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Workers' compensation claims for traumatic brain injuries among private employers– Ohio, 2001–2011

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Abstract

Background: The purpose of this analysis was to identify and prioritize high-risk industry groups for traumatic brain injury (TBI) prevention efforts.

Methods: Workers with TBI from 2001 to 2011 were identified from the Ohio Bureau of Workers' Compensation (OHBWC) data. To prioritize industry groups by claim type (lost-time (≥8 days away from work) and Total claims) and injury event categories, we used a prevention index (PI) that averaged TBI counts and rate ranks (PI= (count rank+ rate rank)/2). TBI rates per 10,000 estimated full-time equivalent (FTE=2000 hours per year) workers were calculated.

Results: From 2001 to 2011, 12,891 TBIs were identified among private employers, resulting in a rate of 5.1 TBIs per 10,000 FTEs. Of these, 40% (n=5,171) were lost-time TBIs, at a rate of 2.0 per 10,000 FTEs. Spectator Sports had the highest lost-time TBI rate (13.5 per 10,000 FTEs),

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whereas General Freight Trucking had the greatest number of lost-time TBIs (n=293). Based on PIs, General Freight Trucking ranked first for lost-time TBIs for all injury events combined. Several industry groups within Construction, General and Specialized Freight Trucking, Services to Building and Dwellings, Employment Services, and Restaurants and Other Eating Places ranked high across multiple injury event categories for lost-time TBIs.

Conclusions: The high-ranking industry groups identified from our study can be used to effectively direct occupational TBI prevention efforts.

Keywords

workers' compensation; brain injury; lost-time; medical-only; prevention index; trucking; construction

INTRODUCTION

In 2013, 2.8 million people were diagnosed with traumatic brain injury (TBIs) in the United States (US) [1]. Further, an estimated 3.2 to 5.3 million persons are living with TBI-related disabilities in the US.[2, 3] TBI is one of the common occupational injuries.[4] Recent studies of fatal and nonfatal work-related TBIs in the U.S. found that TBI accounted from 20% to 25% of all work-related trauma.[5–8] Also, a recent study of nonfatal work-related TBIs in the US found that an estimated 59,000 workers visited emergency departments annually for a work-related TBI from 1998 to 2007.[6] TBIs can result in short-term or long-term disability that can adversely affect physical, cognitive, and/or psychosocial skills.[1] Moreover, work-related TBIs not only impact workers' ability to return to work and/or maintain their pre-injury jobs, but can also be costly for injured workers and employers because of prolonged disability and rehabilitation.[9]

Research focusing on work-related TBIs is more limited than research on TBIs in the general population. This difference may be due to lack of a TBI case definition within occupational injury coding system and difficulties in accurately identifying work-related TBIs from non-work-related TBIs using hospital discharge records .[7,10] Studies have used nonstandardized diagnoses[6] including US Bureau of Labor Statistics (BLS) Occupational Injury and Illness Classification System (OIICS) codes for nature of injury, and body part[7,8] to identify TBIs. However, studies using nonstandardized diagnoses to identify TBIs do not capture all true TBI cases and result in underestimates because of deficiencies in the narrative information available to coders and coding errors.[10] Thus, researchers have recommended that the standardized International Classification of Diseases (ICD) diagnosis codes be used to identify work-related TBI cases.[10] Because workers' compensation (WC) claims databases contain ICD diagnosis codes, they may be a useful data source for describing work-related TBIs. A few studies examined work-related TBIs using WC claims data, but they have not been described in detail by claim type (i.e., medical only and lost-time) to identify industry groups that are at risk for TBIs. [11–13]

Because of the devastating consequences and substantial costs associated with TBIs, it is important to identify and prioritize industry groups in greatest need of TBI prevention efforts. Therefore, we used data from the Ohio Bureau of Workers' Compensation

(OHBWC) and prioritized industry groups by 'prevention index' (PI), a ranking measure calculated as the average of ranks for claim count and claim rate. [14–17] Further, we stratified industry group PI ranks by claim type and injury event, to aid TBI prevention efforts. Industry groups that are ranked higher by PI indicate a greater burden or risk of TBIs and these PI rankings specify which industry groups should be prioritized for prevention.[15]

MATERIALS AND METHODS

The OHBWC is one of four exclusive state-funded WC systems in the US; North Dakota, Washington, and Wyoming are the other three. OHBWC provides insurance to about two-thirds of Ohio's workforce. All Ohio employers with 1 to 499 employees (except sole proprietorships and partnerships) must be insured by OHBWC. Employers with 500 or more employees have the option to self-insure. We analyzed TBI claims filed from January 1, 2001 through December 31, 2011 among state-insured, private-employer establishments. We included both medical-only claims (0–7 days away from work) and lost-time claims (≥8 days away from work). The OHBWC data includes demographics of the injured worker, industry, claim type, ICD-9-CM diagnosis codes, and an unstructured narrative injury description.[17] TBI claims were obtained using allowed diagnosis in the WC system. If these claims were determined by OHBWC or the Ohio Industrial Commission (based on the medical documentation) to be work-related injuries, then they were included. Hereafter, allowed TBI claims are referred to as TBIs.

TBI case definition

Our TBI case definition was informed by the US Centers for Disease Control and Prevention (CDC).[1] The following CDC recommended ICD-9-CM diagnosis codes were used to identify TBIs: 800.00–801.99 (fracture of the vault or base of the skull), 803.00–804.99 (other and unqualified or multiple fractures of the skull), 850.00–854.19 (intracranial injury, including concussion, laceration, and hemorrhage), 959.01 (head injury, unspecified) and 950.1−950.3 (injury to optic nerve and pathways).

TBI severity

TBI severity was classified using the Abbreviated Injury Scale (AIS) for head into the following categories: mild (AIS <3), moderate (AIS=3), and severe (AIS >3).[18, 19] The AIS is a 6-level ordinal scale based on mortality risk where an AIS score of 1 is a minor injury and an AIS score of 6 is a non-survivable injury.[20] Because of severity measurements are not consistently captured in the OHBWC system, we generated AIS scores using the ICD Programs for Injury Categorization (ICDPIC) tool, an ICD-9 mapping module which translates ICD-9-CM codes into AIS scores.[20] This ICDPIC tool was validated [21] and has been used in previous studies.[19, 21–23]

Injury events

Injury events were auto-coded to the two-digit level of the OIICS, version 2.01. The auto-coding methods were developed by NIOSH and are described in detail in Bertke et al. 2016.[24] For this study, we verified the assigned injury event codes for accuracy and corrected any errors we identified. We grouped a few two-digit OIICS injury events into

larger categories where prevention implications would be similar. The following five main injury events were used for detailed analyses: (1) motor vehicle events (pedestrian vehicular incidents, OIICS=24; roadway incidents involving motorized land vehicle, OIICS=26; and non-roadway incidents involving motorized land vehicles, OIICS=27); (2) falls to the same level, OIICS=42; (3) falls to a lower level, OIICS=43; (4) struck-by/against objects or equipment (struck by objects or equipment, OIICS=62; struck against objects or equipment, OIICS=63); and (5) violence and other injuries by persons (intentional injuries by a person, OIICS=11; injuries by a person—unintentional or intent unknown, OIICS=12).

Data analysis

Descriptive analyses were performed on demographic characteristics, employer size, injury events, TBI diagnosis, and severity by claim type. Industry groups were categorized according to the 4-digit 2012 North American Industry Classification System (NAICS). TBI rates per 10,000 estimated full-time equivalent (FTE=2000 hours per year) workers were calculated with use of NAICS codes and number of employee counts from Ohio unemployment insurance (UI) data. To get estimated FTEs, the UI employee counts were adjusted with number of paid work hours from the Bureau of Labor Statistics Labor Productivity, and Costs program data.[14] For rate calculations, 577 TBIs were excluded because no matching employee counts could be reliably derived for the corresponding employer and year. Rates were not calculated for sex and age groups because corresponding employment numbers are not available from Ohio UI data. Detailed methods describing linkage of WC and employment data, adjustment of employee counts to estimate FTEs, and exclusion criteria for OHBWC claims in rate calculations can be found in Wurzelbacher et al. 2016.[14]

We used the PI ranking to prioritize industry groups based on prior research. [14–17] The PI rank gives equal weight to count and rate. To ensure stable PI rankings, our inclusion criteria specified that industry groups have at least one TBI in a year for 9 or more years from 2001 to 2011 and employ ≥100 FTEs per year during the study period. [14, 17] First, the average annual count and rate rank were calculated for TBIs. Then, the PI rank was calculated by averaging the annual rank of TBI count and rate (PI= (count rank+ rate rank)/2) and ordered from lowest to highest. The PI rankings were calculated for 4-digit NAICS industry groups by injury event and lost-time TBIs and total TBIs, which include both lost-time and medical-only TBIs. Further, we identified industry groups that were ranked in the top 10 by PI for lost-time TBIs across two or more injury events so that a more comprehensive approach is followed to prevent TBIs from multiple injury events. A high PI rank for industry group indicates a greater TBI burden or risk of TBIs.[15]

RESULTS

From 2001 to 2011, 12,891 TBIs were identified among OHBWC-insured, private employers, resulting in a rate of 5.1 TBIs per 10,000 FTEs (Table1 and Table 2). Of these, 40% (n=5,171) were lost-time TBIs, at a rate of 2.0 per 10,000 FTEs. While females incurred a higher proportion of medical-only TBIs (35.7%) than lost-time TBIs (25.0%), males incurred a higher proportion of lost-time TBIs (74.9%) than medical-only

TBIs (62.6%). Workers 34 years and older represented a higher proportion of lost-time TBIs (69.8%) than medical-only claims (51.4%). Workers incurred a higher proportion of lost-time TBIs than medical-only TBIs due to motor vehicle events (23.9% vs.8.3%) and falls to a lower level event (22.0% vs.9.8%).

Most TBIs were due to intracranial injury, including concussion, laceration, and hemorrhage (n=10,412, 80.8%; data not shown). Of these, 40.4% were lost-time TBIs (n=4,208). Other common TBI diagnoses were unspecified head injuries which accounted for 13.7% (n=1,765) of all TBIs. Of these, only 18.8% were lost-time TBIs (n=331). Fractures of the vault of the skull and other unqualified or multiple fractures of the skull accounted for 5.5% of all TBI diagnoses (n=713) with almost 90 percent being lost-time TBIs (n=632; 88.6%).

TBI severity

Of 12,891 TBIs, 11,822 were mild TBIs (91.7%), 775 were moderate TBIs (6.0%), and 294 were severe TBIs (2.3%; data not shown). The moderate and severe TBIs frequently resulted in lost-time claims (n=671, (86.6%); n=257, (87.4 %), respectively, whereas mild TBIs frequently resulted in medical-only claims (n=7,579, 64.1%).

All injury events

We focused this paper on lost-time TBI PI ranking results because lost-time claims are considered more severe than medical-only claims and potentially less likely to be underreported. Spectator Sports had the highest lost-time TBI rate (13.5 per 10,000 FTEs). Whereas General Freight Trucking had the greatest number of lost-time TBIs (n=293; Table 2). General Freight Trucking ranked first by PI for lost-time TBIs. Seven of the 10 industry groups within the construction sector (NAICS 23) were in the top 10 PI rankings for lost-time TBIs.

Motor vehicle

For motor vehicle events, Specialized Freight Trucking had the highest lost-time TBI rate (5.8 10,000 FTEs) and General Freight Trucking had the highest number of lost-time TBIs (n=147). Specialized Freight Trucking ranked first in the PI rankings for lost-time TBIs, followed by General Freight Trucking (Table 3). Four of the top 10–ranked industry groups for lost-time were in the Construction sector (NAICS 23). The proportions of lost-time TBIs to all TBIs was very high for the top 10 industry groups (61% to 87%).

Falls on same level

For falls on same level, Restaurants and Other Eating Places had the highest number of lost-time TBIs (n=97; Table 4). Nursing Care Facilities ranked first by PI for lost-time TBIs. Two of Health Care and Social Assistance (NAICS 62) industry groups were represented in the top 10 PI rankings for lost-time TBIs.

Falls to lower level

For falls to a lower level, Foundation, Structure, and Building Exterior Contractors had the highest number and rate for lost-time TBIs (n=137; 4.9 per 10,000 FTEs), resulting in the highest PI ranking for lost-time TBIs (Table 5). Six industry groups within the Construction

sector (NAICS 23) were among the top 10 PI rankings for lost-time TBIs. Among the top 10 industry groups, lost-time TBIs represented more than one-half to two-thirds of the total TBIs.

Struck by or against

For struck-by/against events, Support Activities for Mining had the highest lost-time TBI rate (7.0 per 10,000 FTEs). Whereas Employment Services had the highest number of lost-time TBIs (n=83). Utility System Construction ranked first by PI rank for lost-time TBIs (Table 6). Overall, five industry groups within the Construction sector (NAICS 23) were among in the top 10 PI rankings for lost-time TBIs.

Violence and other injuries by persons

For violence and other injuries by persons, only three industry groups met the PI inclusion criteria for lost-time TBIs and nine industry groups met the PI inclusion criteria for total TBIs. Residential Intellectual and Developmental Disability, Mental Health, and Substance Abuse Facilities ranked first by PI for lost-time TBIs (data not shown).

Industry groups across event categories for lost-time TBIs

Of the 77 industry groups that met the inclusion criteria for lost-time TBIs, 12 had high rankings (in the top 10) for at least two or more injury events (Table 7). Of these, five industry groups were from the Construction sector (NAICS 23, Foundation, Structure, and Building Exterior Contractors; Other Specialty Trade Contractors; Utility System Construction; Highway, Street, and Bridge Construction; and Building Equipment Contractors), two industry groups were from the truck transportation sector (NAICS 48, General and Specialized Freight Trucking), and three industry groups were from the Administrative and Support and Waste Management and Remediation Services sector (NAICS 56, Services to Building and Dwellings, Employment Services, and Investigation and Security Services). Additionally, Restaurants and Other Eating Places and Cement and Concrete Product Manufacturing had high rankings for two event categories.

DISCUSSION

The PI rankings aid in prioritizing industry groups for prevention purposes by giving equal weight to both counts and rates. A high PI rank highlights the need for more research and prevention efforts. Although a few studies used PI ranks to prioritize industry groups for occupational injury and prevention, [14–17] no study has specifically looked at work-related TBIs. In our study, we found that several industry groups consistently ranked high across two or more injury events for lost-time TBIs. Thus, these industry groups should be a top most priority for TBI prevention.

Construction Sector

Five industry groups within the Construction sector (NAICS 23) appeared in the top 10 PI rankings across motor vehicle events, falls to a lower level, and being struck by or against an object or equipment for lost-time TBIs. Workers in construction are at higher risk for TBIs because of their work in dynamic environments involving heavy machinery, working

at heights, and falling and flying objects. Similar to previous studies of TBI within the construction industry, our findings indicate that many construction industry groups need to utilize TBI prevention efforts specific to falls to a lower level, being struck by or against an object or equipment, and motor vehicle events.[7, 8, 25] In the construction industry, falls to a lower level that cause TBIs are mostly from roofs, scaffolds, and ladders.[8] Our study found that falls to a lower level commonly resulted in lost-time TBIs. To prevent these events, NIOSH, the Occupational Safety and Health Administration (OSHA), and the Center for Construction Research and Training (CPWR) developed a fall-prevention campaign that runs annually to raise awareness of worker safety and provide guidance and resources to address fall hazards on construction sites.[26] In order to prevent struck-by/against events in construction, OSHA safety recommendations include wearing hardhats, carefully stacking materials so they do not fall, and using debris nets.[27] Our study also found that motor vehicle incidents in the construction industry commonly resulted in lost-time TBIs. Workers operating construction vehicles or equipment risk injury due to rollover or collision.[28] To prevent these events, employers should mandate use of occupant restraints, decrease impaired, distracted and aggressive driving, and manage driver fatigue.[29, 30] Also, highway construction workers are at risk of being hit by traffic vehicles in roadway work zones.[31] Use of high-visibility apparel and increased presence of law enforcement at work zones also reduce injuries to construction workers.[28]

Truck Transportation

Specialized Freight Trucking (requiring specialized equipment such as flatbeds, tankers, or refrigerated trailers) and General Freight Trucking ranked high for lost-time TBIs from motor vehicle events and lower-level falls. The high rank of truck transportation due to motor vehicle events is not surprising, given the nature of the work in this industry. Our study found that motor vehicle events frequently resulted in lost-time TBIs. Thus, TBI prevention efforts in these industry groups should be a high priority. Many factors may contribute to truck-related incidents, including speeding, fatigue, load shift, mechanical failures, distracted driving, long work hours, bad weather, inadequate training, and a poor company safety climate.[32] To prevent motor vehicle events, all employers should enforce seat belt use, establish a commitment to road safety at all levels of management, provide driver training, prevent distracted and drowsy driving, and incorporate fatigue management into safety programs.[33] Both Specialized Freight Trucking and General Freight Trucking were also ranked high for lost-time TBIs due to falls to a lower level. Job duties other than driving, such as loading and unloading freight, tarping and untarping loads, and entering and exiting the cab contribute to lower-level falls.[34, 35] Recommendations for preventing falls to a lower level include use of access stairs and ladders, and use of handles during ingress and egress, education and training on how to safely work on elevated surfaces, and use of three points of contact while exiting and entering the truck cab.[36]

General Freight Trucking also ranked high for lost-time TBIs from falls on same level and struck-by/against events. Slippery ground conditions such as snow, ice, or oil and fuel spills contribute to falls on the same level.[36] To prevent these events, use of slip-resistant footwear and good housekeeping practices are recommended.[36] Regarding struck-by/against events, truck transportation workers are commonly struck by or against vehicle parts, containers,

and freight.[36] Recommendations for preventing injuries from such objects include training on securing loads, replacing worn binders and straps, watching for falling overhead items, and opening trailers carefully because items may shift and fall.[36]

Services to Building and Dwellings

Workers in Services to Buildings and Dwellings are at high risk for occupational injuries because of the nature of their work in providing a wide variety of services including pest control, janitorial work, landscaping, and carpet cleaning.[15] In our study, services to buildings and dwellings ranked high for lost-time TBIs from motor vehicle events, falls to lower level and struck-by/against events. Many subsectors of this industry group are family-owned or small businesses and are less likely to have safety programs.[16] OSHA has resources and information aimed at small businesses that can help in improving safety and reducing occupational injuries, including TBIs.[37]

Employment Services

Another industry group in need of TBI prevention efforts for several injury events is Employment Services. In our study, Employment Services ranked high for lost-time TBIs from falls on same level, falls to a lower level and struck-by/against events. The majority of the labor force in Employment Services is concentrated in Temporary Help Services (NAICS 56132), who work in a variety of occupations and industry settings.[38] Temporary workers are less likely to have proper safety training, and may lack awareness of hazards.[39] Not surprisingly, research has found that temporary workers have higher injury rates than permanent workers in certain industries.[38] For the purpose of WC insurance, when an injury occurs to a temporary worker, that worker is considered to be in the temporary staffing agency rather than the host employer's industry (where the injury occurred).[15,17] This reporting requirement makes WC data particularly useful for future analyses of Employment Services, particularly Temporary Help Services (NAICS 56132). OSHA and NIOSH have recommended best safety practices to both staffing agencies and host employers to protect temporary workers, including site-specific and task-specific training, review of worksite and safety hazards, and injury tracking.[39]

Restaurants and Other Eating Places

Although the Restaurants and Other Eating Places industry group was not ranked in the top 10 by PI for overall events (Table 2), it consistently ranked high for lost-time TBIs due to falls on same level and violence events. Falls on same level due to liquids, food, and grease on the floor can be reduced by following effective floor–cleaning protocols; implementing procedures and environmental modifications to reduce slip hazards; and using slip-resistant shoes and floor mats.[40] Workers in this industry group, especially in quick serve and fast food casual restaurants, work alone or in small numbers, work late at night, handle cash, and deliver food, thus increasing their risk of exposure to violence.[41] Improving external lighting, reducing cash available on the premises, using surveillance systems, and training employees to handle violent situations have been shown to be effective in reducing robberies and other violent crimes.[42]

Spectator Sports

Although the Spectator Sports had the highest total and lost-time TBI rates, it ranked 8th and 17th by PI for overall events (Table 2). In Ohio, not all professional players are covered by WC insurance.[43]Additionally, some professional teams have medical doctors that serve their injury-related needs and therefore may not file WC claims. Due to these factors, TBI rates presented for this industry group are, at best, lower-bound estimates. Playing in contact and collision sports increases the risk of concussion due to being hit by an opponent or a teammate. In recent years, sports-related concussions have received increased attention, and policies have been developed to limit head injuries.[44] Incidence and severity may be reduced by enforcing stringent rules by coaches and officials, limiting the number of contact practices, teaching correct playing techniques, and educating athletes, parents, coaches, trainers and physicians about the importance of recognizing and responding to a concussion.[44]

Evaluations of TBI prevention efforts in specific industries are rare. Based on the current study findings, safety practices aimed at preventing frequent injury types in these industry groups may also reduce work-related TBIs. Among high-risk industry groups, researchers have suggested adopting different prevention approaches based on the individual count and rate rankings.[15, 17] Industry groups with a high count rank and a high rate rank, such as General Freight Trucking transportation can be characterized as large, hazardous industry group in need of effective comprehensive prevention programs that include enforcement, consultation and outreach. Whereas industry groups with a high count rank and a low rate rank, such as Restaurants and Other Eating Places may indicate large, less hazardous industry group that could use education campaigns in order to reach a large number of workplaces and employees. Industry groups with a low count rank and a high rate rank, such as Spectator Sports indicate small, but likely dangerous industry group where risk is concentrated and focused injury prevention engagements would be appropriate.[15] TBI awareness among the general workforce is limited as compared to awareness among professional athletes[44] and military personnel.[45] Increased worker and employer awareness of causes, signs and symptoms, and consequences of TBIs is needed. If workers are informed about the importance of early diagnosis and medical care, then long-term TBI-related disabilities can be reduced, [2,3,46] which may also result in lower claim costs to the employers and insurers.[47]

The findings in this study are subject to at least five limitations. First, the employment estimates by sex and age group are not available in the Ohio UI data. Therefore, presentation of these characteristics was limited to frequency distributions. Second. we did not include TBIs from large, self-insured private employers. Thus, this study likely underestimated the magnitude of work-related TBIs in Ohio and may have under-or-overestimated rates for some NAICS industry groups.[17] Third, the PI ranking is useful in interpreting ranks for prioritizing prevention efforts but has some weaknesses. Although the PI ranking accounts for the importance of high risk and high burden, information is lost when counts and rates are ranked because the difference between ranks doesn't truly indicate the magnitude of actual difference in count or rate between industry groups.[15] Also, the PI method does not account for other factors for prioritizing one industry group over another (eg, small industry

group such as spectator sports with a low PI rank but high rate will not be prioritized).[17] Fourth, generalizability of findings to other states may be limited because of differences among industry distributions and the state WC systems. Fifth, we did not include TBIs from self-insured private employers as they are not covered by OHBWC. Thus, the effect of TBIs from the industry groups of self-insured private employers on PI rankings of industry groups reported in this study is unknown.

CONCLUSIONS

Although TBIs occur in many industry groups, we identified industry groups that should be prioritized for prevention efforts, including several industry groups that are at high risk for TBI from specific events. We also found that motor vehicle events and falls to a lower level commonly resulted in lost-time TBIs. PI rankings are an important initial step to identify industry groups in need of targeted prevention efforts. Additional research is needed to identify high-risk occupations and the task-specific hazards within the identified industry groups to aide in further prioritizing prevention efforts.

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Table 1.

Number and percentage of TBIs by claim status, sex, age group, and event among private employers in Ohio, 2001–2011.

Characteristic	Lost-time TBIs, n (%)	Medical-only TBIs, n (%)	Total TBIs, n (%)
Sex			
Female	1,291 (25.0)	2,758 (35.7)	4,049 (31.4)
Male	3,871 (74.9)	4,834 (62.6)	8,705 (67.5)
Unknown	9 (0.2)	128 (1.7)	137 (1.1)
Age group (in years)			
14–17	30 (0.6)	138 (1.8)	168 (1.3)
18–19	110 (2.1)	397 (5.1)	507 (3.9)
20–24	373 (7.2)	1,225 (15.9)	1,598 (12.4)
25–34	1,047 (20.2)	1,982 (25.7)	3,029 (23.5)
35–44	1,282 (24.8)	1,500 (19.4)	2,782 (21.6)
45–54	1,339 (25.9)	1,409 (18.3)	2,748 (21.3)
55–64	761 (14.7)	848 (11.0)	1,609 (12.5)
65 and over	229 (4.4)	208 (2.7)	437 (3.4)
Unknown	–	13 (0.2)	13 (0.1)
Injury event (2-digit OIICS code)			
Motor vehicle events			
Pedestrian vehicular incident (24)	98 (1.9)	33 (0.4)	131 (1.0)
Roadway incidents involving motorized land vehicle (26)	1,028 (19.9)	518 (6.7)	1,546 (12)
Non-roadway incidents involving motorized land vehicles (27)	107 (2.1)	93 (1.2)	200 (1.6)
Falls, slips, trips			
Falls on same level (42)	951 (18.4)	1,888 (24.5)	2,839 (22.0)
Falls to lower level (43)	1,138 (22.0)	757 (9.8)	1,895 (14.7)
Contact with objects and equipment			
Struck by objects or equipment (62)	1,064 (20.6)	2,298 (29.8)	3,362 (26.1)
Struck against objects or equipment (63)	232 (4.5)	1,265 (16.4)	1,497 (11.6)
Violence and other injuries by persons			
Intentional injury by person (11)	232 (4.5)	373 (4.8)	605 (4.7)

Characteristic	Lost-time TBIs, n (%)	Medical-only TBIs, n (%)	Total TBIs, n (%)
Injury by person—unintentional or intent unknown (12)	54 (1.0)	150 (1.9)	204 (1.6)
All others	267 (5.2)	345 (4.5)	612 (4.7)
Total	5,171 (100)	7,720 (100)	12,891 (100)

Abbreviations: TBI, traumatic brain injury, FTE, full-time equivalents; OIICS, Occupational Injury and Illness Classification System

Table 2:

Top 10 industry groups by prevention index rankings for lost-time and total TBIs among private employers in Ohio, 2001–2011.

	Lost-time TBIs					Total TBIs					
Industry group (4-digit NAICS)	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Proportion of lost-time TBIs (%)**
General Freight Trucking (4841)	293 (5.7)	1	9.2	3	1	482 (3.7)	3	15.1	4	1	61
Foundation, Structure, and Building Exterior Contractors (2381)	220 (4.3)	3	7.8	5	2	365 (2.8)	5	13.0	6	2	60
Specialized Freight Trucking (4842)	127 (2.5)	7	10.0	2	3	210 (1.6)	9	16.7	3	3	60
Other Specialty Trade Contractors (2389)	99 (1.9)	8	4.9	11	4	178 (1.4)	13	8.8	14	6	56
Services to Buildings and Dwellings (5617)	174 (3.4)	6	4.1	13	5	353 (2.7)	6	8.4	16	5	49
Utility System Construction (2371)	76 (1.5)	13	6.6	8	6	137 (1.1)	20	11.9	9	7	55
Highway, Street, and Bridge Construction (2373)	54 (1.0)	17	7.5	6	7	90 (0.7)	36	12.5	11	16	60
Building Finishing Contractors (2383)	96 (1.9)	10	4.1	15	8	179 (1.4)	16	7.8	26	13	54
Building Equipment Contractors (2382)	199 (3.8)	5	3.1	22	9	440 (3.4)	4	6.8	32	10	45
Residential Building Construction (2361)	90 (1.7)	12	4.2	16	10	169 (1.3)	17	7.9	25	12	53
Cement and Concrete Product Manufacturing (3273)	46 (0.9)	24	6.3	10	13	97 (0.8)	28	13.4	7	9	47
Residential Intellectual and Developmental Disability, Mental Health and Substance Abuse Facilities (6232)	63 (1.2)	16	3.5	21	15	218 (1.7)	10	12.0	8	4	29
Spectator Sports (7112)	29 (0.6)	42	13.5	1	17	89 (0.7)	30	40.4	1	8	33
Restaurants and other eating places (7225)[b]	249 (4.8)	2	1.4	63	31	917 (7.1)	1	5.0	78	33	27
All industry groups	5,171 (100)	--	2.0	--	--	12,891 (100)	--	5.1	--	--	40

[a]Rates were calculated on the basis of allowed claims that could be matched with employee counts for the corresponding policy-year.

[b] Ranked 1st for total TBIs but not ranked in the top 10 by PI.

Abbreviations: TBI, traumatic brain injury; NAICS, North American Industry Classification System; FTEs, full-time equivalents.

Note: Rank for count and rate is the average annual rank; The PI rankings for all injury events were limited to 150 industry groups (of 300) that met the inclusion criteria for total TBIs (N=11,757) and 77 industry groups (of 277) who met the inclusion criteria for lost-time TBIs (N=3,986).

2-digit NAICS sectors: Agriculture, Forestry, Fishing and Hunting (11); Mining, Quarrying, and Oil and Gas Extraction (21); Utilities (22); Construction (23); Manufacturing (31–33); Wholesale Trade (42); Retail Trade (44–45); Transportation and Warehousing (48–49); Information (51); Finance and Insurance (52); Real Estate and Rental and Leasing (53); Professional, Scientific, and Technical Services (54); Management of Companies and enterprises (55); Administrative and Support and Waste Management and Remediation Services (56); Educational Services (61); Health Care and Social Assistance (62); Arts, Entertainment, and Recreation (71); Accommodation and Food Services (72); Other Services (except Public Administration) (81).

Table 3:

Top 10 industry groups by prevention index rankings for lost-time and total TBIs due to motor vehicle events among private employers in Ohio, 2001–2011.

	Lost-time TBIs					Total TBIs					
Industry group (4-digit NAICS)	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Proportion of lost-time TBIs (%)**
Specialized Freight Trucking (4842)	72 (5.8)	2	5.8	1	1	89 (4.7)	2	7.1	1	1	87
General Freight Trucking (4841)	147 (11.9)	1	4.6	2	2	190 (10.1)	1	5.9	3	2	77
Services to Buildings and Dwellings (5617)	54 (4.4)	3	1.3	7	3	77 (4.1)	4	1.9	8	3	70
Highway, Street, and Bridge Construction (2373)	24 (1.9)	8	3.4	4	4	28 (1.5)	13	4.0	4	5	86
Utility System Construction (2371)	24 (1.9)	10	2.0	5	5	31 (1.7)	11	2.6	6	6	77
Other Specialty Trade Contractors (2389)	24 (1.9)	8	1.1	9	6	36 (1.9)	8	1.7	11	7	67
Foundation, Structure, and Building Exterior Contractors (2381)	27 (2.2)	7	1.0	10	7	36 (1.9)	10	1.3	15	14	75
Waste Collection (5621)	17 (1.4)	15	4.8	3	8	24 (1.3)	15	6.7	2	4	71
Cement and Concrete Product Manufacturing (3273)	17 (1.4)	13	2.3	6	9	24 (1.3)	15	3.3	5	8	71
Investigation and Security Services (5616)	20 (1.6)	12	1.3	8	10	33 (1.8)	12	2.2	9	9	61
Home Health Care Services (6216)	20 (1.6)	11	0.8	12	13	41 (2.2)	9	1.6	14	10	49
All industry groups	1,233 (100)	--	0.5	--	--	1,877 (100)	--	0.7	--	--	66

[a]Rates were calculated on the basis of allowed claims that could be matched with employee counts for the corresponding policy-year. Abbreviations: TBI, traumatic brain injury; NAICS, North American Industry Classification System; FTEs, full-time equivalents.

Note: Rank for count and rate is the average annual rank; For total TBIs, 23 industry groups met the PI inclusion criteria, whereas for lost-time TBIs, 19 industry groups met the PI inclusion criteria.

2-digit NAICS sectors: Agriculture, Forestry, Fishing and Hunting (11); Mining, Quarrying, and Oil and Gas Extraction (21); Utilities (22); Construction (23); Manufacturing (31–33); Wholesale Trade (42); Retail Trade (44–45); Transportation and Warehousing (48–49); Information (51); Finance and Insurance (52); Real Estate and Rental and Leasing (53); Professional, Scientific, and Technical Services (54); Management of Companies and enterprises (55); Administrative and Support and Waste Management and Remediation Services (56); Educational Services (61); Health Care and Social Assistance (62); Arts, Entertainment, and Recreation (71); Accommodation and Food Services (72); Other Services (except Public Administration) (81).

Table 4:

Top 10 industry groups by prevention index rankings for lost-time and total TBIs due to falls on same level among private employers in Ohio, 2001–2011.

	Lost-time TBIs					Total TBIs					
Industry group (4-digit NAICS)	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Proportio n of lost-time TBIs (%)**
Nursing Care Facilities (6231)	46 (4.8)	2	0.8	4	1	158 (5.6)	2	2.7	2	1	29
General Freight Trucking (4841)	27 (2.8)	5	0.9	2	2	69 (2.4)	5	2.2	4	4	39
Investigation and Security Services (5616)	16 (1.7)	7	1.1	1	3	29 (1)	19	1.9	11	14	55
Restaurants and other eating places (7225)	97 (10.2)	1	0.5	7	4	354 (12.5)	1	1.9	6	3	27
Individual and Family Services (6241)	21 (2.2)	6	0.9	3	5	55 (1.9)	6	2.2	7	5	38
Automobile Dealers (4411)	38 (4)	4	0.9	5	6	105 (3.7)	3	2.4	3	2	36
Employment Services (5613)	31 (3.3)	3	0.4	9	7	84 (3)	4	1.1	23	12	37
Traveler Accommodation (7211)	14 (1.5)	8	0.7	6	8	48 (1.7)	9	2.4	9	7	29
Automotive Repair and Maintenance (8111)	13 (1.4)	9	0.5	8	9	31 (1.1)	14	1.1	24	19	42
Grocery Stores (4451)	–[b]	–	–	–	–	41 (1.4)	8	1.5	13	10	NA
Residential Intellectual and Developmental Disability, Mental Health, and Substance Abuse Facilities (6232)	–	–	–	–	–	41 (1.4)	12	2.4	8	9	NA
Community Care Facilities for the Elderly (6233)	–	–	–	–	–	40 (1.4)	11	2.6	5	6	NA
Vocational Rehabilitation Services (6243)	–	–	–	–	–	31 (1.1)	18	4.9	1	8	NA
All industry groups	951 (100)	--	0.4	--	--	2,839 (100)	--	1.1	--	--	33

[a]Rates were calculated on the basis of allowed claims that could be matched with employee counts for the corresponding policy-year.

[b]For industry groups, dashed cells indicate cells that do not meet the PI inclusion criteria.

Abbreviations: TBI, traumatic brain injury; NAICS, North American Industry Classification System; FTEs, full-time equivalents; NA, not applicable.

Note: Rank for count and rate is the average annual rank; For total TBIs, 39 industry groups met the PI inclusion criteria, whereas for lost-time TBIs, only 9 industry groups met the inclusion criteria.

2-digit NAICS sectors: Agriculture, Forestry, Fishing and Hunting (11); Mining, Quarrying, and Oil and Gas Extraction (21); Utilities (22); Construction (23); Manufacturing (31–33); Wholesale Trade (42); Retail Trade (44–45); Transportation and Warehousing (48–49); Information (51); Finance and Insurance (52); Real Estate and Rental and Leasing (53); Professional, Scientific, and Technical Services (54); Management of Companies and enterprises (55); Administrative and Support and Waste Management and Remediation Services (56); Educational Services (61); Health Care and Social Assistance (62); Arts, Entertainment, and Recreation (71); Accommodation and Food Services (72); Other Services (except Public Administration) (81).

Table 5:

Top 10 industry groups by prevention index rankings for lost-time and total TBIs due to falls to lower level among private employers in Ohio, 2001–2011.

	Lost-time TBIs					Total TBIs					
Industry group (4-digit NAICS)	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Proportion of lost-time TBIs (%)**
Foundation, Structure, and Building Exterior Contractors (2381)	137 (12)	1	4.9	1	1	179 (9.4)	1	6.4	1	1	76
Residential Building Construction (2361)	62 (5.4)	4	2.9	2	2	91 (4.8)	5	4.3	2	3	68
General Freight Trucking (4841)	65 (5.7)	3	2.1	4	3	85 (4.5)	4	2.7	7	5	76
Building Finishing Contractors (2383)	63 (5.5)	5	2.8	3	4	94 (5)	3	4.1	3	2	67
Building Equipment Contractors (2382)	94 (8.3)	2	1.4	7	5	160 (8.4)	2	2.5	6	4	59
Nonresidential Building Construction (2362)	43 (3.8)	6	1.8	6	6	66 (3.5)	7	2.8	5	7	65
Specialized Freight Trucking (4842)	25 (2.2)	9	2.0	5	7	43 (2.3)	8	3.4	4	6	58
Services to Buildings and Dwellings (5617)	39 (3.4)	7	0.9	9	8	69 (3.6)	6	1.6	12	8	57
Other Specialty Trade Contractors (2389)	24 (2.1)	10	1.2	8	9	35 (1.8)	10	1.7	10	9	69
Employment Services (5613)	31 (2.7)	8	0.4	10	10	50 (2.6)	9	0.7	19	14	62
Utility System Construction (2371)	–[b]	–	–	–	–	26 (1.4)	12	2.3	9	10	NA
All industry groups	1,138 (100)	--	0.5	--	--	1,895 (100)	--	0.8	--	--	60

[a]Rates were calculated on the basis of allowed claims that could be matched with employee counts for the corresponding policy-year.

[b]For industry groups, dashed cells indicate cells that do not meet the PI inclusion criteria.

Abbreviations: TBI, traumatic brain injury; NAICS, North American Industry Classification System; FTEs, full-time equivalents; NA, not applicable.

Note: Rank for count and rate is the average annual rank; For total TBIs, 24 industry groups met the PI inclusion criteria and only 11 industry groups met the inclusion criterial for lost-time TBIs.

2-digit NAICS sectors: Agriculture, Forestry, Fishing and Hunting (11); Mining, Quarrying, and Oil and Gas Extraction (21); Utilities (22); Construction (23); Manufacturing (31–33); Wholesale Trade (42); Retail Trade (44–45); Transportation and Warehousing (48–49); Information (51); Finance and Insurance (52); Real Estate and Rental and Leasing (53); Professional, Scientific, and Technical Services

(54); Management of Companies and enterprises (55); Administrative and Support and Waste Management and Remediation Services (56); Educational Services (61); Health Care and Social Assistance (62); Arts, Entertainment, and Recreation (71); Accommodation and Food Services (72); Other Services (except Public Administration) (81).

Table 6:

Top 10 industry groups by prevention index rankings for lost-time and total TBIs due to struck-by/against events among private employers in Ohio, 2001–2011

	Lost-time TBIs					Total TBIs					
Industry group (4-digit NAICS)	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Count (%)**	**Count rank**	**Rate per 10,000 FTEs[a]**	**Rate rank**	**PI Rank**	**Proportion of lost-time TBIs (%)**
Utility System Construction (2371)	28 (2.2)	8	2.4	2	1	58 (1.2)	21	5.1	8	8	48
Foundation, Structure, and Building Exterior Contractors (2381)	43 (3.3)	4	1.5	6	2	122 (2.5)	5	4.4	6	1	35
Services to Buildings and Dwellings (5617)	51 (3.9)	2	1.2	8	3	132 (2.7)	4	3.2	26	10	39
Other Specialty Trade Contractors (2389)	30 (2.3)	7	1.5	4	4	74 (1.5)	11	3.6	13	7	41
Employment Services (5613)	83 (6.4)	1	1.1	10	5	255 (5.3)	2	3.4	19	4	33
Support Activities for Mining (2131)	20 (1.5)	13	7.0	1	6	31 (0.6)	45	10.8	1	15	65
General Freight Trucking (4841)	41 (3.2)	6	1.3	9	7	113 (2.3)	7	3.4	24	12	36
Highway, Street, and Bridge Construction (2373)	15 (1.2)	17	2.1	3	8	35 (0.7)	40	4.8	12	20	43
Building Equipment Contractors (2382)	45 (3.5)	5	0.7	16	9	157 (3.2)	3	2.4	41	14	29
Cement and Concrete Product Manufacturing (3273)	16 (1.2)	15	2.1	7	10	39 (0.8)	29	5.4	5	13	41
Automotive Repair and Maintenance (8111)	25 (1.9)	9	0.9	13	12	94 (1.9)	8	3.4	22	9	27
Building Material and Supplies Dealers (4441)	18 (1.4)	12	0.9	11	15	79 (1.6)	12	3.9	11	6	23
Plastics Product Manufacturing (3261)	25 (1.9)	11	0.9	14	16	108 (2.2)	6	3.8	8	2	23
Foundries (3315)	–[b]	–	–	–	–	46 (0.9)	18	4.6	3	3	NA
Warehousing and Storage (4931)	–	–	–	–	–	47 (1)	20	5.3	2	5	NA
Restaurants and other eating places (7225) [c]	52 (4.0)	3	0.3	19	13	315 (6.5)	1	1.7	62	30	17

	Lost-time TBIs					Total TBIs					
Industry group (4-digit NAICS)	Count (%)	Count rank	Rate per 10,000 FTEs[a]	Rate rank	PI Rank	Count (%)	Count rank	Rate per 10,000 FTEs[a]	Rate rank	PI Rank	Proportion of lost-time TBIs (%)
All industry groups	1,296 (100)	--	0.5	--	--	4,859 (100)	--	1.9	--	--	27

[a]Rates were calculated on the basis of allowed claims that could be matched with employee counts for the corresponding policy-year.

[b]For industry groups, dashed cells indicate cells that do not meet the PI inclusion criteria.

Abbreviations: TBI, traumatic brain injury; NAICS, North American Industry Classification System; FTEs, full-time equivalents; NA, Not applicable.

[c] Ranked 1st for total TBI count but not ranked in the top 10 by PI.

Note: Rank for count and rate is the average annual rank; For total TBIs, 74 industry groups met the PI inclusion criteria and 19 industry groups met the inclusion criterial for lost-time TBIs. 2-digit NAICS sectors: Agriculture, Forestry, Fishing and Hunting (11); Mining, Quarrying, and Oil and Gas Extraction (21); Utilities (22); Construction (23); Manufacturing (31–33); Wholesale Trade (42); Retail Trade (44–45); Transportation and Warehousing (48–49); Information (51); Finance and Insurance (52); Real Estate and Rental and Leasing (53); Professional, Scientific, and Technical Services (54); Management of Companies and enterprises (55); Administrative and Support and Waste Management and Remediation Services (56); Educational Services (61); Health Care and Social Assistance (62); Arts, Entertainment, and Recreation (71); Accommodation and Food Services (72); Other Services (except Public Administration) (81).

Table 7:

Industry groups ranked in the Top 10 by prevention index for lost-time TBIs across two or more injury events among private employers in Ohio, 2001–2011.

Industry group (4-digit NAICS)	Prevention index ranks for lost-time TBIs				
	Motor vehicle	Falls on same level	Falls to lower level	Struck by or against	Violence and other injuries by persons
General Freight Trucking (4841)	2	2	3	7	–
Foundation, Structure, and Building Exterior Contractors (2381)	7	–[a]	1	2	–
Services to Buildings and Dwellings (5617)	3	–	8	3	–
Other Specialty Trade Contractors (2389)	6	–	9	4	–
Employment Services (5613)	11	7	10	5	–
Utility System Construction (2371)	5	–	-	1	–
Specialized Freight Trucking (4842)	1	–	7	–	–
Highway, Street, and Bridge Construction (2373)	4	–	–	8	–
Investigation and Security Services (5616)	10	3	–	–	–
Cement and Concrete Product Manufacturing (3273)	9	–	–	10	–
Building Equipment Contractors (2382)	14	–	5	9	–
Restaurants and Other Eating Places (7225)	12	4	–	13	3

[a]Dashed cells indicate cells that did not meet the PI inclusion criteria.

Abbreviations: TBI, traumatic brain injury; NAICS, North American Industry Classification System.

2-digit NAICS sectors: Agriculture, Forestry, Fishing and Hunting (11); Mining, Quarrying, and Oil and Gas Extraction (21); Utilities (22); Construction (23); Manufacturing (31–33); Wholesale Trade (42); Retail Trade (44–45); Transportation and Warehousing (48–49); Information (51); Finance and Insurance (52); Real Estate and Rental and Leasing (53); Professional, Scientific, and Technical Services (54); Management of Companies and enterprises (55); Administrative and Support and Waste Management and Remediation Services (56); Educational Services (61); Health Care and Social Assistance (62); Arts, Entertainment, and Recreation (71); Accommodation and Food Services (72); Other Services (except Public Administration) (81).