Safety and Health at Work 11 (2020) 165–172

Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.net

Original Article

Using Workers' Compensation Claims Data to Describe Nonfatal Injuries among Workers in Alaska

Devin L. Lucas*, Jennifer R. Lee, Kyle M. Moller, Mary B. O'Connor, Laura N. Syron, Joanna R. Watson

National Institute for Occupational Safety and Health, Western States Division, USA

ARTICLE INFO

Article history:
Received 8 August 2019
Received in revised form
3 January 2020
Accepted 11 January 2020
Available online 21 February 2020

Keywords:
Alaska
Occupational injuries
Workers' compensation

ABSTRACT

Background: To gain a better understanding of nonfatal injuries in Alaska, underutilized data sources such as workers' compensation claims must be analyzed. The purpose of the current study was to utilize workers' compensation claims data to estimate the risk of nonfatal, work-related injuries among occupations in Alaska, characterize injury patterns, and prioritize future research.

Methods: A dataset with information on all submitted claims during 2014–2015 was provided for analysis. Claims were manually reviewed and coded. For inclusion in this study, claims had to represent incidents that resulted in a nonfatal acute traumatic injury, occurred in Alaska during 2014–2015, and were approved for compensation.

Results: Construction workers had the highest number of injuries (2,220), but a rate lower than the overall rate (34 per 1,000 construction workers, compared to 40 per 1,000 workers overall). Fire fighters had the highest rate of injuries on the job, with 162 injuries per 1,000 workers, followed by law enforcement officers with 121 injuries per 1,000 workers. The most common types of injuries across all occupations were sprains/strains/tears, contusions, and lacerations.

Conclusion: The successful use of Alaska workers' compensation data demonstrates that the information provided in the claims dataset is meaningful for epidemiologic research. The predominance of sprains, strains, and tears among all occupations in Alaska indicates that ergonomic interventions to prevent overexertion are needed. These findings will be used to promote and guide future injury prevention research and interventions.

1. Introduction

Scientific research on nonfatal work-related injuries in Alaska has lagged behind efforts to understand and prevent fatalities. Work-related injuries have been documented as a public health concern in Alaska since the 1980s, when government and academic researchers began publishing reports describing elevated risks of fatal injuries among workers in the state [1–3]. During the 1980s, the risk of dying on the job in Alaska was seven times higher than in the rest of the United States (US) [4]. During the following two decades (1990–2009), extensive efforts by government agencies, industry leaders, nongovernmental organizations, and other stakeholders contributed to substantial reductions in the rate of work-related fatalities [5]. By 2017, the fatality rate in Alaska was three times higher than the US rate, at 10.2 deaths per 100,000 workers, compared with the US rate of 3.5 deaths per 100,000 workers [6]. This decrease in the occupational fatality rate in Alaska is remarkable, although efforts to further protect workers must continue.

Work-related injuries range in severity from minor (e.g., bruise not requiring medical attention) to nonsurvivable (e.g., decapitation). Injuries that result in death are understandably the highest priority for prevention, and action to further reduce fatalities in Alaska is needed. However, nonfatal injuries are also important to recognize and prevent. Nonfatal injuries can result in life-altering disabilities, lost income, chronic pain, and ongoing medical costs, all resulting in lowered quality of life [7,8]. Not all nonfatal injuries are severe with life-long consequences, but even less-serious injuries can result in lost work time, lower productivity, and high medical costs. Studying and mitigating workplace hazards that

* Corresponding author. 4230 University Drive Suite 310, Anchorage, AK, 99508, USA.
E-mail address: dlucas@cdc.gov (D.L. Lucas).

2093-7911/$ – see front matter
https://doi.org/10.1016/j.shaw.2020.01.004

cause frequent minor injuries can also prevent more severe injuries caused by the same hazards in slightly different conditions [9].

The earliest research on nonfatal injuries among workers in Alaska was published in 1998, and used data from the Alaska Trauma Registry to produce the first epidemiologic profile of work-related injuries in Alaska [10]. The study found that during 1991–1995, 2,384 serious injuries requiring hospitalization occurred to workers in Alaska. The industries with the highest number of serious injuries during the five-year period were commercial fishing (390), construction (365), and logging (215). The highest rates of serious injuries were in logging (25 per 1,000 workers), water transportation (13 per 1,000 workers), and wood product manufacturing (9 per 1,000 workers). The study concluded that the Alaska Trauma Registry was useful for estimating and comparing serious injury rates among industries, monitoring trends, and prioritizing injury prevention activities.

The Alaska Trauma Registry has several strengths and weaknesses as a source of data for nonfatal work-related injuries. One advantage is it captures good quality medical data on all trauma patients admitted to all hospitals in Alaska. This provides data that can be used to describe serious injuries that occur to all workers, regardless of the industry, employer, or work arrangement (such as self-employed or contract). The major limitation of this data source is only injuries resulting in hospitalization are included, excluding a vast array of injuries to persons who are treated and released from emergency departments, medical clinics, and worksites.

Since 1998, several other studies have also used the Alaska Trauma Registry to explore nonfatal injuries at work. These additional studies focused on understanding nonfatal injuries caused by specific hazards, such as cold-related injuries [11] and animal-related injuries [12]. Other studies used the trauma registry to describe serious injuries in certain industries such as commercial fishing [13], construction [14], logging [15], and aviation [16]. All of these studies are useful for providing some information about the burden of serious nonfatal injuries in certain groups of workers, but miss the larger burden of injuries that may not result in hospitalization and inclusion in the trauma registry.

To gain a broader understanding of the burden and characteristics of nonfatal injuries in Alaska than is possible by analyzing trauma registry data, other sources of data must be accessed and analyzed. One source of injury data that has been successfully utilized for occupational injury research in other states is the workers' compensation claims system [17]. Workers' compensation claims systems are state-based; but collectively are the largest source of occupational injury data in the United States, covering an estimated 90% of US wage and salary workers [17]. Even so, data generated from workers' compensation claims systems are an underutilized resource for occupational injury research, likely due to many barriers in accessing the data, which vary from state to state [17]. This challenge is reflected in Alaska, where as of this writing, only one study on occupational safety and health has been published using the state's workers' compensation data, and the study was limited to the seafood processing industry [33].

In Alaska, the State Division of Workers' Compensation is charged with administering the Alaska Workers' Compensation Act, which requires employers or their insurance carriers to pay for injured or ill employees' work-related medical, disability, and reemployment benefits [18]. Most workers in Alaska are covered by the state-based workers' compensation system, including those working for private employers, state government agencies, and local governments. Certain workers are not covered by the Alaska Workers' Compensation system, including those who are self-employed or work for the military, federal government, or maritime sectors.

Employers in the Workers' Compensation system must report to the Division an employee's death, injury, disease, or infection arising out of and in the course of employment [19]. These reports provide a rich source of information for injury research. The purpose of the present study was to utilize workers' compensation claims data to estimate and compare the risk of nonfatal, work-related, acute traumatic injuries among occupations in Alaska, characterize the injury patterns within occupations, and prioritize future injury prevention research.

2. Materials and methods

2.1. Data source and measures

A Memorandum of Understanding and Data Use Agreement were formed between the National Institute for Occupational Safety and Health (NIOSH) and the State of Alaska Division of Workers' Compensation to facilitate the sharing and analysis of claims data. In February 2017, a data set with information on all submitted claims originating from the employer's First Report of Injury during 2014–2015 was provided to NIOSH for analysis.

The claims data set contained an array of variables describing each claim, including demographic characteristics of the claimant (age, sex, residence city, industry, and occupation), and claim characteristics (date of incident, location, cause of incident, and narrative description). Many variables were formatted as freeform text fields, such as the claimant's occupation and residence city, rather than numerically coded data. One of several exceptions was the claimant's industry, which was coded with the North American Industry Classification System.

The claims data set did not include key elements of coded data from standardized classification systems commonly used in occupational injury research, such as the Occupational Injury and Illness Classification System (OIICS) [20] and Standard Occupational Classification (SOC) [21]. However, the data set did include information in freeform text and other fields that enabled the coding of data with the desired classification systems. Using this information, all claims were manually reviewed and coded with OIICS nature of injury, body part affected, event/exposure resulting in injury, and source of injury. Each claimant's occupation was coded with SOC by the NIOSH Industry and Occupation Computerized Coding System (NIOCCS) [22]. The system successfully auto coded 88% of cases with SOC, and the remaining cases were manually coded. NIOCCS produces a confidence score for each code and generates a list of cases for "suggested review." Those cases marked as "suggested review" were all manually checked for accuracy, as well as a random selection of 10% of the auto coded cases regardless of their confidence score. Additional manual coding was completed to categorize each incident's geographic economic region as defined by the State of Alaska [23].

2.2. Case definition

For inclusion in this study, claims had to represent incidents that resulted in a nonfatal acute traumatic injury, occurred in Alaska during 2014–2015, and were approved for compensation. An acute traumatic injury was defined as "any wound or damage to the body resulting from acute exposure to energy… caused by a specific event or incident within a single workday or shift" [24]. This case definition was operationalized by restricting the analysis to claims coded in Division 1 "Traumatic Injuries and Disorders" of OIICS Nature of Injury, which defines traumatic injuries the same way as referenced previously. As such, musculoskeletal injuries and illnesses of a cumulative nature (e.g., repetitive motion injuries) and

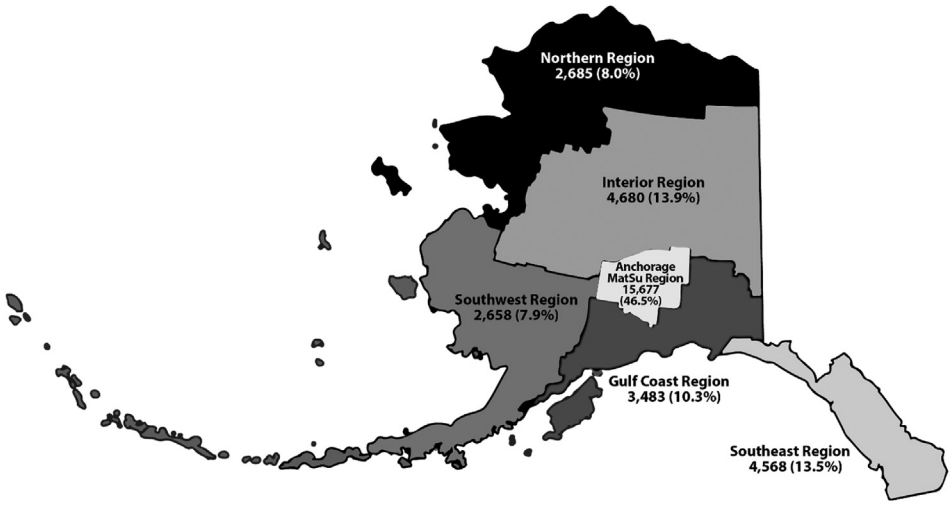

Fig. 1. Geographic distribution of injuries during 2014–2015.

noise-induced hearing loss were excluded from this study, as were illnesses and claims for potential exposures that did not result in injury or illness (e.g., medical testing for infectious disease such as tuberculosis).

2.3. Analysis

To identify injury patterns and describe characteristics in the data, descriptive statistics such as frequency and percent distributions, cross-tabulations, and measures of central tendency and dispersion were calculated in Stata version 14.2. To calculate rates of injuries among occupation groups, we utilized worker count data from the Alaska Department of Labor and Workforce Development's Research and Analysis Section [25]. Injury rates were calculated using occupation groups at the three-digit level of the SOC hierarchy, to identify and compare injury risk among specific occupations.

3. Results

The workers' compensation data set contained 38,111 claims submitted for incidents that occurred during 2014–2015. We excluded 40 claims for fatal incidents, 446 claims that were denied, 500 claims that occurred outside of Alaska, and 2,892 claims for illnesses, musculoskeletal injuries/illnesses of a cumulative nature, and other incidents that did not result in acute traumatic injuries. After applying these exclusion criteria, 34,233 injuries met the case definition for this study.

Table 1
Occupations with highest number and rate of injuries during 2014–2015*

SOC†	Rank	Occupation title	2-yr total workers	2-yr total injuries	Rate (injuries per 1,000 workers)
Occupations with highest rate of injuries					
332	1	Fire fighting and prevention workers	3,443	559	162
333	2	Law enforcement workers	6,929	836	121
331	3	Supervisors of protective service workers	1,386	131	95
311	4	Nursing, psychiatric, and home health aides	10,475	913	87
519	5	Other production occupations	8,300	685	83
454	6	Forest, conservation, and logging workers	1,210	99	82
511	7	Supervisors of production workers	1,951	129	66
392	8	Animal care and service workers	1,472	96	65
411	9	Supervisors of sales workers	7,182	440	61
512	10	Assemblers and fabricators	1,354	75	55
Occupations with highest number of injuries					
472	1	Construction trades workers	66,004	2,220	34
513	2	Food processing workers	46,447	1,710	37
537	3	Material moving workers	36,892	1,527	41
372	4	Building cleaning and pest control workers	38,154	1,337	35
291	5	Health diagnosing and treating practitioners	25,130	1,122	45
533	6	Motor vehicle operators	27,544	1,047	38
352	7	Cooks and food preparation workers	34,782	1,031	30
499	8	Other installation, maintenance, and repair occupations	26,488	940	35
252	9	Preschool, primary, secondary, and special education school teachers	22,885	915	40
311	10	Nursing, psychiatric, and home health aides	10,475	913	87

* Excludes claims for fatal injuries, illnesses, exposure-only incidents, extraterritorial incidents, and claims missing data on occupation.
† Standard Occupational Classification (3-digit level).

Table 2
Types of acute traumatic injuries among broad occupational groups in Alaska during 2014–2015*

Types of acute traumatic injuries†	Transportation, material moving	Production	Construction, extraction	Office, admin support	Food preparation, serving	Installation, maintenance, repair	Health practitioners, technicians	Protective services	Building, grounds cleaning, maintenance	Sales	Education, training library	Health care support	Personal care, service	Management	Business, financial operations	Science	Community, social service	Architecture, engineering	Farming, fishing, forestry	Arts, design, entertain, sports, media	Computer, math	Legal	Total with known occupation‡
	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %
Sprains, strains, tears	1451 *50.8*	1213 *44.8*	997 *42.2*	1028 *51.6*	521 *29.2*	721 *44.7*	641 *40.3*	728 *51.0*	644 *45.5*	641 *46.0*	507 *39.2*	523 *46.0*	449 *48.8*	438 *52.1*	151 *43.6*	144 *42.0*	171 *51.0*	100 *47.6*	71 *44.7*	43 *34.1*	26 *41.3*	24 *51.1*	11,232 *45.0*
Contusions	468 *16.4*	561 *20.7*	281 *11.9*	381 *19.1*	242 *13.5*	228 *14.1*	233 *14.7*	187 *13.1*	221 *15.6*	298 *21.4*	415 *32.0*	179 *15.8*	180 *19.6*	153 *18.2*	93 *26.9*	55 *16.0*	87 *26.0*	35 *16.7*	25 *15.7*	25 *19.8*	11 *17.5*	7 *14.9*	4365 *17.5*
Lacerations	385 *13.5*	380 *14.0*	425 *18.0*	241 *12.1*	599 *33.5*	338 *21.0*	114 *7.2*	137 *9.6*	216 *15.3*	240 *17.2*	124 *9.6*	103 *9.1*	73 *7.9*	86 *10.2*	48 *13.9*	56 *16.3*	17 *5.1*	32 *15.2*	28 *17.6*	26 *20.6*	11 *17.5*	8 *17.0*	3687 *14.8*
Punctures	92 *3.2*	83 *3.1*	154 *6.5*	53 *2.7*	20 *1.1*	52 *3.2*	403 *25.3*	85 *6.0*	93 *6.6*	48 *3.4*	60 *4.6*	201 *17.7*	86 *9.3*	28 *3.3*	10 *2.9*	20 *5.8*	16 *4.8*	9 *4.3*	11 *6.9*	6 *4.8*	3 *4.8*	1 *2.1*	1534 *6.1*
Fractures	162 *5.7*	123 *4.5*	166 *7.0*	90 *4.5*	44 *2.5*	80 *5.0*	34 *2.1*	48 *3.4*	59 *4.2*	36 *2.6*	56 *4.3*	11 *1.0*	41 *4.5*	52 *6.2*	16 *4.6*	14 *4.1*	11 *3.3*	10 *4.8*	8 *5.0*	10 *7.9*	2 *3.2*	3 *6.4*	1076 *4.3*
Other traumatic injuries	47 *1.6*	58 *2.1*	68 *2.9*	32 *1.6*	29 *1.6*	34 *2.1*	20 *1.3*	45 *3.2*	28 *2.0*	23 *1.7*	10 *0.8*	9 *0.8*	18 *2.0*	18 *2.1*	9 *2.6*	15 *4.4*	9 *2.7*	6 *2.9*	2 *1.3*	4 *3.2*	1 *1.6*	1 *2.1*	486 *1.9*
Toxic or allergenic effects	40 *1.4*	45 *1.7*	40 *1.7*	31 *1.6*	20 *1.1*	27 *1.7*	39 *2.5*	97 *6.8*	30 *2.1*	14 *1.0*	13 *1.0*	10 *0.9*	5 *0.5*	11 *1.3*	4 *1.2*	15 *4.4*	1 *0.3*	0 *0.0*	0 *0.0*	2 *1.6*	1 *1.6*	0 *0.0*	445 *1.8*
Thermal burns	27 *0.9*	64 *2.4*	30 *1.3*	19 *1.0*	201 *11.2*	19 *1.2*	5 *0.3*	12 *0.8*	10 *0.7*	13 *0.9*	4 *0.3*	10 *0.9*	7 *0.8*	10 *1.2*	0 *0.0*	7 *2.0*	1 *0.3*	3 *1.4*	1 *0.6*	1 *0.8*	0 *0.0*	0 *0.0*	444 *1.8*
Abrasions	31 *1.1*	30 *1.1*	54 *2.3*	33 *1.7*	8 *0.4*	32 *2.0*	38 *2.4*	25 *1.8*	23 *1.6*	16 *1.1*	52 *4.0*	35 *3.1*	25 *2.7*	6 *0.7*	3 *0.9*	6 *1.7*	6 *1.8*	1 *0.5*	3 *1.9*	2 *1.6*	3 *4.8*	1 *2.1*	433 *1.7*
Concussions	29 *1.0*	15 *0.6*	16 *0.7*	25 *1.3*	19 *1.1*	9 *0.6*	11 *0.7*	12 *0.8*	8 *0.6*	16 *1.1*	27 *2.1*	8 *0.7*	17 *1.8*	14 *1.7*	4 *1.2*	1 *0.3*	5 *1.5*	2 *1.0*	1 *0.6*	7 *5.6*	3 *4.8*	1 *2.1*	250 *1.0*
Dislocations	33 *1.2*	29 *1.1*	34 *1.4*	22 *1.1*	14 *0.8*	14 *0.9*	6 *0.4*	15 *1.1*	13 *0.9*	6 *0.4*	17 *1.3*	7 *0.6*	9 *1.0*	9 *1.1*	2 *0.6*	3 *0.9*	4 *1.2*	2 *1.0*	3 *1.9*	0 *0.0*	1 *1.6*	0 *0.0*	243 *1.0*
Acute dermatitis	19 *0.7*	40 *1.5*	26 *1.1*	9 *0.5*	28 *1.6*	7 *0.4*	27 *1.7*	11 *0.8*	29 *2.1*	12 *0.9*	2 *0.2*	19 *1.7*	4 *0.4*	3 *0.4*	3 *0.9*	2 *0.6*	0 *0.0*	1 *0.5*	1 *0.6*	0 *0.0*	0 *0.0*	0 *0.0*	243 *1.0*
Chemical burns	24 *0.8*	17 *0.6*	17 *0.7*	10 *0.5*	27 *1.5*	12 *0.7*	11 *0.7*	21 *1.5*	22 *1.6*	17 *1.2*	5 *0.4*	17 *1.5*	2 *0.2*	1 *0.1*	2 *0.6*	2 *0.6*	6 *1.8*	3 *1.4*	1 *0.6*	0 *0.0*	0 *0.0*	0 *0.0*	217 *0.9*
Traumatic hernias	37 *1.3*	34 *1.3*	33 *1.4*	10 *0.5*	10 *0.6*	24 *1.5*	3 *0.2*	4 *0.3*	12 *0.8*	10 *0.7*	3 *0.2*	1 *0.1*	2 *0.2*	8 *1.0*	0 *0.0*	1 *0.3*	1 *0.3*	5 *2.4*	4 *2.5*	0 *0.0*	0 *0.0*	0 *0.0*	202 *0.8*
Amputations, avulsions	13 *0.5*	17 *0.6*	23 *1.0*	9 *0.5*	5 *0.3*	15 *0.9*	5 *0.3*	0 *0.0*	6 *0.4*	3 *0.2*	0 *0.0*	3 *0.3*	2 *0.2*	4 *0.5*	1 *0.3*	2 *0.6*	0 *0.0*	1 *0.5*	0 *0.0*	0 *0.0*	1 *1.6*	1 *2.1*	111 *0.4*
Total with known injury type	2858 *100.0*	2709 *100.0*	2364 *100.0*	1993 *100.0*	1787 *100.0*	1612 *100.0*	1590 *100.0*	1427 *100.0*	1414 *100.0*	1393 *100.0*	1295 *100.0*	1136 *100.0*	920 *100.0*	841 *100.0*	346 *100.0*	343 *100.0*	335 *100.0*	210 *100.0*	159 *100.0*	126 *100.0*	63 *100.0*	47 *100.0*	24,968 *100.0*

* Excludes claims for fatal injuries, illnesses, exposure-only incidents, extraterritorial incidents, and claims missing data on occupation or cause of injury.
† Occupational Injury and Illness Classification System (OIICS), Nature of Injury Code.
‡ Standard Occupational Classification (SOC), 2-digit level.

The average age of injured workers was 40.3 years (13 to 95 years). At the youngest and oldest margins of the age distribution, workers under age 20 years had 1,140 injuries (3.3%), and workers over age 65 years had 714 (2.1%) injuries. More injuries occurred to males (61.8%) than females (38.2%). Alaska residents experienced 87.4% of injuries. Of the 4,292 non-Alaska residents, 2,071 (48%) were from Washington State. Among the six major economic regions of Alaska, most injuries occurred in the Anchorage/Matanuska-Susitna region followed by the Interior (Fig. 1).

Construction workers had the highest number of injuries during 2014–2015 (2,220), but a rate lower than the overall rate (34 per 1,000 construction workers, compared with 40 per 1,000 workers overall) (Table 1). Food processing workers, comprised almost entirely of seafood processing workers, had the second highest number of injuries (1,710), and a similar injury rate to the overall rate (37 per 1,000 workers).

The highest-rate occupations tended to be different than the occupations with the highest number of injuries (Table 1). The overall injury rate during 2014–2015 was 40 injuries per 1,000 workers. Fire fighters had the highest rate of injuries on the job, with 162 injuries per 1,000 workers, followed by law enforcement officers with 121 injuries per 1,000 workers, and supervisors of protective service workers at 95 injuries per 1,000 workers (Table 1).

The nature (or type) of injury was coded for 86.8% of cases (29,728). Of the coded cases, 45.1% of injuries (13,411) were sprains, strains, and tears; primarily to the back (4,114; 30.8%), knees (1,698; 12.7%), and shoulders (1,697; 12.7%). Sprains, strains, and tears were the leading types of injuries among all broad occupation groups except food preparation and serving, where lacerations were the most frequent (Table 2).

Contusions were the second most common type of injury overall, with 5,157 cases (17.4% of coded cases), primarily affecting the head (946; 18.4), hands (812; 15.8%), and knees (597; 11.6%). When ranked by broad occupation groups, contusions were found to be the second most common injury type among 13 of the 22 groups (Table 2), and third most common in the other nine occupation groups.

Almost as frequent as contusions, lacerations accounted for 4,392 injuries (14.8% of coded cases). Most lacerations occurred to the hands (2,832; 64.6%), followed by the head (757; 17.3%). Although lacerations represented about 15% of injuries overall, that proportion varied widely among broad occupations. For instance, lacerations accounted for 33.5% of injuries to food preparation and serving workers, but only 5.1% of injuries to community and social service workers (Table 2).

The cause of injury (termed "event or exposure" in OIICS), was coded for 95.3% of cases (32,619). At the most general coding level within the OIICS hierarchy for cause of injury, there are seven broad categories. Of the coded cases, contact with objects (for example, being struck by an object or caught in equipment) caused 31.1% of injuries (10,131), followed by overexertion and bodily reactions (8,600; 26.4%), and slips, trips, and falls (7,515; 23.0%). These three broad categories accounted for 80.5% of injuries. The remaining injuries were categorized as violence and other injuries by persons or animals (2,579; 7.9%), exposure to harmful substances or environments (2,414; 7.4%), transportation incidents (1,224; 3.8%); and fires and explosions (159; 0.5%).

Of the injuries caused by contact with objects, being struck by an object was the most frequent specific cause, although its contribution to injuries varied between occupations (Table 3). Being struck by an object caused over 20% of injuries among production workers; construction and extraction workers; food preparation and serving workers; installation, maintenance and repair workers; and farming, fishing, and forestry workers (Table 3). The most common sources of these "struck by object" injuries were non-powered hand tools such as knives and hammers (1,150 injuries), various types of containers such as buckets, pots, and barrels (549 injuries), and scrap, waste, and debris such as chips, particles, and splinters (536 injuries).

Among overexertion-related injuries, 5,742 involved an object (such as lifting or lowering) and 2,413 did not involve an object (such as twisting or bending unencumbered). Health care support workers had the highest proportion of injuries caused by overexertion with an object, contributing to 24.9% of injuries (Table 3). Health care support work includes specific occupations such as nursing assistants, health aides, and orderlies. The vast majority (83%) of injuries caused by overexertion with an object among health care support workers involved lifting a patient.

Most of the 7,515 injuries caused by slips, trips, and falls were specifically falls on the same level (4,251 injuries), followed by falls to a lower level (1,606), and slip or trip without fall (1,237). Across all occupations, falls on the same level accounted for 12.9% of all injuries (Table 3); however, the proportion was higher in some occupations such as community and social service occupations (26.4% of injuries) and lower in others, such as construction and extraction workers (6.8% of injuries).

4. Discussion

This study is the most comprehensive description of nonfatal work-related injuries in Alaska that has been published as of this time. The successful use of Alaska workers' compensation claims data demonstrates that the information provided in the workers' compensation data set is meaningful for epidemiologic research on work-related injuries and can produce detailed, important findings. These findings will be used to promote and guide future injury prevention research and interventions. As an overview of all nonfatal injuries in Alaska, the results presented are necessarily broad. However, because the coding for this study was performed at the finest level of detail for OIICS (nature, body part, event, and source), SOC, and North American Industry Classification System, the resulting data set can be used in the future for more detailed analyses focused on particular industries, occupations, injury events, or injury types. The findings of this study will serve as a compass to point future in-depth research in the right direction and increase the impact that workers' compensation claims data can have on preventing injuries.

This study found an overall rate of 40 acute traumatic injuries per 1,000 workers in Alaska during 2014–2015. Workers' compensation systems are state-based, with substantial variability in coverage requirements and reporting criteria. Therefore, injury rates based on claims data are not comparable between states. Workers' compensation claims rates published in other studies using other methodologies with different case definitions and workforce estimates may also differ from the injury rates identified for Alaska in this study. However, it is interesting to note that the injury rates identified in this study are similar to those identified by the national Survey of Occupational Injuries and Illnesses, which found 38 injuries per 1,000 workers in Alaska in 2014 [26], and 37 per 1,000 in 2015 [27].

This study identified occupations in Alaska that have elevated rates of injuries. Fire fighters, law enforcement officers, and their supervisors had the top three highest rates of injury, which should be concerning to local and state governments that employ these protective service workers, as well as safety professionals, labor organizations, and regulators. Similar to other occupations, about half of injuries involving protective service workers were sprains, strains, and tears. The predominance of sprains, strains, and tears among all occupations in Alaska indicates that ergonomic

Table 3
Causes of acute traumatic injuries among occupational groups in Alaska during 2014–2015[*]

Causes of acute traumatic injuries[†]	Transportation, material moving	Production	Construction, extraction	Office, admin support	Food preparation, serving	Installation, maintenance, repair	Protective services	Health practitioners, technicians	Building, grounds cleaning, maintenance	Sales	Education, training library	Health care support	Personal care, service	Management	Community, social service	Business, financial operations	Science	Architecture, engineering	Farming, fishing, forestry	Arts, design, entertain, sports, media	Computer, math	Legal	Total with known occupation[‡]
	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %	col %
Overexertion with object	692 *22.2*	617 *20.6*	445 *17.3*	465 *20.7*	231 *12.2*	334 *19.0*	225 *12.9*	317 *18.9*	287 *18.7*	317 *21.0*	117 *7.8*	295 *24.9*	169 *17.1*	171 *18.1*	27 *6.9*	76 *20.1*	56 *15.0*	37 *16.4*	20 *11.8*	14 *10.1*	10 *14.3*	7 *13.5*	4929 *17.9*
Struck by object	528 *16.9*	626 *20.9*	571 *22.1*	311 *13.8*	454 *23.9*	392 *22.3*	108 *6.2*	79 *4.7*	268 *17.5*	270 *17.9*	111 *7.4*	63 *5.3*	53 *5.4*	91 *9.6*	16 *4.1*	51 *13.5*	51 *13.7*	38 *16.8*	40 *23.5*	20 *14.4*	8 *11.4*	6 *11.5*	4155 *15.1*
Falls on same level	345 *11.0*	279 *9.3*	176 *6.8*	454 *20.2*	229 *12.1*	140 *8.0*	173 *9.9*	203 *12.1*	192 *12.5*	199 *13.2*	357 *23.9*	89 *7.5*	173 *17.5*	206 *21.8*	104 *26.4*	70 *18.5*	48 *12.9*	28 *12.4*	15 *8.8*	32 *23.0*	22 *31.4*	12 *23.1*	3546 *12.9*
Exposure to substances or environments	142 *4.5*	219 *7.3*	146 *5.7*	85 *3.8*	286 *15.1*	75 *4.3*	111 *6.4*	359 *21.4*	147 *9.6*	70 *4.6*	26 *1.7*	210 *17.7*	35 *3.5*	37 *3.9*	14 *3.6*	13 *3.4*	27 *7.2*	9 *4.0*	2 *1.2*	7 *5.0*	1 *1.4*	0 *0.0*	2021 *7.4*
Overexertion without object	233 *7.5*	195 *6.5*	218 *8.5*	165 *7.3*	80 *4.2*	175 *9.9*	196 *11.3*	91 *5.4*	132 *8.6*	99 *6.6*	83 *5.5*	56 *4.7*	84 *8.5*	74 *7.8*	31 *7.9*	18 *4.8*	31 *8.3*	24 *10.6*	13 *7.6*	3 *2.2*	7 *10.0*	4 *7.7*	2012 *7.3*
Struck against object	203 *6.5*	200 *6.7*	260 *10.1*	172 *7.7*	181 *9.5*	183 *10.4*	88 *5.1*	60 *3.6*	151 *9.8*	159 *10.5*	48 *3.2*	53 *4.5*	44 *4.4*	59 *6.2*	14 *3.6*	24 *6.3*	30 *8.0*	25 *11.1*	18 *10.6*	9 *6.5*	4 *5.7*	4 *7.7*	1989 *7.2*
Other contact with objects	122 *3.9*	135 *4.5*	151 *5.9*	97 *4.3*	134 *7.1*	99 *5.6*	42 *2.4*	140 *8.3*	67 *4.4*	112 *7.4*	26 *1.7*	75 *6.3*	33 *3.3*	26 *2.8*	6 *1.5*	26 *6.9*	16 *4.3*	7 *3.1*	16 *9.4*	13 *9.4*	3 *4.3*	2 *3.8*	1348 *4.9*
Falls to lower level	189 *6.1*	127 *4.2*	198 *7.7*	110 *4.9*	50 *2.6*	105 *6.0*	67 *3.9*	35 *2.1*	92 *6.0*	54 *3.6*	62 *4.1*	13 *1.1*	62 *6.3*	69 *7.3*	20 *5.1*	24 *6.3*	16 *4.3*	12 *5.3*	14 *8.2*	6 *4.3*	6 *8.6*	5 *9.6*	1336 *4.9*
Intentional injury by person	18 *0.6*	13 *0.4*	4 *0.2*	21 *0.9*	5 *0.3*	2 *0.1*	163 *9.4*	136 *8.1*	9 *0.6*	25 *1.7*	374 *25.0*	175 *14.8*	97 *9.8*	18 *1.9*	34 *8.6*	4 *1.1*	23 *6.2*	0 *0.0*	0 *0.0*	4 *2.9*	2 *2.9*	1 *1.9*	1128 *4.1*
Slip or trip without fall	118 *3.8*	94 *3.1*	82 *3.2*	110 *4.9*	62 *3.3*	49 *2.8*	77 *4.4*	41 *2.4*	49 *3.2*	59 *3.9*	69 *4.6*	20 *1.7*	43 *4.3*	46 *4.9*	30 *7.6*	16 *4.2*	11 *2.9*	13 *5.8*	5 *2.9*	6 *4.3*	3 *4.3*	5 *9.6*	1008 *3.7*
Caught in or compressed	124 *4.0*	186 *6.2*	109 *4.2*	29 *1.3*	65 *3.4*	70 *4.0*	17 *1.0*	9 *0.5*	40 *2.6*	33 *2.2*	6 *0.4*	5 *0.4*	5 *0.5*	13 *1.4*	2 *0.5*	9 *2.4*	12 *3.2*	11 *4.9*	3 *1.8*	3 *2.2*	0 *0.0*	1 *1.9*	752 *2.7*
Unintentional injury by person	11 *0.4*	9 *0.3*	6 *0.2*	18 *0.8*	13 *0.7*	5 *0.3*	184 *10.6*	73 *4.4*	4 *0.3*	11 *0.7*	166 *11.1*	79 *6.7*	48 *4.8*	19 *2.0*	58 *14.7*	7 *1.9*	5 *1.3*	1 *0.4*	0 *0.0*	6 *4.3*	0 *0.0*	2 *3.8*	725 *2.6*
Motor vehicle incident	154 *4.9*	54 *1.8*	58 *2.2*	43 *1.9*	7 *0.4*	30 *1.7*	75 *4.3*	23 *1.4*	26 *1.7*	23 *1.5*	15 *1.0*	8 *0.7*	39 *3.9*	46 *4.9*	13 *3.3*	10 *2.6*	5 *1.3*	6 *2.7*	5 *2.9*	6 *4.3*	1 *1.4*	2 *3.8*	649 *2.4*
Injury by animal	25 *0.8*	22 *0.7*	16 *0.6*	22 *1.0*	7 *0.4*	11 *0.6*	42 *2.4*	69 *4.1*	20 *1.3*	17 *1.1*	10 *0.7*	19 *1.6*	72 *7.3*	13 *1.4*	8 *2.0*	4 *1.1*	11 *2.9*	2 *0.9*	5 *2.9*	0 *0.0*	1 *1.4*	1 *1.9*	397 *1.4*
Other overexertion and bodily reaction	48 *1.5*	72 *2.4*	29 *1.1*	51 *2.3*	25 *1.3*	14 *0.8*	34 *2.0*	16 *1.0*	23 *1.5*	21 *1.4*	4 *0.3*	14 *1.2*	6 *0.6*	10 *1.1*	5 *1.3*	5 *1.3*	4 *1.1*	2 *0.9*	3 *1.8*	1 *0.7*	2 *2.9*	0 *0.0*	389 *1.4*
Other slips, trips, falls	36 *1.2*	38 *1.3*	16 *0.6*	51 *2.3*	32 *1.7*	12 *0.7*	17 *1.0*	20 *1.2*	12 *0.8*	23 *1.5*	14 *0.9*	6 *0.5*	9 *0.9*	20 *2.1*	8 *2.0*	10 *2.6*	6 *1.6*	2 *0.9*	3 *1.8*	7 *5.0*	0 *0.0*	0 *0.0*	342 *1.2*
Rubbed or abraded by object	27 *0.9*	57 *1.9*	76 *2.9*	16 *0.7*	10 *0.5*	40 *2.3*	7 *0.4*	3 *0.2*	12 *0.8*	5 *0.3*	1 *0.1*	4 *0.3*	5 *0.5*	4 *0.4*	0 *0.0*	1 *0.3*	3 *0.8*	4 *1.8*	2 *1.2*	0 *0.0*	0 *0.0*	0 *0.0*	277 *1.0*
Water vehicle incident	61 *2.0*	29 *1.0*	5 *0.2*	7 *0.3*	10 *0.5*	4 *0.2*	20 *1.1*	0 *0.0*	0 *0.0*	3 *0.2*	2 *0.1*	0 *0.0*	5 *0.5*	15 *1.6*	1 *0.3*	3 *0.8*	11 *2.9*	4 *1.8*	3 *1.8*	0 *0.0*	0 *0.0*	0 *0.0*	183 *0.7*
Fires and explosions	8 *0.3*	6 *0.2*	8 *0.3*	1 *0.0*	9 *0.5*	13 *0.7*	78 *4.5*	1 *0.1*	0 *0.0*	0 *0.0*	1 *0.1*	0 *0.0*	0 *0.0*	3 *0.3*	0 *0.0*	1 *0.3*	6 *1.6*	0 *0.0*	1 *0.6*	0 *0.0*	0 *0.0*	0 *0.0*	136 *0.5*

Pedestrian vehicular incident	11	15	5	11	3	3	8	1	2	6	2	0	0	3	2	4	0	0	1	1	0	0	78
	0.4	*0.5*	*0.2*	*0.5*	*0.2*	*0.2*	*0.5*	*0.1*	*0.1*	*0.4*	*0.1*	*0.0*	*0.0*	*0.3*	*0.5*	*1.1*	*0.0*	*0.0*	*0.6*	*0.7*	*0.0*	*0.0*	*0.3*
Aircraft incident	25	2	0	5	0	3	2	2	0	1	0	0	3	0	0	2	0	1	0	0	0	0	46
	0.8	*0.1*	*0.0*	*0.2*	*0.0*	*0.2*	*0.1*	*0.1*	*0.0*	*0.1*	*0.0*	*0.0*	*0.3*	*0.0*	*0.0*	*0.5*	*0.0*	*0.4*	*0.0*	*0.0*	*0.0*	*0.0*	*0.2*
Other transportation incidents	3	0	0	2	3	1	6	0	1	1	2	1	5	2	1	0	1	0	1	1	0	0	31
	0.1	*0.0*	*0.0*	*0.1*	*0.2*	*0.1*	*0.3*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.5*	*0.2*	*0.3*	*0.0*	*0.3*	*0.0*	*0.6*	*0.7*	*0.0*	*0.0*	*0.1*
Total with known cause	3123	2995	2579	2246	1896	1760	1740	1678	1534	1508	1496	1185	990	945	394	378	373	226	170	139	70	52	27,477
	100.0	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

* Excludes claims for fatal injuries, illnesses, exposure-only incidents, extraterritorial incidents, and claims missing data on occupation or cause of injury.
† Occupational Injury and Illness Classification System (OIICS), Event/Exposure Code.
‡ Standard Occupational Classification (SOC), 2-digit level.

interventions to prevent overexertion are sorely needed. Extensive research on the safety and health of protective service workers has been completed by NIOSH and other agencies, and many resources are available to help prevent work-related injuries [28].

Health care aides such as nursing assistants and home health aides had the fourth highest injury rate. The occupation of "other production workers," ranked fifth in terms of injury rate, mostly comprised helpers of more experienced production workers. Highlighting these occupations with high rates of injuries is important for prioritizing interventions and reducing the disproportionate injury risk among certain workers. However, targeting injury prevention efforts at occupations with the largest number of injuries is also important because a single intervention can result in large reductions in the total number of injured workers, as well as costs associated with treatment and recovery. From this perspective, considering the volume of injuries, construction workers are an occupation of concern, as are food processing workers, who in Alaska are almost entirely seafood processors. One occupation, health care aides, was in the top ten rankings for both the number and rate of injuries, which should make this group of workers an especially high priority for occupational safety improvements. A wealth of research and injury prevention resources are available from NIOSH and other agencies and organizations which can reduce hazards faced by health care workers [29].

Previous studies have found that the two occupations in Alaska with the highest rates of fatal injuries are fishermen and pilots [5]; but these workers were not among the occupations in this study with the highest rates of nonfatal injuries. In the case of fishermen, there are no nonfatal injuries reported in this study because fishermen are not covered by workers' compensation insurance. Instead, the Alaska Fishermen's Fund provides for the treatment and care of Alaska licensed commercial fishermen who have been injured while fishing in Alaska, and fishermen are also able to sue vessel owners under the Jones Act for injury compensation. Previous studies have shown that fishermen are indeed at high risk of nonfatal injuries, even though they are not identified as such in this study [30–32]. In the case of commercial pilots, most are covered by workers' compensation insurance, and data on their nonfatal injury claims were included in this analysis. The low nonfatal injury rate for pilots implies that although their risk of fatal occupational injuries is high, they are not at especially high risk of nonfatal injuries.

There are many other opportunities for future research using Alaska workers' compensation data. Narrative fields provide detailed information on the incident that can be used to code "work task," to indicate the activity being completed at the time of injury. This type of research has been done previously using Alaska workers' compensation data for the seafood processing industry [33] and could be replicated for other industries and occupations, and by hazard type (e.g., ergonomic hazards). Future research will also explore the data in more detail by geographic region, worker demographics (e.g., young workers, older workers), severity, time lost, and disability. Although data on claim costs were not available in the data set for this study, it appears such data exist and may be available for future studies as well.

This analysis has several limitations. First, workers' compensation claims data likely under-represent the true burden of nonfatal injuries because of a wide variety of factors involving reporting and compensability, especially among vulnerable workers [17]. Second, using worker counts as the exposure estimate to calculate rates and make risk comparisons is not ideal because this exposure estimate does not take into account the varying lengths of time that workers spend on the job throughout the year. Using full-time equivalent worker estimates, which accounts for hours worked, would have provided better risk measures, but these data currently

do not exist. Third, comprehensive workforce demographic data do not exist to calculate rates by age and sex. Finally, workers' compensation systems do not have data on injuries to workers not covered by workers' compensation insurance, such as commercial fishing workers, military members, federal government workers, and self-employed workers.

As the primary purpose of the workers' compensation claims data used in this study is administrative rather than research, substantial cleaning and coding of the data was required before statistical analyses could be completed. Data coding—particularly manual coding of OIICS codes—was resource intensive. However, assigning standardized codes to a high percentage of cases, often at the highest level of detail available in the coding hierarchies, increased the usefulness of the data for epidemiologic research substantially. Automated coding is less resource-intensive than manual coding, and SOC codes assigned by the publicly available NIOCCS-3 system have previously been shown to have excellent agreement with 2-digit SOC codes manually assigned by an expert coder and fair to good agreement for 6-digit SOC codes [34]. In this study, NIOCCS-3 successfully translated the coded industry field, and the freeform occupation field in the workers' compensation data to SOC codes for almost 90% of cases, enabling the estimation of occupation-specific injury rates and description of injury characteristics among occupation groups. Applying a combination of manual and automated coding methods to workers' compensation data allowed the information to be successfully used for epidemiologic research on work-related injuries, and the identification of research and prevention priorities.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

Conflicts of interest

The authors have no conflicts of interest to declare.

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