other cancer-related fatalities coded as unspecified or not elsewhere classified, 90% of firefighter deaths in Canada are attributable to a form of cancer. Graph 2 shows that an increasing trend of cancer-related firefighter fatalities start in 2014 and reaches the

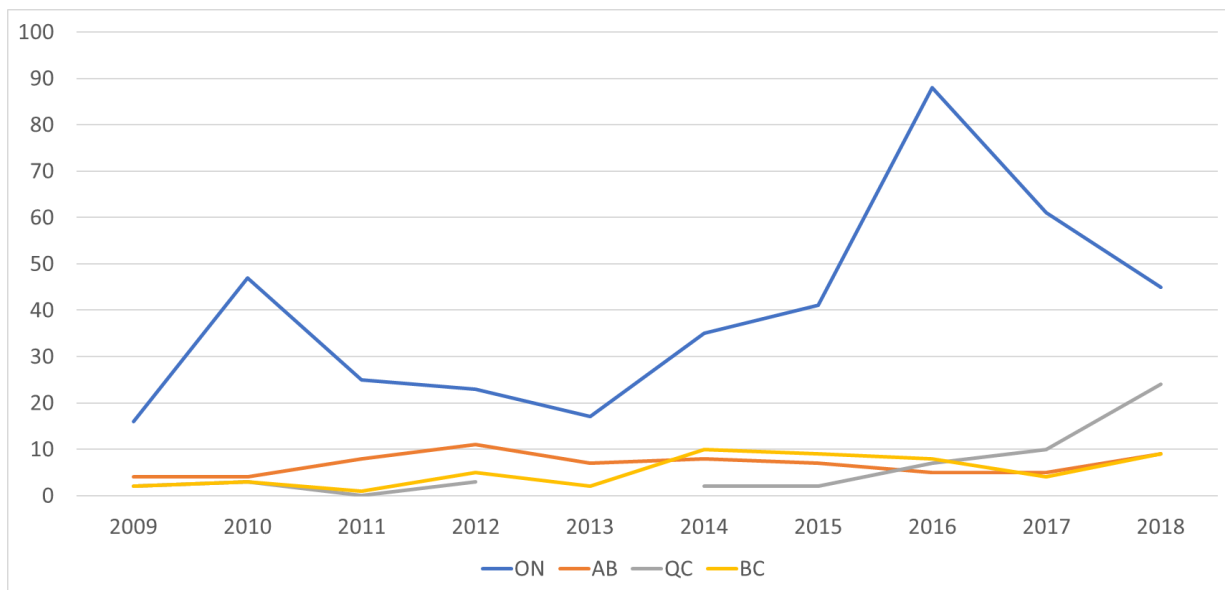
peak in 2016 before they decline in the subsequent years. A plateau seems to be present in the cancer-related fatality rates in 2017 and 2018. In 2018 the rate of malignant neoplasms and tumors (cancers, carcinomas, sarcomas) decreases but there is a rise for the other cancer unspecified group (see Graph 2).

GRAPH 2: FIREFIGHTER FATALITY CLAIMS FROM CANCER IN CANADA: 2009 – 2018



The analysis by province demonstrates that over 80% of cancer-related firefighter fatality claims in Canada took place in four provinces: Ontario, Alberta, Quebec, and British Columbia. Nearly 60% of them were reported in Ontario. Most claims reported in Ontario influences the trend across Canada, with declining fatalities in Ontario over the last two years of 2017 and 2018. In the other three provinces, an increasing trend of cancer-related fatality claims seems to be present (see Graph 3).

GRAPH 3: FIREFIGHTER FATALITY CLAIMS FROM CANCER IN CANADA BY PROVINCES WITH MAJORITY CLAIMS: 2009 – 2018



The increasing trend of older age groups took place over the 3 Cohorts with 76%, 79% and 82% of those in 55 years of age fall in Cohort 1, 2 and 3 respectively (see Table 3).

TABLE 3: CANADIAN FIREFIGHTER CANCER-RELATED FATALITY CLAIMS BY AGE GROUP OVER COHORTS

| Age Group | Cohort 1 | Cohort 2 | Cohort 3 |
|-------------------|----------|----------|----------|
| 30-34 years | 0.6% | 0.0% | 0.0% |
| 35-39 years | 1.2% | 0.6% | 0.6% |
| 40-44 years | 4.2% | 4.0% | 3.3% |
| 45-49 years | 5.4% | 4.8% | 4.6% |
| 50-54 years | 12.5% | 11.5% | 10.0% |
| 55-59 years | 13.1% | 12.3% | 11.8% |
| 60-64 years | 17.1% | 14.4% | 14.0% |
| 65 years and over | 45.8% | 52.4% | 55.7% |

Traumatic Injury (Fatality)

A modest increase of 6% relative to the previous Cohort is shown in Cohort 3 at the proportion of Traumatic Injury over total firefighter fatalities (4.9% of total fatalities) – see Table 1. The majority of trauma injury related fatality claims (over 75%) fell in the category of multiple traumatic injuries and disorders or other traumatic injuries and disorders.

The analysis by province show the following provinces have reported fatality claims caused by traumatic injury: Alberta, British Columbia, Ontario, Quebec, Saskatchewan, and Manitoba. Ontario reports the most claims (36% of total claims) followed by Alberta (26%) and British Columbia (18%).

Although nearly 50% of firefighter fatalities caused by traumatic injury are claimed by those younger than 50 years old, an increasing proportion of older age groups (55 years old or older) can be seen over the three Cohorts. Nearly 37% of fatalities in Cohort 1 are in the age group of 55 years or older. The percentage is increased to 43% and 49% in Cohort 2 and Cohort 3 respectively (see Table 4).

TABLE 4: CANADIAN FIREFIGHTER TRAUMA INJURY-RELATED FATALITY CLAIMS BY AGE GROUP OVER COHORTS

| Age Group | Cohort_1 | Cohort_2 | Cohort_3 |
|-------------------|----------|----------|----------|
| 15-19 years | 2.9% | 3.4% | 0.0% |
| 20-24 years | 4.4% | 1.7% | 1.8% |
| 25-29 years | 11.8% | 13.8% | 9.1% |
| 30-34 years | 10.3% | 17.2% | 12.7% |
| 35-39 years | 8.8% | 5.2% | 5.5% |
| 40-44 years | 4.4% | 0.0% | 0.0% |
| 45-49 years | 10.3% | 10.3% | 16.4% |
| 50-54 years | 10.3% | 5.2% | 5.5% |
| 55-59 years | 8.8% | 8.6% | 7.3% |
| 60-64 years | 5.9% | 5.2% | 10.9% |
| 65 years and over | 22.1% | 29.3% | 30.9% |

FIREFIGHTER TIME-LOSS INJURY CLAIMS

In time-loss claims over the 10-year time span of Cohort 3, there is approximately a decrease of 25 claims overall. This translates to a decrease of 2.5 time-loss claims per 100,000 firefighters or 0.2% drop from the previous cohort. Traumatic Injury time-loss claims were the highest with 86.7% of total claims in Cohort 3 which is a reduction of 1.8% from Cohort 2.

Mental Health Disorder is second for time-loss claims among firefighters, contributing approximately 3.7% of total claims. This represents an increase of 28 % from Cohort 2. Musculoskeletal system and connective tissue diseases represent 2.1% of total time-loss claims. Cancer follows with 2% of total time-loss claims. See Table 5 for the time-loss claims by nature of injury, (Cohort 1: 2006-2015) vs (Cohort 2: 2008-2017) vs (Cohort 3: 2009-2018).

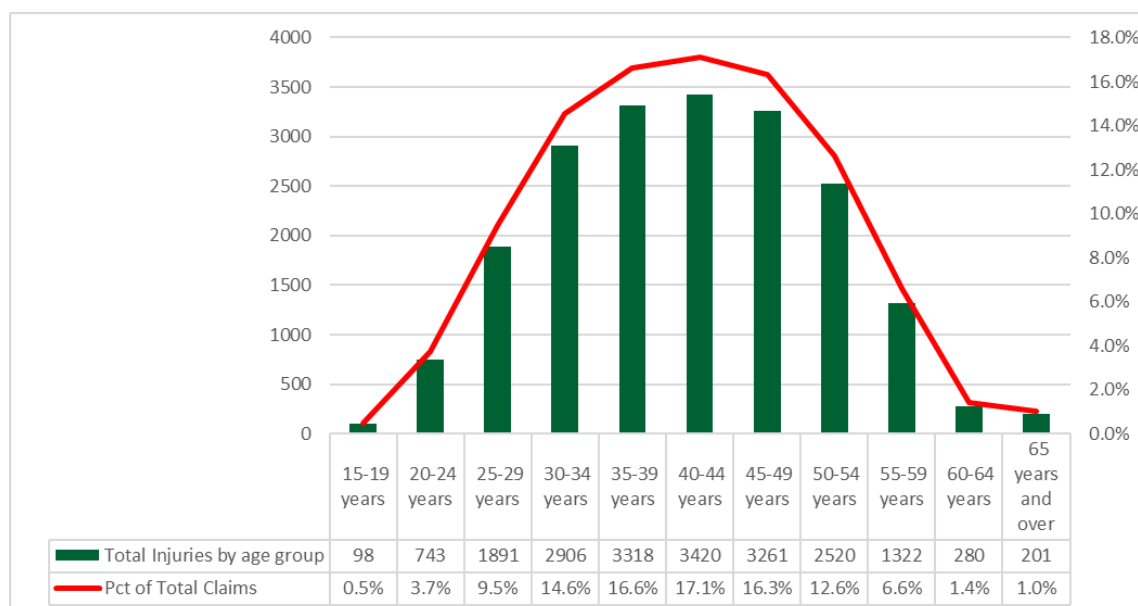
TABLE 5: CANADIAN FIREFIGHTER INJURY CLAIMS BY NATURE OF INJURY

| Nature of Injury | Percentage of Time-Loss Claims | | | | | Annual Time-Loss Claims per 100,000 FF* | | | | |
|------------------|--------------------------------|----------|----------|-----------------|-----------------|---|----------|----------|----------------|----------------|
| | Cohort 1 | Cohort 2 | Cohort 3 | Pct. Diff (2-1) | Pct. Diff (3-2) | Cohort 1 | Cohort 2 | Cohort 3 | Pct Diff (2-1) | Pct Diff (3-2) |
| Trauma Injury | 89.9% | 88.3% | 86.7% | (1.7%) | (1.8%) | 1414 | 1336.2 | 1310 | (6%) | (1.9%) |
| Mental Disorder | 1.6% | 2.9% | 3.7% | 81% | 27.5% | 25.9 | 44.4 | 56.6 | 171% | 27% |
| Musculoskeletal | 2.3% | 2.1% | 2.1% | (8.7%) | 0% | 36.4 | 32.9 | 31.3 | (10%) | (5%) |
| Cancer | 1.5% | 1.8% | 2% | 20% | 11% | 23.2 | 27.6 | 30.4 | 119% | 10% |
| Digestive System | 1% | 0.9% | 0.8% | (10%) | (11%) | 16.3 | 14.3 | 13.1 | (13%) | (8.4%) |
| Nervous System | 0.9% | 1% | 1.1% | 11% | 10% | 14.2 | 16.0 | 17.4 | 113% | 8.8% |

Note: random allocation of suppressed numbers was performed; therefore, the numbers represented here may not reflect the true numbers from the raw data. * only includes AB, BC, MB, NB, NS, ON, QC, SK, YT.

Unlike fatality claims which were dominated by older age groups, nearly 80% of time-loss claims have been reported by those of younger than 50 years old (see Graph 5).

GRAPH 5: CANADIAN FIREFIGHTER INJURY CLAIMS BY AGE GROUP (2006 - 2018)



The comparisons among different Cohorts show consistencies across the years that younger age groups (less than 50 years old) have had the most time-loss claims. Over 79% 78%, and 77% of claims are from those under 50 years of age in Cohort 1, 2, and 3 respectively (see Table 6).

TABLE 6: CANADIAN FIREFIGHTER INJURY CLAIMS BY AGE GROUP OVER COHORTS

| Age Group | Cohort 1 | Cohort 2 | Cohort 3 |
|-------------------|----------|----------|----------|
| 15-19 years | 0.5% | 0.4% | 0.5% |
| 20-24 years | 3.7% | 3.6% | 3.8% |
| 25-29 years | 9.6% | 9.6% | 9.5% |
| 30-34 years | 14.4% | 14.3% | 14.5% |
| 35-39 years | 16.8% | 16.5% | 16.3% |
| 40-44 years | 17.6% | 16.9% | 16.6% |
| 45-49 years | 16.7% | 16.3% | 15.9% |
| 50-54 years | 12.6% | 12.9% | 12.9% |
| 55-59 years | 6.1% | 6.9% | 7.2% |
| 60-64 years | 1.1% | 1.4% | 1.6% |
| 65 years and over | 0.7% | 1.0% | 1.2% |

Traumatic injury (Time-loss)

Over 86% of time-loss claims have been reported for Traumatic Injury. The percentage is down 1.7% and 1.8% relative to Cohort 1 and 2 respectively. Most claims under Traumatic Injury, over 67%, belong to Traumatic Injuries of the muscles, tendons, ligaments, joints etc. Surface wounds and bruises are next with around 8% of total claims.

TABLE 7: CANADIAN FIREFIGHTER INJURY CLAIMS FOR TRAUMATIC INJURY BY COHORTS

| Nature of Injury | Cohort_1 | Cohort_2 | Cohort_3 |
|--|----------|----------|----------|
| 00 - Traumatic injuries and disorders, uns. | 0.3% | 0.4% | 0.4% |
| 01 - Traumatic injuries to bones, nerves, spinal cord | 7.7% | 7.6% | 7.5% |
| 02 - Traumatic injuries to muscles, tendons, ligaments, joints, etc. | 67.2% | 67.3% | 67.6% |
| 03 - Open wounds | 6.1% | 6.1% | 6.0% |
| 04 - Surface wounds and bruises | 8.5% | 8.1% | 7.7% |
| 05 - Burns | 2.0% | 1.8% | 1.7% |
| 06 - Intracranial injuries | 1.1% | 1.2% | 1.3% |
| 08 - Multiple traumatic injuries and disorders | 1.8% | 1.6% | 1.5% |
| 09 - Other traumatic injuries and disorders | 5.4% | 5.9% | 6.2% |

When the time-loss claims are broken down by province, Ontario, Quebec, British Columbia, and Alberta represent a majority of the claims . These Provinces reported over 80% of the total claims with over 30%, 19%, 18%, and 15% respectively. Ontario has shown a slight decline across Cohorts from 33% to 30% for Cohort 1 to Cohort 3 whereas Alberta has shown a modest increase across Cohorts (see Table 8).

TABLE 8: FIREFIGHTER INJURY CLAIMS FROM TRAUMA INJURY IN CANADA BY PROVINCES

| Province | Cohort_1 | Cohort_2 | Cohort_3 |
|----------|----------|----------|----------|
| AB | 13.9% | 15.5% | 15.8% |
| BC | 18.4% | 18.5% | 18.4% |
| MB | 7.7% | 7.8% | 7.9% |
| NB | 2.1% | 2.4% | 2.6% |
| NL | 0.8% | 0.8% | 0.8% |
| NS | 1.2% | 1.3% | 1.3% |
| NT/NU | 0.5% | 0.6% | 0.6% |
| ON | 33.2% | 31.1% | 30.2% |
| PE | 0.2% | 0.3% | 0.3% |
| QC | 19.3% | 18.8% | 19.0% |
| SK | 2.4% | 2.6% | 2.7% |
| YT | 0.3% | 0.4% | 0.4% |

Nearly 80% of the total number of claims for Traumatic Injury are submitted by firefighters in the age groups of under 50 years of age. A slight decline across the Cohorts from 80.2% in Cohort 1 to Cohort 78.8% in Cohort 3. At the same time, the total number of claims for Traumatic Injury submitted by those in the older age groups slightly increased over the 3 Cohorts from 19.8% to 21.2% of total number of claims (see Table 9).

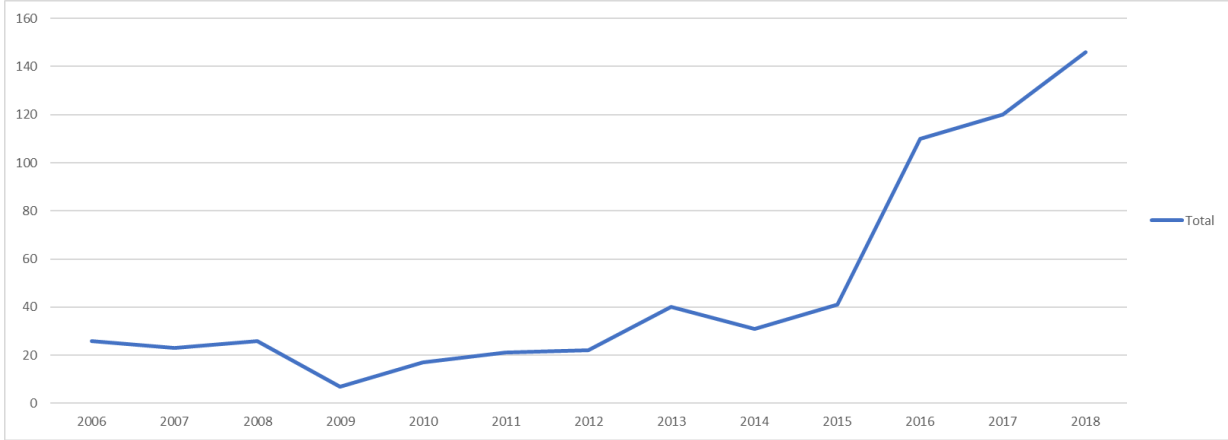
TABLE 9: FIREFIGHTER INJURY CLAIMS FROM TRAUMA INJURY IN CANADA BY AGE GROUPS

| Age Group | Cohort_1 | Cohort_2 | Cohort_3 |
|-------------------|----------|----------|----------|
| 15-19 years | 0.8% | 0.9% | 0.9% |
| 20-24 years | 3.9% | 3.9% | 4.1% |
| 25-29 years | 9.9% | 9.9% | 9.8% |
| 30-34 years | 14.7% | 14.7% | 15.1% |
| 35-39 years | 16.8% | 16.7% | 16.5% |
| 40-44 years | 17.6% | 16.9% | 16.7% |
| 45-49 years | 16.6% | 16.1% | 15.6% |
| 50-54 years | 12.4% | 12.5% | 12.5% |
| 55-59 years | 5.9% | 6.5% | 6.7% |
| 60-64 years | 1.2% | 1.4% | 1.5% |
| 65 years and over | 0.4% | 0.5% | 0.5% |

Mental Health (Time-loss)

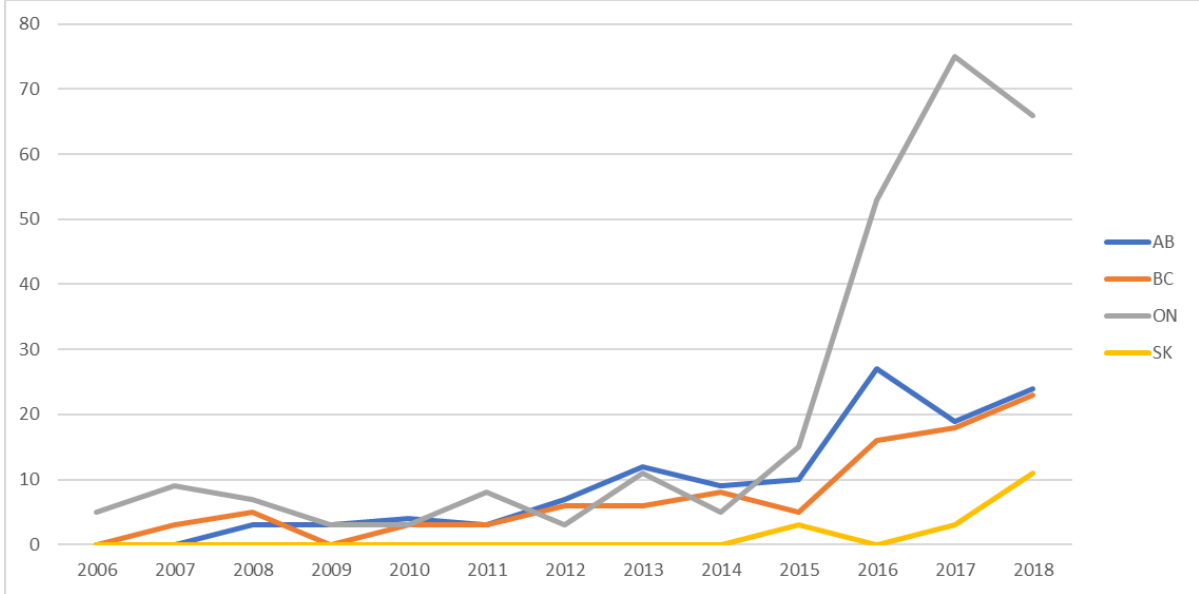
Over the last 10 years from 2009 to 2018, Mental Health ranks second in the total number of time-loss claim submissions with 3.7% of total claims. The percentage has increased nearly 4% from the previous Cohort. Graph 6 shows an increase of nearly 5 times of total number of claims under mental disorders or syndromes since 2006: from 26 claims to 146 claims in 2018 with a significant increase occurring since 2016.

GRAPH 6: CANADIAN FIREFIGHTER INJURY CLAIMS OF MENTAL DISORDER



Three provinces have submitted over 75% of the claims for Mental Disorder: Ontario, Alberta, and British Columbia with 41%, 20% and 15% respectively. These three provinces have seen a significant spike in the last 3 years of 2016, 2017, and 2018, although in 2018, Ontario experienced a decline relative to the previous year of 2017. Saskatchewan also experienced a significant increase in the last 3 years (see Graph 7) although they only contribute to 3% of total claims.

GRAPH 7: CANADIAN FIREFIGHTER INJURY CLAIMS OF MENTAL DISORDER (TOP 4 PROVINCES)



When the data is broken down by age groups across the Cohorts, it has shown a shift of how Mental Disorder affects firefighters in the older age groups over the years. Graph 8 displays the contrast comparisons in the proportions of injury claims for Mental Disorder between Cohort 1 and Cohort 2 or Cohort 3. In Cohort 1, the highest proportion of Mental Disorder injury claims belongs to the age group of 40-44 years old. Over 60% of total claims are from those 44 years of age or less. The

significant decrease of this proportion occurred in Cohort 2 and 3 to become approximately 50% of total claims. Simultaneously, those 45 years or older have increased their proportions of claims.

GRAPH 8: FIREFIGHTER INJURY CLAIMS FROM MENTAL DISORDER IN CANADA BY AGE GROUPS



Conclusion

Revisiting the previous research, the findings in this study demonstrate consistence evidence of injury and fatality risks that Canadian firefighters experience in fulfilling their duties. The current evidence has demonstrated a deceleration in the increases of fatality claims, as well as a decrease in the time-loss injury claims. It has shown a consistent picture to the previous studies with Cancer and Traumatic Injury contributing most to fatalities. Traumatic Injury and Mental Disorder contribute most to time-loss injury claims among Canadian firefighters.

Cancer is still the leading cause of fatalities. This study shows an increasing trend of firefighters' fatalities that have been caused by this disease which has contributed to nearly 90% of total deaths over the last 10 years. Despite the increasing trend, the evidence demonstrates a decline for the Cancer related fatalities in Ontario. As the province with the most Cancer-related fatality claims, Ontario has influenced this decline in its fatality claims over the last 2 years, whereas the other top contributors: British Columbia, Alberta, and Quebec, have seen an increase in their claims. The data also show an increasing trend of those in the older age groups (55+) to have succumbed to Cancer-related fatalities.

Traumatic Injury is the second contributor of fatalities and the leading cause of injury time-loss claims among Canadian firefighters. The analysis has shown a decline over the years in both fatality and injury claims by this nature. The data also show an increasing trend of those in the older age groups to have fatalities caused by this nature of injury. Firefighters in the age group of under 50

years old consistently dominated the injury claims caused by Traumatic Injury with nearly 80% of total claims over the years.

The increasing trend of fatality and time-loss injury claims has been seen in the Mental Disorder nature. A significant spike in time-loss injury claims occurred over the last three years of 2016, 2017, and 2018. Ontario, British Columbia, Alberta, and Saskatchewan have the highest counts and have seen similar trends through time. Recently Ontario has shown a decline in the year of 2018. A shift to more injury claims reported by the older age groups in the recent year also demonstrates the effect of Mental Disorder in firefighter's health as it is now becoming equally spread across various age groups.

The results of this report demonstrate further reliable evidence that Cancer, Traumatic Injury, and Mental Disorder should be priority issues for researchers, employers, and policymakers to improve firefighter health and safety. This study also echoes the conclusions from previous studies in emphasizing the importance of a national firefighter injury surveillance model. There are limitations in the analysis of firefighter injury and fatality analysis, when relying only on claims data.

It is recommended that a surveillance model is needed to track the injury status and fatality experiences in this occupation so that the causes of occupational injury and fatality among firefighters can be accurately described to improve prevention mechanisms.

References

- [1] M. Dow, K. Kunz, L. Garis and L. Thomas, *Firefighters and Cancer: Understanding Risk Factors in an environment of change*, June 2015, Centre for Public Safety and Criminal Justice Research, School of Criminology and Criminal Justice, University of the Fraser Valley.
- [2] R. Ramsden, J. Smith, K. Turcotte, L. Garis, K. Kunz, P. Maxim, L. Thomas, and I. Pike, *Determinants of Injury and Death in Canadian Firefighters: A Case for a National Firefighter Wellness Surveillance System*, February 2018, Centre for Public Safety and Criminal Justice Research, School of Criminology and Criminal Justice, University of the Fraser Valley.
- [3] R. Daniels, *Firefighter Cancer Rates: The Facts from NIOSH Research*, May 2017, Centers for Disease Control and Prevention, <https://blogs.cdc.gov/niosh-science-blog/2017/05/10/ff-cancer-facts/>
- [4] K. Kunz, *Cancer in firefighters*, November 15 2019, Firefighting in Canada, <https://www.firefightingincanada.com/cancer-in-firefighters/>
- [5] Association of Workers' Compensation Boards of Canada, *National Work Injury/Disease Statistics Program (NWISP) Definitions*, http://awcbc.org/?page_id=4040

Author Biographical Information

Larry Thomas is a Fire Chief for the City of Surrey BC and is a Chartered Manager, C. Mgr. and Executive Chief Fire Officer, ECFO with 31 years' experience. He has a background in Science from Simon Fraser University and Economics from Douglas College. Contact him at LSThomas@surrey.ca

Len Garis, is a Senior Advisor for the Centre for Social Data Insights and Innovation at Statistics Canada, Fire Chief (ret) for the City of Surrey BC, an Adjunct Professor in the School of Criminology and Criminal Justice & Associate to the Centre for Social Research at the University of the Fraser Valley (UFV), a member of the Affiliated Research Faculty at John Jay College of Criminal Justice in New York, and a faculty member of the Institute of Canadian Urban Research Studies at Simon Fraser University. Contact him at lwgaris@outlook.com

Chris Biantoro is the strategic planning analyst for the City of Surrey Fire Service, BC. He has a background of operations research and extensive working experiences in advanced analytics, data science, and statistical modeling. He possesses a Doctorate degree in Operations Engineering. Contact him at chris.biantoro@surrey.ca

Acknowledgements

The authors wish to thank Association of Worker's Compensation Boards of Canada (AWCBC) for the data provision.

Deputy Chiefs John Lehmann and David Burns for their assistance with reviewing the findings of this report.

Appendix A

TABLE 1: NUMBER OF FIRE DEPARTMENTS, PROFESSIONAL FULL-TIME FIREFIGHTERS AND VOLUNTEER FIREFIGHTERS IN CANADA, BY PROVINCE/TERRITORY, 2012, CANADIAN ASSOCIATION OF FIRE CHIEFS

| | AB | BC | MB | NB | NL | NWT | NS | NU | ON | PEI | QU | SK | YU |
|------------------------|------|------|------|------|------|------|------|-----|-------|------|-------|------|-----|
| Fire Departments | 435 | 460 | 215 | 170 | 301 | 33 | 314 | 25 | 462 | 36 | 723 | 508 | 26 |
| Full Time Firefighters | 3500 | 3800 | 977 | 600 | 315 | 31.5 | 425 | 17 | 11032 | 10 | 4288 | 650 | 40 |
| Volunteer Firefighters | 6500 | 8100 | 3364 | 4000 | 5900 | 402 | 7500 | 346 | 19263 | 1000 | 17310 | 6400 | 305 |

Appendix B

TABLE 2: REPORTED NUMBER OF YEARS BY PROVINCE FOR NATURE OF INJURY VARIABLE, AWCBC

| PROVINCE | FATALITY CLAIMS | TIME-LOSS CLAIMS |
|---------------------------|--------------------------|----------------------|
| ALBERTA | 2006-2018 | 2006 - 2018 |
| BRITISH COLUMBIA | 2006-2018 | 2006 - 2018 |
| MANITOBA | 2006-2018 | 2006 - 2018 |
| NEW BRUNSWICK | 2009,2010, 2012-2018 | 2006 - 2018 |
| NEWFOUNDLAND AND LABRADOR | 2016-2018 | 2006 -2018 |
| NOVA SCOTIA | 2008, 2012-2018 | 2006 - 2018 |
| NORTHWEST TERRITORIES | 2016-2018 | 2006 - 2018 |
| ONTARIO | 2006-2018 | 2006 - 2018 |
| PRINCE EDWARD ISLAND | 2016-2018 | 2006-2011, 2013-2018 |
| QUEBEC | 2006-2012,2014,2015-2018 | 2006-2018 |
| SASKATCHEWAN | 2006-2008,2010-2018 | 2006-2018 |
| YUKON | 2012-2018 | 2006-2009, 2011-2018 |

Appendix C

TABLE 3: DATA ANALYSIS GROUPING BASED ON AWCBC CODING FOR NATURE OF INJURY

| Analysis Grouping | AWCBC Coding |
|--|---|
| Cancer | 30- Neoplasms, tumors, and cancer, unspecified 31- Malignant neoplasms and tumors (cancers, carcinomas, sarcomas) 32- Benign neoplasms and tumors 33- Neoplasms and tumors of unknown properties 39- Neoplasms, tumors, and cancer, not elsewhere classified (n.e.c.) |
| Cardiovascular system diseases | 13- Circulatory system diseases |
| Digestive system diseases | 15- Digestive system diseases and disorders |
| Genitourinary system diseases | 16- Genitourinary system diseases and disorders |
| Infectious, bacterial, viral, parasitic diseases | 20- Infectious and parasitic diseases, unspecified 21- Bacterial diseases 22- Viral diseases 23- Other arthropod-borne diseases 26- Infectious diseases peculiar to the intestines 29- Other infectious and parasitic diseases |
| Mental health | 52- Mental disorders or syndromes |
| Musculoskeletal system and connective tissue disease | 17- Musculoskeletal system and connective tissue diseases and disorders |
| Nervous system diseases | 12- Nervous system and sense organs diseases |
| Other | 41- Symptoms 49- Other symptoms, signs and ill-defined conditions, n.e.c. 59- Other diseases, conditions and disorders, n.e.c. 80- Multiple diseases, conditions, and disorders NC- Not coded |
| Respiratory system diseases | 14- Respiratory system diseases |
| Skin and subcutaneous tissue diseases | 18- Disorders of the skin and subcutaneous tissue |
| Traumatic injuries | 00- Traumatic injuries and disorders, unspecified 01- Traumatic injuries to bones, nerves, spinal cord 02- Traumatic injuries to muscles, tendons, ligaments, joints, etc. 03- Open wounds 04- Surface wounds and bruises 05- Burns 06- Intracranial injuries 07- Effects of environmental conditions 08- Multiple traumatic injuries and disorders 09- Other traumatic injuries and disorders |
| Unknown | 99- Unknown |

