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Cost of workers' compensation claims among firefighters in Ohio, 2001–2020

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Abstract

Background: Firefighters face significant occupational hazards resulting in fatal and nonfatal injuries as well as illnesses. This study characterizes the costs of workers' compensation (WC) claims among Ohio firefighters from 2001 to 2020, providing insights for prevention and resource allocation strategies.

Methods: WC claims data for public and private fire departments were analyzed. Claims were categorized by type (medical-only vs. lost-time), demographics, tasks that led to the injury/illness, injury/illness events, and diagnoses. Costs included medical care, indemnity payments, and reserves for future anticipated costs, evaluated as of Q2 2022.

Results: Among 37,306 claims, costs totaled $542 million. Lost-time claims accounted for $497 million, while medical-only claims totaled $45 million. Overexertion involving outside sources was the most frequent event, contributing to 27% of claims and $176 million in costs. Patient care activities and long-term exposures had disproportionately high cost-to-claim ratios,

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Institution and Ethics approval and informed consent

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CRediT authorship contribution statement

Suzanne M. Marsh: Writing – original draft. **Alysha R. Meyers:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Tyler D. Quinn:** Writing – review & editing, Writing – original draft, Validation, Methodology. **Steven J. Wurzelbacher:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Steven J. Naber:** Writing – review & editing, Validation, Project administration, Methodology.

Declaration of competing interest

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highlighting their significant financial burden. A notable increase in cancer-related claims was observed following Ohio's firefighter cancer presumption law implementation in 2017, reflecting the impact of policy changes on claim trends.

Conclusions: This analysis highlights the substantial cost of WC claims among firefighters, emphasizing the need for targeted prevention efforts and resource allocation. The findings underscore the impact of policy changes, such as presumption laws, in shaping WC trends. Future research could examine cost differences across firefighter subgroups and assess the long-term impacts of presumption laws on compensation systems.

Practical Applications: Insights from this study provide fire departments and policymakers with critical data to prioritize prevention strategies for high cost injuries, such as overexertion and cancer-related conditions. Findings also support the development of policies and resource allocations aimed at improving firefighter safety.

Keywords

Occupational injury/illness; Surveillance; Cancer; Neoplasms; Economic burden; Firefighters; Workers' compensation

1. Introduction

Firefighters respond to many types of emergencies where they are responsible for public health and safety. Emergencies can include structural and wildland fires, motor-vehicle incidents, medical emergencies, and hazardous materials incidents. As such, firefighting is an inherently dangerous occupation that requires performing a large variety of tasks within often hazardous, highly variable, and unpredictable environments. Because of these demanding occupational circumstances, occupational injuries and illnesses are common among firefighters. Specifically, the National Fire Protection Association (NFPA) estimated, within their annual firefighter injury report, that over 60,000 line-of-duty injuries occurred in 2023 (Campbell & Shelby, 2024). The same report indicated that the majority of these injuries (45%) were characterized as strains, sprains, and muscular pain, followed by wounds, cuts, bleeding, and bruising, which made up 13% of the injuries (Campbell & Shelby, 2024). Other literature has described nonfatal firefighter injuries with similar results using data sources such as the National Electronic Injury Surveillance System occupational supplement (NEISS-Work) (Marsh et al., 2018); individual or small groups of fire department data (Poplin et al., 2012; Jahnke et al., 2013); and workers' compensation (WC) claims data (Quinn et al., 2023). Our research group characterized the frequency and rate of firefighter injuries among WC claims in Ohio that largely supported previous surveillance results (Quinn et al., 2023).

While the previous descriptive injury surveillance research is critical to focusing limited intervention program resources on highly prevalent injuries, the cost of injuries and illnesses remains an understudied but important component to guide intervention development. There are a variety of cost sources for occupational injuries/illnesses within the fire service, including medical treatment and rehabilitation, medical follow-up, lost time from work, legal and administrative fees, and in some cases long-term costs of disability and fatalities

(Anderson et al., 2023; Butry et al., 2019; Walton et al., 2003). A 2019 National Institute of Standards and Technology (NIST) report estimated that firefighter injuries cost $1.6–5.9 billion annually in the United States, which is roughly equivalent to $1,500–5,500 per firefighter per year (Butry et al., 2019). While these data provide some useful context, they are estimates based on NFPA reported injury counts matched to expected injury-related costs across all professions (Butry et al., 2019). A few other studies have summarized the cost of firefighter injuries more directly but were focused on limited samples that may not be generalizable to other firefighting populations. Anderson and colleagues analyzed firefighter claims from the Washington State WC system for 2006–2020 and determined that the mean cost of a lost-time case (generally 4 or more days away from work) was $46,318 (median $8,286) (Anderson et al., 2023). Walton and colleagues examined just over 1,300 WC claims from northeastern Illinois from 1992 to 1999 and concluded that the average total cost of injury per claim for both medical only and lost-time cases was $5,168 and the average total cost of an overexertion-related injury was $9,715 (Walton et al., 2003). Additionally, Frost et al. summarized the cost associated with 244 injuries in one large Canadian fire department over a one-year period (2012), concluding that the total cost of all injuries was $555,955 or an average of $2,279 per claim (Frost et al., 2016). The same analysis found that knee and back injuries were the most costly among all injury types (Frost et al., 2016). While these previous studies provide useful insight, they were limited, especially the latter two, to a small sample or were conducted many years ago.

To advance the understanding of the financial burden of firefighter WC claim costs, costs of medical care and costs for indemnity (partial wage replacement for temporary disability, or permanent disability), as well as actuarial reserves for future anticipated costs can be examined. To address this gap, the current study aims to describe and summarize the costs of WC claims among Ohio firefighters from 2001 to 2020. Because fatalities have been addressed in other studies, the current study focuses on disabling, nonfatal claims.

2. Methods

The National Institute for Occupational Safety and Health (NIOSH) and the Ohio Bureau of Workers' Compensation (OHBWC) have a formal agreement established to collaborate on research and surveillance efforts using the WC claims data within Ohio. As part of this agreement, NIOSH receives de-identified information about the claims from OHBWC, including claims data (claim type, occupation, demographics, diagnoses, narratives, and related costs) and policy holder denominator data.

2.1. Claim identification and study population

This study is an examination of WC claim costs among career and volunteer firefighters in Ohio from 2001 to 2020. The claims were identified and characterized by their type, causes, and occupational tasks in a previously published paper that described the methods of claim identification in detail (Quinn et al., 2023). The study population for this paper was selected through a series of steps. First, all claims from the previous paper (Quinn et al., 2023) for 2001 to 2017 were included. In short, these cases were identified using the following OHBWC-specific occupational codes: 5111 (Supervisors: Firefighting and Fire

Prevention Occupations), 5120 (Firefighting and Fire Prevention Occupations, Firefighters, Firemen), or 5122 (Fire Inspection and Fire Prevention Occupations). Following initial identification, claims outside of those occupational codes that included the text “fire” or “ff” in the occupation title were also included. Following this initial claim identification, the occupation title and injury narrative were manually reviewed by two independent researchers to verify that the claimants were indeed firefighters. Claims that were mutually agreed upon as not appearing to be firefighters were excluded. These same steps were followed to identify additional cases from 2018 to 2020 for the current study. Combining the 2001–2017 and 2018–2020 data identified in these processes resulted in an initial sample of n = 37,180 claims. A final step used the unique identifier for each injured firefighter included in the claims data to identify additional claims from 2001 to 2020 associated with previously identified firefighters that were not flagged in the previous steps. These cases were also manually reviewed by two independent researchers. This final step identified an additional n = 126 claims. Together, these steps resulted in a final analytic sample of n = 37,306 claims.

Both lost-time and medical-only claims were included in this analysis. Lost-time claims are defined as claims that involved indemnity payments for death, permanent disability or temporary disability (eight or more days away from work), while medical-only claims required seven or fewer days away or medical treatment only. As such, lost-time claims were generally considered to be of greater severity than medical-only, although that assumption may not always be valid. All compensable (not disallowed or dismissed) diagnoses as of October 4, 2024 were included in the current study.

2.2. Claim description variables

The included claims and associated costs are summarized by a variety of descriptive variables including claimant demographics (sex and age), events (e.g., struck by objects or equipment, overexertion involving outside sources, falls on the same level), diagnoses (e.g., back sprain, lower extremity sprain, burn), and the task the claimant was performing.

A “task” variable was added to all claims that categorized each claim into one of the following eight task categories: (1) firefighting, (2) patient care, (3) responding to a motor vehicle incident (MVI), including patient care, (4) training tasks, (5) physical fitness/exercise, (6) worker involved in an MVI, (7) long-term or repeated chronic exposure to firefighting hazards (musculoskeletal pain, hearing loss, cancer, etc.), and (8) other/unclear. The coding method for data in the initial study has been previously described (Quinn et al., 2023). In short, the task variable was manually coded and adjudicated using an initial random sample (n = 2,000) of claims by two independent researchers based on the narrative text. These initial claims were then used as a training set to create a machine-learning algorithm to auto-code the task for the remaining claims; auto-coded tasks with < 95% prediction confidence (74% of the original claims) were reviewed and checked for accuracy by two independent researchers (Quinn et al., 2023). All new cases identified for the current study were manually reviewed and checked for accuracy by two independent researchers.

The event for each claim was defined using the Occupational Injury and Illness Classification System (OIICS) version 2.01 (BLS). These events were originally assigned a two-digit OIICS event or exposure code based on the incident narrative and the diagnosis

of the claim using a previously used and described computer-assisted auto-coder developed by NIOSH (Bertke et al., 2016). This coding algorithm was improved in 2022 to use a Long Short-Term Memory (LSTM) deep learning algorithm (Meyers et al., 2022). While the previous paper (Quinn et al., 2023) used the older process to assign codes, the current analysis used the updated method. Two independent researchers conducted additional manual review on high-cost claims (≥95th percentile) and those with the lowest auto-coder probabilities (bottom 7%) to reach positive predictive values of 95% and 85% for 1-digit and 2-digit event/exposure codes, respectively (Meyers et al., 2022).

Diagnosis group(s) were assigned to each claim based on the compensable International Classification of Diseases – Clinical Modification (Version 9 and 10) diagnosis codes. All diagnoses were considered equally. In other words, there was not a principal diagnosis assigned for each claim. There were 57 diagnosis groups, including various traumatic injuries and disease diagnoses (Supplemental Table 1), as described by Meyers et al. (Meyers et al., 2025) For claims with multiple diagnoses in the same diagnosis group, each diagnosis group was only counted once.

Claims were described using six disability status categories as of December 2022: permanent total (PTD), permanent partial (PPD), permanent partial and temporary total (PPTTD), temporary total (TTD) disability, medical only, and death (Utterback et al., 2014). Information on medical only claims were excluded from analyses of the disability status category but was presented elsewhere. The 88 death claims, accounting for a total cost of $55,349 K and a mean cost per claim of $629 K, were excluded from analyses of the disability status category. PTD pertains to cases where an employee is permanently and entirely unable to engage in any form of gainful employment due to a work-related injury or illness. This category typically encompasses severe injuries or debilitating medical conditions. Individuals with PTD usually receive ongoing financial compensation and medical benefits. PPD describes situations where a worker sustains a permanent impairment or loss of bodily function as a result of a work-related incident. Unlike PTD, individuals categorized under PPD may still possess the ability to perform some work; however, their earning capacity may be reduced due to the enduring effects of their injuries. PPTTD combines elements of both permanent partial and temporary total disability. Workers in this category have experienced an injury or illness resulting in partial permanent impairment but also necessitating a temporary period of complete disability during their recovery. TTD encompasses situations where an employee is entirely unable to work for a temporary period due to a work-related injury or illness. This condition is often of a short-term nature, with the expectation that the worker will recover and resume their regular job duties once their medical condition improves.

2.3. Cost variables

For all claims, costs extracted by OHBWC were current through the second quarter of 2024; costs included payments for medical care and indemnity (partial wage replacement for temporary disability, permanent disability, and/or death) as well as actuarial reserves for future anticipated costs. OHBWC offers a salary continuation program where employers can continue to pay employees their salary for lost-time claims during periods where the

injured worker could have received TTD indemnity payments from OHBWC (Ohio Bureau of Workers Compensation Salary Continuation, 2024). Although these payments were by employers, OHBWC provided NIOSH with estimates of employer-provided TTD indemnity payments for employers in this program. There were 367 policies (out of 1,044 policies, 35%) that were part of the salary continuation program; there were 7,154 claims from these policies, with a mean cost of $12,342 per claim. To best represent the total cost of claims, these employer-paid indemnity costs were included in the cost analyses for this study. Some claims may have zero cost in the OHBWC database, which can occur if no medical treatment was provided (Ohio Bureau of Workers, 2024). For these reasons, per claim calculations were performed for total costs and total costs excluding zero cost claims (mean, median). While costs for claims, especially those highest in severity, are paid out over several years, inflation adjustments were not applied to cost data.

2.4. Analytic Approach

Descriptive analyses were used to calculate the frequency of claims by year, claimant demographic characteristics, task, events, and diagnosis groups. A ratio of the percentage of total costs over the percentage of total claims, which represents the proportion of costs relative to the number of claims, were calculated and presented. Therefore, a higher cost/claim ratio indicates a higher cost burden relative to the number of claims in that category. Descriptive analyses of costs and claim frequencies were stratified by type of claim (medical-only or lost-time) and claim severity (disability category).

During the study period, specifically in April of 2017, Ohio implemented a firefighter cancer presumption law (Michael Louis Palumbo, Jr. Act) (Palumbo, 2017). To explore possible early impact on the number of claims, a separate exploratory analysis was conducted for claims with any neoplasm diagnosis to describe annual trends in distribution (percent) of neoplasm claims: (1) between firefighters and non-firefighters, and (2) as a percentage of all OHBWC compensable diagnosis categories.

3. Results

There were 37,306 claims among Ohio firefighters from 2001 to 2020 totaling approximately $542 million dollars (Table 1). Males accounted for 94% of the total claims, which parallels the sex composition among firefighters (Fahy et al., 2022). Firefighters aged 35–44 had the highest percentage of claims (35%). However, firefighters aged 45–54 had the highest total costs ($212 million, 39%). The highest claim cost/count ratio was observed among ages 65+ (ratio = 2.8), reflecting the higher relative cost burden of claims in this age group compared to firefighters younger than 65. Aside from the other/unclear task category, claims were most frequent during firefighting activities (n = 7,452, 20%). However, the cost burden was highest among claims involving patient care activities ($97 million, 18%). The highest claim cost/count ratio was observed among cases involving long-term exposures, where the percent of the cost in that task category was almost 10 times higher than the percent of represented claims. Frequency of claims by event category found that claims were most frequently associated with overexertion involving outside sources (n = 10,088, 27%). The total cost of claims in that event category was also the highest at $176 million (33%).

However, the cost/count ratio was highest among cases associated with events involving exposure to other harmful substances (ratio = 3.1).

3.1. Lost-time versus medical-only claims

Table 2 provides a detailed comparison of claimant demographics and cost characteristics between lost-time and medical-only WC claims. Lost-time claims, indicating more severe injuries and illnesses, accounted for 13,573 with a total cost of $513 million, a mean cost of $37,776, and a median cost of $8,605. In contrast, medical-only claims, involving less severe injuries and illnesses that required seven or fewer days off work, totaled 23,733 with a considerably lower associated cost of $29 million, a mean cost of $1,235, and a median cost of $529. A consistent sex distribution was seen across both claim types, with males comprising most claimants (95% for lost-time and 93% for medical-only). By age group, those 25–34, 35–44, and 45–54 had the highest percentages of total lost-time and medical-only claims, although the order of these three percentages differed. While the highest total cost for medical-only claims was among those aged 35–44, the highest total cost for lost time claims was observed among those 45–54 years old ($206 million, 40%).

Task and event analyses illustrated the varying nature of firefighter tasks and related events. However, the distribution of claim frequency and costs across the types of tasks and events were largely similar across the two claim types (Table 2). For example, firefighting and patient care tasks were prominently represented across both claim types. Also, overexertion involving outside sources had the highest claim frequency and total cost for both lost-time and medical only claims.

3.2. Injury/Illness diagnoses

Table 3 presents costs for the most common diagnosis groups, including fatal claims. Of the 37,306 claims, 26,389 (71%) had a single diagnoses and 10,839 (29%) had multiple diagnoses (up to 25 per claim). For this reason, claim and cost counts in this table are not mutually exclusive as some claims were assigned to multiple diagnosis groups. Back sprains; disc disorders and spinal stenosis; and mental, behavioral and neurodevelopmental disorders, not elsewhere classified had the highest total cost for claims overall and among lost-time claims. Conversely, diagnoses such as open wounds and burns had lower total costs despite the relatively high proportion of claims represented. Furthermore, diseases of blood and blood forming organs; mental, behavioral and neurodevelopmental disorders, not elsewhere classified; and amputations, showed exceptionally high cost-to-claim ratios for all claims (ratio range = 40.6–51.9) and diseases of blood and bloodforming organs, amputations, and neoplasms showing exceptionally high cost-to-claim ratios for lost-time claims (ratio range = 11.7–16.8). Neoplasms had the highest cost-to-claim ratio (72.8) of all medical-only claims.

Fig. 1 presents neoplasm claims' frequency over time to provide context for the changing distribution of costs. Across all OHBWC claims during the study period, neoplasm claims were rare (0.01–0.05%) as a percentage of all distinct diagnosis groups (data not shown). Nonfirefighter neoplasm claims (N = 410) as a percentage of all OHBWC distinct diagnoses, has been relatively stable per year (0.01–0.02%) throughout the study period. As

mesothelioma claims declined (data not shown), the total number of neoplasm claims per year decreased from 2001 to 2012 then began increasing. Since 2017, we observed > 41 neoplasm claims per year, above the previous highest count from 2001; this trend coincided with the implementation of Ohio's firefighter cancer presumption law in April 2017. Across 20 years, we observed 149 firefighter neoplasm claims, including 36 fatalities [most (N = 20) fatalities occurred 2017–2020]. Prior to 2016, the percentage of neoplasm claims from firefighters was unstable, ranging from 0% in 2010 to 27% (N = 3) in 2008. Beginning in 2016, the pattern changed; firefighter neoplasm claims accounted for 48% (N = 11) of all neoplasm claims in 2016 and increased to 59% (N = 26) in 2020.

3.3. Disability category

Table 4 presents firefighter claims categorized by disability category (PTD, PPD, PPTTD, or TTD). A total of 197 PTD claims accounted for $121 million in costs (24% of total cost with a mean cost of $616,044 and median cost of $615,188 [data not shown]), highlighting the significant financial impact of the most severe injuries. In contrast, the 3,506 PPD claims had a lower cost of $34 million (7% of total cost with mean and median costs of $9,733 and $4,909, respectively [data not shown]). The PPTTD claims, which represent a combination of severity, were the second most frequently occurring with 4,201 claims but had the highest cost burden across all severity types with $222 million in total costs (43% of total cost), a mean cost of $52,904 and a median cost of $29,078 [data not shown]. TTD claims were the most frequent (n = 4,303) but incurred relatively lower costs of $73 million (14% of total cost, Table 4), and mean and median costs of $17,007 and $6,508, respectively [data not shown].

Like the overall distribution by sex, male firefighters accounted for most claims across all disability categories, with costs aligning closely to the distribution of total claims. Conversely, while female firefighters represented a small fraction of the total claims, they had higher cost to claim ratios in all four disability categories (ratios = 1.07, 1.05, 1.28, 1.79, respectively; Table 4). By age, claims were generally most frequent and had higher costs among those 35–44 and 45–54 years (Table 4). However, the cost/claim ratio reveals that injuries among younger firefighters (25–34 years) resulted in the highest cost burden relative to the number of claims for PTD. Conversely, firefighters 65 + years had the highest cost/claim ratio for PPD and PPTTD while firefighters 55–64 had the highest cost/claim ratio for TTD claims (Table 4).

Like the overall results, analyses by task and severity type indicated injuries that were incurred during patient care and firefighting activities were generally the most frequent and came with the highest costs, particularly for PTD, PPTTD, and TTD categories (Table 4). However, the highest cost/claim ratios among PPD, PPTTD, and TTD claims were observed for long-term exposure tasks (PPD ratio = 7.9, PPTTD ratio = 1.5, and TTD ratio = 11.5). These high ratios are likely reflective of the relatively low claim numbers in these disability categories. The least frequent event that had the highest associated cost/claim ratios was exposure to other harmful substances (PPD: n = 39, ratio = 7.3; PPTTD: n = 31, ratio = 1.8; and TTD: n = 118, ratio = 4.8) (Table 4). Supplemental Table 2 presents the claims by select diagnoses and disability category.

4. Discussion

In our study, the financial implications of occupational injuries/illnesses among firefighters in Ohio were investigated to address the gap in comprehensive analyses of the economic burdens these injuries impose. By analyzing claims data spanning from 2001 to 2020, this study illuminated the mean/median costs associated with these claims and offered insights into the injury and disease types that carry significant financial impacts. Our study observed a financial burden of $542 million across 37,306 firefighter claims.

Notably, injuries during patient care activities and overexertion involving outside sources were among the highest-cost claims, totaling ~$97 million and ~$176 million, respectively. The analysis also highlighted the disproportionate cost burden of injuries among firefighters in the middle age groups (35–44 and 45–54 years), who accounted for 32% and 39% of total costs, respectively, underscoring the importance of focused injury and disease prevention and management strategies in this demographic. Unsurprisingly, our findings suggest that more severe injuries and diseases (e.g., those resulting in lost-time or some form of disability) accounted for a disproportionately larger portion of the total costs compared to other, less severe, claims. This emphasizes the importance of effective prevention and rehabilitation strategies to mitigate these severe claims.

While the research examining the cost of claims in this worker population is limited, there are some analyses to which our results can be compared. The closest comparison can be made to the recent analysis of firefighter claims in Washington State by Anderson et al. (Anderson et al., 2023). Both studies found that claims caused by overexertion were the predominant injury/illness type among firefighters, with rates significantly higher than comparison groups. However, among those with 4 or more days away from work, Washington reported notably lower medical costs and time loss days for firefighters compared to other workers. The Ohio data in the current study were not compared directly with other worker populations, but we observed relatively higher costs for more severe claims like neoplasms and permanent disability cases among firefighters. One striking similarity was the sharp temporal impact of presumption laws. Washington saw increased PTSD claims after their 2019 law change (Anderson et al., 2023); similar to our observed spike in neoplasm claims following Ohio's 2017 cancer presumption legislation. The Washington analysis included valuable cost comparisons between state-fund and self-insured claims (Anderson et al., 2023) that our study lacked, though both studies were limited by incomplete cost data from self-insured employers.

Another important study for comparison is the 2003 study by Walton et al. from Northeastern Illinois, which reported a mean WC cost of $5168 per claim in the years 1992–1999 (Walton et al., 2003). This observed claim cost is significantly lower than the mean of $14,530 that we observed in our study (Walton et al., 2003). This discrepancy could be attributed to inflation, geographical cost differences, or variations in injury/illness severity. Moreover, a Canadian study by Frost et al. examining WC claims cost among firefighter injuries within Alberta in 2012 found the total cost of claims to be at least $555,955 with a high incidence of sprain/strain injuries (77%) (Frost et al., 2016). While direct comparison of the values is not appropriate due to the different population size and observation periods,

these results generally align with our observation that sprains and strains, particularly in the back and upper extremities, are major cost drivers in this working population.

The results of this study indicated a marked increase in firefighter neoplasm claims starting in 2016, with a sharp rise during 2017–2020. This increase appears to be directly related to the implementation of Ohio's firefighter cancer presumption law (Michael Louis Palumbo, Jr. Act) in April 2017 (Palumbo, 2017). The stability of non-firefighter neoplasm claims during this period suggests the increase was specific to firefighters rather than reflecting broader changes in cancer claim patterns. For occupational disease claims, Ohio allows a two-year filing window; therefore, claims with 2016 injury dates may have been filed after the law was passed (Ohio Bureau of Workers, 2025). While these data reflect the severity and high relative cost of neoplasms among firefighters, they also highlight the importance of focusing on the cumulative exposures to carcinogens to prevent cancer among firefighters. This study and future studies that quantify WC cost as well as the human burden may serve as a catalyst for change to identify and implement exposure reduction measures, wellness initiatives, routine physical examinations, and age-appropriate screenings to prevent or improve health outcomes for firefighters. In Ohio, one way that risks can be understood and addressed is the OHBWC Firefighter Exposure to Environmental Elements Grant (FEEEG) that can assist fire departments in minimizing or removing hazard sources found in firefighter environments, including but not limited to diesel exhaust and carcinogens on firefighter personal protective gear (FEEEG, 2025). In addition, the establishment of the National Firefighter Registry for Cancer by NIOSH in 2023 could help provide additional insights into cancer risk factors and trends among firefighters nationwide, complementing state-level WC data (Fent et al., 2020).

4.1. Strengths and Limitations

This study provided the first comprehensive analysis of WC claim costs among Ohio firefighters, including novel insights into worker and claims characteristics by disability categories and temporal trends in neoplasm claims following presumption law changes. The analysis of claim costs across tasks, events, diagnoses, and disability categories offers valuable data for targeting prevention efforts and allocating resources. The large sample size spanning 20 years and inclusion of both public and private firefighter claims strengthen the generalizability of findings.

Several limitations should also be noted. First, this analysis was limited to the WC data from a single state. There may be differences in the types and severity of injuries and illnesses that cannot be fully explained using data from a single state. Second, differentiation between volunteer and career firefighters was not possible in the dataset, potentially masking important differences in injury/illness patterns and costs between these groups. While the task categorization provided useful insights, many narratives were ambiguous or indicated multiple tasks, resulting in 46% being classified as "other/unclear." The analysis was limited to incidents severe enough to warrant WC claims, likely missing minor incidents handled through first aid or those incidents that went unreported. The study's external validity was limited by excluding self-insured employers in Ohio. Additionally, the analysis did not calculate rates due to lack of reliable denominator data for the firefighter

population, particularly volunteers. This prevented comparisons of injury/illness risk across demographic groups or over time. Lastly, while the analysis captured the early impact of Ohio's cancer presumption law for firefighter claims, longer-term cost implications may still emerge.

These limitations suggest opportunities for future research, particularly in examining differences between career and volunteer firefighters, gathering accurate workforce denominators, and evaluating long-term impacts of presumption laws on WC systems.

5. Conclusions

This analysis of Ohio firefighter WC claims from 2001 to 2020 revealed total costs of $542 million from 37,306 claims. Patient care and firefighting activities generated the highest costs, with overexertion injuries and neoplasms showing notably high cost-to-claim ratios. While medical-only claims were more frequent, lost-time claims accounted for the majority of costs, particularly those involving permanent disabilities. The sharp increase in neoplasm claims following Ohio's 2017 cancer presumption law demonstrates the significant impact of policy changes on WC costs. These findings provide critical data for targeting prevention efforts and resource allocation in the fire service, particularly for high-cost incidents related to patient handling and cancer prevention. Future research could focus on examining cost differences between career and volunteer firefighters and assessing long-term impacts of presumption laws on WC systems.

6. Practical Applications

The findings of this study offer actionable insights for improving firefighter safety and reducing the economic burden of occupational injuries and diseases. Fire departments can leverage these data to prioritize prevention strategies for high-cost injuries and diseases, such as safe patient handling protocols, ergonomic equipment use, and programs to mitigate chronic exposures. Additionally, the analysis provides a framework for evaluating the financial and health impacts of legislative changes like cancer presumption laws, supporting informed decision-making for resource allocation and policy development. These insights can guide efforts to enhance worker safety, reduce financial strain on compensation systems, and maintain operational readiness in fire services.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jsr.2025.10.017.

References

Anderson N, Marcum J, Bonauto D, Siegel M, & LaSee C (2023). The Relative Burden of Occupational Injuries and Illnesses in Firefighters: An Analysis of Washington Workers' Compensation Claims, 2006–2020. International Journal of Environmental Research Public Health., 20(22), 7077. https://www.mdpi.com/1660-4601/20/22/7077. [PubMed: 37998308]

Bertke SJ, Meyers A, Wurzelbacher S, Measure A, Lampl M, & Robins D (2016). Comparison of Methods for Auto-coding Causation of Injury Narratives. Accident Analysis & Prevention., 88, 117–123. https://www.sciencedirect.com/science/article/pii/S0001457515301573?via%3Dihub. [PubMed: 26745274]

Bureau of Labor Statics (BLS). Occupational Injury and Illness Classification manual. https://www.bls.gov/iif/oshoiics.htm.

Butry DT, Webb D, Gilbert S, & Taylor J (2019) The Economics of Firefighter Injuries in the United States. Technical Note (NIST TN), National Institute of Standards and Technology, Gaithersburg. 10.6028/NIST.TN.2078. Accessed February 28, 2024.

Campbell R, & Shelby H (2024). United States Firefighter Injuries in 2023. MA: National Fire Protection Association Quincy.

Fahy R, Evarts B, & Stein GP (2022). US Fire Department Profile 2020, supporting Tables. MA: National Fire Protection Association Quincy.

Ohio Bureau of Workers' Compensation Firefighter Exposure to Envrionmental Elements Grant (FEEEG). https://info.bwc.ohio.gov/for-employers/safety-services/safety-grants/feeeg. Accessed February 10, 2025.

Fent KW, Siegel M, Mayer A, Wilkinson A (2020). National Firefighter Registry (NFR) protocol. https://www.cdc.gov/niosh/docket/archive/pdfs/niosh-278/nfr-protocoldraftoct2020_508.pdf. Accessed March 19, 2025.

Frost D, Beach T, Crosby I, & McGill S (2016). The cost and distribution of Firefighter Injuries in a Large Canadian Fire Department. Work, 55(3), 497–504. https://journals.sagepub.com/doi/full/10.3233/WOR-162420. [PubMed: 27768003]

Jahnke S, Poston W, Haddock C, & Jitnarin N (2013). Obesity and Incident Injury among Career Firefighters in the Central United States. Obesity, 21(8), 1505–1508. https://onlinelibrary.wiley.com/doi/10.1002/oby.20436. [PubMed: 23512940]

Marsh SM, Gwilliam M, Konda S, Tiesman HM, & Fahy R (2018). Nonfatal Injuries to Firefighters Treated in U.S. Emergency Departments, 2003–2014. American Journal of Preventive Medicine, 55(3), 353–360. 10.1016/j.amepre.2018.04.051 [PubMed: 30031637]

Meyers AR, Bertke SJ, & Wurzelbacher SJ. (2022). Narrative Auto-coding Improvements Using Deep Neural Network Methods. Presented at: National Institute for Occupational Safety Health Center for Workers' Compensation Studies Meeting; December 2022; Cincinnati, OH.

Meyers AR, Schrader TN, Krieg E, Naber SJ, Tseng CY, Lampl MP, Chin B, & Wurzelbacher SJ (2025). Clinical Diagnosis groups developed to Bridge the ICD-9-CM to ICD-10-CM Coding transition and Monitor Trends in Workers' Compensation Claims — Ohio, 2011–2018. Journal of Safety Research., 92, 408–419. https://www.sciencedirect.com/science/article/pii/S0022437524002159?via%3Dihub. [PubMed: 39986860]

Ohio Bureau of Workers' Compensation bs0055,000 Medical-only Program. https://info.bwc.ohio.gov/for-employers/workers-compensation-coverage/rates-and-bonuses/15000-medical-only-program. Accessed February 28, 2024.

Ohio Bureau of Workers' Compensation Filing a Claim. https://info.bwc.ohio.gov/for-workers/claims/filing-a-claim. Accessed February 10, 2025.

Ohio Bureau of Workers' Compensation Salary Continuation. https://info.bwc.ohio.gov/for-employers/workers-compensation-claims/salary-continuation. Accessed February 28, 2024.

Patton T. (2017). Michael Louis Palumbo, Jr. Act.

Poplin GS, Harris RB, Pollack KM, Peate WF, & Burgess JL (2012). Beyond the Fireground: Injuries in the Fire Service. Injury Prevention., 18(4), 228–233. https://injuryprevention.bmj.com/content/18/4/228. [PubMed: 22117024]

Quinn TD, Marsh SM, Oldham K, Wurzelbacher SJ, & Naber SJ (2023). Workers' Compensation Injury Claims among Firefighters in Ohio, 2001–2017. Journal of Safety Research., 85, 147–156. https://www.sciencedirect.com/science/article/pii/S0022437523000142?via%3Dihub. [PubMed: 37330864]

Utterback DF, Meyers AR, & Wurzelbacher SJ (2014). Workers' Compensation Insurance: A Primer for Public Health. https://www.academia.edu/79374064/

Workers_compensation_insurance_a_primer_for_public_health. Accessed February 28, 2024.

Walton SM, Conrad KM, Furner SE, & Samo DG (2003). Cause, Type, and Workers' Compensation costs of Injury to Fire Fighters. American Journal of Industrial Medicine., 43(4), 454–458. https://onlinelibrary.wiley.com/doi/10.1002/ajim.10200. [PubMed: 12645102]

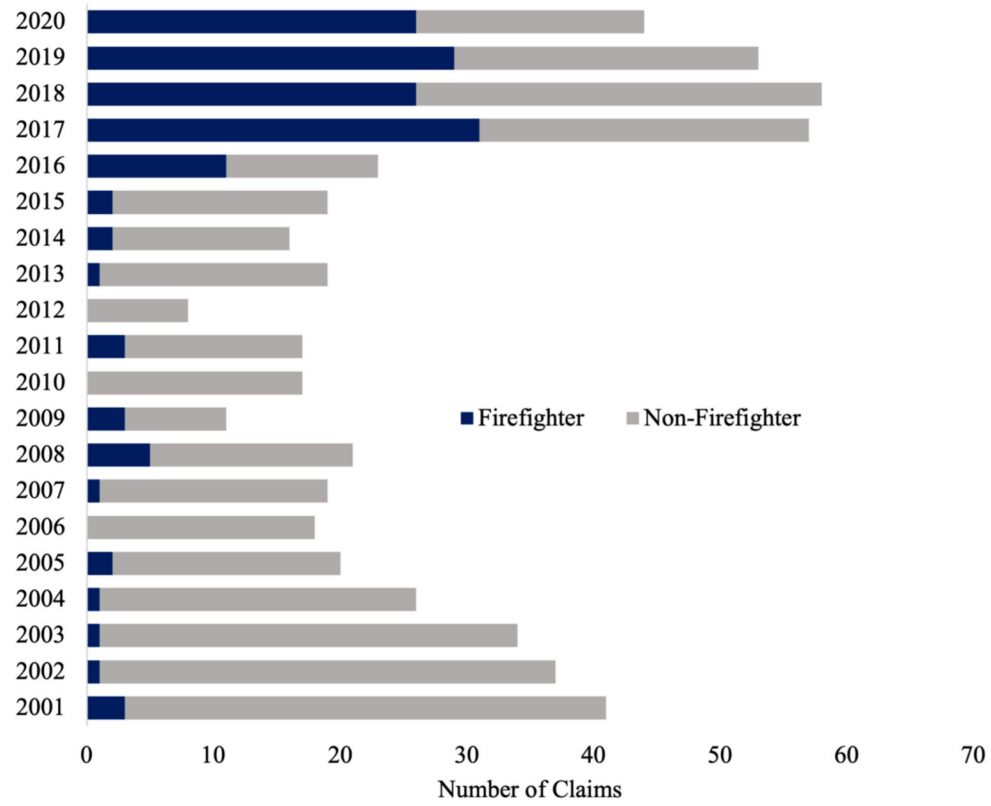

Fig. 1.

Distribution of claims with at least one neoplasm diagnosis by year among firefighters and non-firefighters, 2001–2020.

Table 1

Ohio firefighter industry workers' compensation total claims by demographics, and injury/illness characteristics 2001–2020.

Characteristic	N	% Total Claims (d)	Total Cost (e)	% Total Cost (d)	Ratio (Cost %/ Count %) (d)	Mean Cost	Median Cost	Mean Cost (Non-Zero)	Median Cost (Non-Zero)
Total	37,306	---	$542,036K	---	---	$14,530	$1,027	$14,862	$1,085
Sex									
Male	34,938	93.7	$508,740K	93.9	1.0	$14,562	$1,039	$14,890	$1,095
Female	2,199	5.9	$32,874K	6.1	1.0	$14,949	$944	$15,319	$990
Unknown	169	0.5	$422K	0.1	0.2	$2,498	$640	$2,655	$689
Age groups, in years									
<25	2,580	6.9	$7,563K	1.4	0.2	$2,931	$591	$3,029	$615
25-34	9,660	25.9	$65,827K	12.1	0.5	$6,815	$678	$6,995	$706
35-44	12,901	34.6	$173,147K	31.9	0.9	$13,421	$1,128	$13,707	$1,193
45-54	9,497	25.5	$212,487K	39.2	1.5	$22,374	$1,919	$22,787	$2,031
55-64	2,395	6.4	$72,383K	13.4	2.1	$30,223	$2,577	$30,920	$2,857
65+	265	0.7	$10,624K	2.0	2.8	$40,092	$3,583	$41,021	$3,935
Missing	8	0.0	$4K	0.0	0.0	$537	$418	$716	$519
Tasks (b)									
Firefighting	7,452	20.0	$78,876K	14.6	0.7	$10,584	$998	$10,758	$1,027
Patient care	6,594	17.7	$96,890K	17.8	1.0	$14,696	$1,250	$15,038	$1,348
Training	2,188	5.9	$27,483K	5.1	0.9	$12,561	$1,203	$12,807	$1,062
Physical fitness/exercising	1,427	3.8	$18,684K	3.5	0.9	$13,093	$1,909	$13,374	$2,015
Responding to an MVI	1,132	3.0	$12,134K	2.2	0.7	$10,719	$692	$10,961	$727
Worker involved in an MVI	839	2.3	$20,482K	3.8	1.7	$24,413	$1,452	$24,677	$1,518
Long term exposure	539	1.4	$77,319K	14.3	9.9	$143,449	$19,592	$147,837	$20,267
Other/unclear	17,135	46.0	$210,168K	38.8	0.8	$12,265	$918	$12,590	$975
Events (c)									
Overexertion involving outside sources (71)	10,088	27.0	$176,081K	32.5	1.2	$17,454	$2,309	$17,714	$2,395
Other exertions or bodily reactions (73)	3,416	9.2	$44,300K	8.2	0.9	$12,968	$1,997	$13,141	$2,074
Fires (31)	3,395	9.1	$32,056K	5.9	0.7	$9,442	$911	$9,563	$924
Struck by object or equipment (62)	3,322	8.9	$15,586K	2.9	0.3	$4,692	$555	$4,845	$577

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Characteristic	N	% Total Claims (d)	Total Cost (e)	% Total Cost (d)	Ratio (Cost %/ Count %) (d)	Mean Cost	Median Cost	Mean Cost (Non-Zero)	Median Cost (Non-Zero)
Falls on same level (42)	2,677	7.2	$35,205K	6.5	0.9	$13,151	$1,521	$13,417	$1,614
Slip or trip without fall (41)	2,258	6.1	$31,669K	5.8	1.0	$14,025	$1,881	$14,278	$1,960
Falls to lower level (43)	2,021	5.4	$43,251K	8.0	1.5	$21,401	$2,059	$21,767	$2,208
Struck against object or equipment (63)	1,849	5.0	$8,832K	1.6	0.3	$4,777	$567	$4,934	$581
Exposure to other harmful substances (55)	1,612	4.3	$72,051K	13.3	3.1	$44,697	$459	$48,389	$510
Roadway incidents (26)	1,366	3.7	$29,142K	5.4	1.5	$21,334	$1,228	$21,651	$1,286
Needlestick w/out exposure to harmful sub	918	2.5	$374K	0.1	0.0	$408	$361	$427	$374
Animal and insect related incidents	378	1.0	$299K	0.1	0.1	$791	$367	$835	$381
Bodily conditions, n.e.c,	272	0.7	$10,035K	1.9	2.5	$36,892	$1,512	$38,447	$1,594
Exposure to radition and noise	237	0.6	$3,710K	0.7	1.1	$15,653	$11,105	$15,719	$11,153
Jumps to lower level	103	0.3	$1,134K	0.2	0.8	$11,013	$1,960	$11,121	$2,082

Footnotes: (a) Lost-time claims are defined as being absent for more than 8 days of work due to some injury/illness, compensation is paid to worker under their medical insurance policy; Medical-only claims are claims in which an injury/illness requires attention from a healthcare provider, typically 0–7 days away from work. (b) Task claims were manually coded and defined by using the narrative text to identify the “task” that the claimant performed when the injury/illness occurred. (c) Based on the two-digit OIICS injury event codes classified by parentheses. (d) Except for % total claims for other/unclear tasks, the cell shading is representative of the top three values within each category (age, task, etc.) and column where a darker color indicates a higher value. (e) total cost presented as “as of” cost calculated with salary continuation. Abbreviations: MVI = motor vehicle incident.

Table 2

Ohio firefighter industry workers' compensation total claims by demographics, and injury/illness characteristics 2001–2020.

Characteristic	Lost-time claims					Medical-only claims				
	N	% Total Claims (f)	Total Cost (e)	% Total Cost (f)	Ratio (Cost %/ Count %) (d, f)	N	% Total Claims (f)	Total Cost (e)	% Total Cost (f)	Ratio (Cost %/ Count %)(d,f)
Total	13,573	---	$512,738K	---	---	23,733	---	$29.298K	---	---
Sex										
Male	12,849	94.7	$480,948K	93.8	1.0	22,089	93.1	$27,792K	94.9	1.0
Female	693	5.1	$31,491K	6.1	1.2	1,506	6.4	$1,383K	4.7	0.7
Unknown	31	0.2	$299K	0.1	0.3	138	0.6	$123K	0.4	0.7
Age groups, in years										
<25	354	2.6	$5,826K	1.1	0.4	2,226	9.4	$1,737K	5.9	0.6
25-34	2,398	17.7	$59,685K	11.6	0.7	7,262	30.6	$6,143K	21.0	0.7
35-44	5,035	37.1	$165,264K	32.2	0.9	7,886	33.1	$7,884K	26.9	0.8
45-54	4,552	33.5	$206,155K	40.2	1.2	4,945	20.8	$6,332K	21.6	1.0
55-64	1,150	8.5	$67,763K	13.2	1.6	1,245	5.3	$4,619K	15.8	3.0
65+	83	0.6	$8,043K	1.6	2.6	182	0.8	$2,581K	8.8	11.5
Missing	1	---	---	---	---	7	0.0	$3K	0.0	0.3
Tasks (b)										
Firefighting	2,343	17.3	$73,587K	14.4	0.8	5,109	21.5	$5,289K	18.1	0.8
Patient care	2,791	20.6	$93,378K	18.2	0.9	3,803	16.0	$3,512K	12.0	0.7
Training	710	5.2	$26,075K	5.1	1.0	1,478	6.2	$1,408K	4.8	0.8
Physical fitness/exercising	671	4.9	$17,790K	3.5	0.7	756	3.2	$893K	3.1	1.0
Responding to an MVI	336	2.5	$11,453K	2.2	0.9	796	3.4	$681K	2.3	0.7
Worker involved in an MVI	301	2.2	$19,821K	3.9	1.7	538	2.3	$661K	2.3	1.0
Long term exposure	311	2.3	$70,935K	13.8	6.0	228	1.0	$6,384K	21.8	22.7
Other/unclear	6,110	45.0	$199,699K	39.0	0.9	11,025	46.5	$10,469K	35,7	0.8
Events (c)										
Overexertion involving outside sources (71)	5,027	37.0	$169,963K	33.1	0.9	5,061	21.3	$6,117K	20.9	1.0
Other exertions or bodily reactions (73)	1,638	12.1	$42,306K	8.3	0.7	1,778	7.5	$1,994K	6.8	0.9
Fires (31)	870	6.4	$27,597K	5.4	0.8	2,525	10.6	$4,458K	15.2	1.4
Struck by object or equipment (62)	543	4.0	$13,721K	2.7	0.7	2,779	11.7	$1,864K	6.4	0.5

Characteristic	Lost-time claims					Medical-only claims				
	N	% Total Claims (f)	Total Cost (e)	% Total Cost (f)	Ratio (Cost %/ Count %) (d, f)	N	% Total Claims (f)	Total Cost (e)	% Total Cost (f)	Ratio (Cost %/ Count %)(d,f)
Falls on same level (42)	1,101	8.1	$33,286K	6.5	0.8	1,576	6.6	$1,919K	6.6	1.0
Slip or trip without fall (41)	1,068	7.9	$30,338K	5.9	0.8	1,190	5.0	$1,331K	4.5	0.9
Falls to lower level (43)	973	7.2	$41,931K	8.2	1.1	1,048	4.4	$1,319K	4.5	1.0
Struck against object or equipment (63)	386	2.8	$7,864K	1.5	0.5	1,463	6.2	$968K	3.3	0.5
Exposure to other harmful substances (55)	412	3.4	$69,661K	13.6	4.5	1,200	5.1	$2,390K	8.2	1.6
Roadway incidents (26)	459	3.4	$28,061K	5.5	1.6	907	3.8	$1,082K	3.7	1.0
Needlestick w/out exposure to harmful sub	4	0.0	$9K	0.0	---	914	3.9	$366K	1.2	0.3
Animal and insect related incidents	21	0.2	$117K	0.0	0.1	357	1.5	$182K	0.6	0.4
Bodily conditions, n.e.c.	73	0.5	$9,697K	1.9	3.5	199	0.8	$338K	1.2	1.4
Exposure to radition and noise	56	0.4	$1,378K	0.3	0.7	181	0.8	$2,332K	8.0	10.4
Jumps to lower level	44	0.3	$1,051K	0.2	0.6	59	0.2	$83K	0.3	1.1

Footnotes: (a) Lost-time claims are defined as being absent for more than 8 days of work due to some injury/illness, compensation is paid to worker under their medical insurance policy; Medical-only claims are claims in which an injury/illness requires attention from a healthcare provider, typically 0–7 days away from work. (b) Task claims were manually coded and defined by using the narrative text to identify the “task” that the claimant performed when the injury/illness occurred. (c) Based on the two-digit OIICS injury event codes classified by parentheses. (d) cells with no ratio reported were omitted from calculations due to small cell sample size (n < 5). (e) total cost presented as “as of” cost calculated with salary continuation. (f) Except for % total claims for other/unclear tasks, the cell shading is representative of the top three values within each category (age, task, etc.) and column where a darker color indicates a higher value. Abbreviations: MVI = motor vehicle incident.

Table 3

Ohio firefighter industry workers' compensation total, lost-time, and medical only claims by most common diagnosis group 2001–2020.

Diagnosis Group (b, c)	All claims			Lost-time claims (a)			Medical-only claims (a)		
	N	Total Cost (e)	Ratio (Cost %/ Count %) (d, f)	N	Total Cost (e)	Ratio (Cost %/ Count %) (d, f)	N	Total Cost (e)	Ratio (Cost %/ Count %) (d, f)
Sprains - back	7,812	$170,201K	2.2	3,807	$165,107K	1.1	4,005	$5,093K	1.0
Sprains - lower extremity except knee	6,344	$94,468K	1.5	2,975	$90,579K	0.8	3,369	$3,889K	0.9
Sprains – upper extremity	5,805	$123,736K	2.1	3,068	$120,121K	1.0	2,737	$3,616K	1.1
Contusion w/intact skin surface	5,234	$62,125K	1.2	1,474	$58,842K	1.1	3,760	$3,283K	0.7
Open wounds NEC	4,705	$18,623K	0.4	516	$16,122K	0.8	4,189	$2,501K	0.5
Soft tissue/enthesopathy	2,423	$106,106K	4.4	1,777	$104,736K	1.6	646	$1,371K	1.7
Other and unspecified	1,753	$16,948K	1.0	281	$15,375K	1.4	1,472	$1,572K	0.9
Disc disorders and spinal stenosis	1,661	$167,073K	10.1	1,477	$166,204K	3.0	184	$869K	3.8
Superficial injury	1,535	$12,361K	0.8	230	$11,533K	1.3	1,305	$828K	0.5
Knee sprain or tear	1,392	$41,389K	3.0	993	$40,522K	1.1	399	$867K	1.8
Burn	1,359	$8,637K	0.6	394	$8,092K	0.5	965	$545K	0.5
Musculoskeletal and connective tissue, NEC	1,271	$128,097K	10.1	1,176	$127,061K	2.9	95	$1,035K	8.8
Sprains - NEC	926	$7,991K	0.9	351	$7,406 K	0.6	575	$586K	0.8
Poisoning and toxic effects	902	$8,436K	0.9	86	$7,616K	2.3	816	$820K	0.8
Mental, behavioral & neurodev disorders, NEC	348	$152,470K	43.8	345	$152,458K	11.7	3	$12K	---
Neoplasms	149	$44,649K	29.9	108	$40,965K	10.0	41	$3,684K	72.8
Amputations	25	$10,154K	40.6	22	$10,150K	12.2	3	$4K	---
Diseases of blood & blood-forming organs (g)	11	$5,708	51.9	9	$5,706K	16.8	2	$2K	---
Death, cause unknown	8	$3,017K	37.7	8	$3,017K	10.0	0	---	---

Footnotes: (a) Lost-time claims are defined as being absent for more than 8 days of work due to some injury/illness, compensation is paid to worker under their medical insurance policy; Medical-only claims are claims in which an injury/illness requires attention from a healthcare provider, typically 0–7 days away from work. (b) distinct diagnosis groups, counted once per claim. (c) Based on ICD-9 and ICD-10 codes. (d) cells with no ratio reported were omitted from calculations due to small cell sample size (n < 5). (e) total cost presented as "as of" cost calculated with salary continuation. (f) the cell shading is representative of the top three values within each category and column where a darker color indicates a higher value. (g) includes thrombocytopenia, anemias, elevated white blood cell count, lymphadenitis, and hypercoagulable state. Abbreviations: NEC = not elsewhere classifiable.

Table 4

Firefighter claim counts and as of costs by disability category (f).

Characteristic	Permanent Total Disability			Permanent Partial Disability			Permanent Partial & Temporary Total Disability			Temporary Total Disability		
	N	Total Cost (g)	Ratio (a, b)	N	Total Cost (g)	Ratio (a, b)	N	Total Cost (g)	Ratio (a, b)	N	Total Cost (g)	Ratio (a, b)
Total	197	$121,361K	---	3,506	$34,113K	---	4,201	$222,248K	---	4,303	$72,741K	---
Sex (c)												
Male	191	$117,421K	1.00	3,339	$32,380K	1.00	3,980	$207,491K	0.99	4,043	$65,227K	0.95
Female	6	$3,940K	1.07	159	$1,624K	1.05	216	$14,660K	1.28	246	$7,423K	1.79
Age groups, in years												
<25	0	---	---	52	$357K	0.71	60	$3,380K	1.06	183	$1,779K	0.58
25-34	9	$8,630K	1.56	584	$4,963K	0.87	555	$27,765K	0.95	981	$14,473K	0.87
35-44	37	$29,366K	1.29	1,274	$11,899K	0.96	1,662	$88,507K	1.01	1,625	$23,862K	0.87
45-54	108	$60,526K	0.91	1,279	$12,035K	0.97	1,544	$81,281K	1.00	1,203	$25,315K	1.24
55-64	39	$20,039K	0.83	302	$4,617	1.57	369	$20,436K	1.05	298	$7,064K	1.40
65+	4	$2,800K	---	14	$240K	1.76	11	$880K	1.51	13	$247K	1.12
Tasks (d)												
Firefighting	24	$16,052K	1.09	604	$5,227K	0.89	700	$36,231K	0.98	765	$11,387K	0.88
Patient care	31	$19,601K	1.03	769	$7,748K	1.04	905	$50,637K	1.06	893	$14,713K	0.97
Training	10	$7,804K	1.27	159	$1,464K	0.95	222	$12,849K	1.09	258	$3,756K	0.86
Physical fitness/exercising	6	$2,241K	0.61	195	$1,938K	1.02	231	$9,700K	0.79	182	$2,508K	0.82
Responding to an MVI	6	$3,063K	0.83	77	$532K	0.71	111	$5,470K	0.93	98	$1,055K	0.64
Worker involved in an MVI	13	$9,378K	1.17	111	$1,336K	1.24	99	$6,896K	1.32	66	$1,399K	1.25
Long term exposure	30	$16,481K	0.89	36	$2,779K	7.93	36	$2,894K	1.52	48	$9,333K	11.50
Other/unclear	77	$46,740K	0.99	1,555	$13,091K	0.87	1,897	$97,572K	0.97	1,993	$28,590K	0.85
Events (e)												
Overexertion involving outside sources (71)	65	$41,040K	1.02	1,432	$13,977K	1.00	1,690	$91,013K	1.02	1,494	$22,727K	0.90
Other exertions or bodily reactions (73)	15	$7,306K	0.79	352	$2,723K	0.79	553	$23,211K	0.79	567	$7,597K	0.79
Fires (31)	9	$6,791K	1.22	203	$1,767K	0.89	231	$10,782K	0.88	307	$3,263K	0.63
Struck by object or equipment (62)	4	$4,152K	---	165	$938K	0.58	122	$6.318K	0.98	193	$1,613K	0.49
Falls on same level (42)	14	$5,203K	0.60	281	$2,706K	0.99	349	$19,032K	1.03	374	$5,825K	0.92
Slip or trip without fall (41)	13	$5,652K	0.71	246	$1,976K	0.83	370	$16,979K	0.87	351	$5,522K	0.93

Characteristic	Permanent Total Disability			Permanent Partial Disability			Permanent Partial & Temporary Total Disability			Temporary Total Disability		
	N	Total Cost (g)	Ratio (a, b)	N	Total Cost (g)	Ratio (a, b)	N	Total Cost (g)	Ratio (a, b)	N	Total Cost (g)	Ratio (a, b)
Falls to lower level (43)	16	$12,053K	1.22	219	$1,855K	0.87	330	$18,252K	1.05	340	$8,385K	1.46
Struck against object or equipment (63)	2	$1,986K	---	128	$832K	0.67	88	$4,021K	0.86	117	$933K	0.47
Exposure to other harmful substances (55)	28	$16,107K	0.93	39	$2,773K	7.31	31	$2,900K	1.77	118	$9,664K	4.84
Roadway incidents (26)	16	$11,113K	1.13	153	$1,765K	1.19	158	$11,105K	1.33	108	$2,063K	1.13

Footnotes: (a) ratio presented is the percentage of total cost represented by the category divided by the percentage of total claims represented by the category. A higher ratio value indicates a higher cost relative to the amount of claims in the category. (b) Except for % total claims for other/unclear tasks, the cell shading is representative of the top three values within each category (age, task, etc.) and column where a darker color indicates a higher value. (c) the category of unknown sex was omitted due to low sample size (n = 13). (d) Task claims were manually coded and defined by using the narrative text to identify the “task” that the claimant performed when the injury/illness occurred. (e) Based on the two-digit OIICS injury event codes classified by parentheses. (f) medical only and death disability categories were omitted from this table. (g) total cost presented as “as of” cost calculated with salary continuation. Abbreviations: MVI = motor vehicle incident.