Occupational Injuries to Oregon Workers 24 years and Younger: An Analysis of Workers' Compensation Claims, 2000–2007

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Background *Occupational injuries to adolescents and young adults are a known public health problem. We sought to describe and estimate rates of occupational injuries to workers younger than 25 years of age in Oregon during an 8-year period.*
Methods *Oregon workers' compensation disabling claims data (n = 23,325) and one commercial insurance carrier's non-disabling claims data (n = 16,153) were analyzed. Total employment from the Local Employment Dynamics of the U.S. Census Bureau and the Oregon Labor Market Information System was used as a denominator for rates.*
Results *Injuries were more frequent among 22–24 year olds and among males, though females accounted for a higher proportion of claims in the youngest age group. The most common injury type was a sprain or strain, but lacerations and burns were more frequently reported in the 14–18 year olds. When non-disabling claims were included, the rate of injury for 14–18 year olds doubled. The overall rate of injury was 122.7/10,000 workers, but was higher in the construction, manufacturing, and transportation sectors, and in the agriculture, forestry, fishing, and hunting sector for older teens and young adults.*
Conclusions *Young workers continue to be at risk for occupational injuries. Our results show that specific interventions may be needed for older teen and young adult workers to reduce their rate of injury.* Am. J. Ind. Med. 53:984–994, 2010. *© 2010 Wiley-Liss, Inc.*

KEY WORDS: workers'compensation; young workers; occupational injuries

INTRODUCTION

Work is an integral part of life, for adults as well as youth. Most teens (70–80%) have jobs before they graduate from high school, and thus are exposed to many different work experiences and environments [Runyan and Zakocs, 2000; National Institute for Occupational Safety and Health, 2010]. Benefits to young employees include increased self-esteem, responsibility, autonomy and job skills, as well as income [National Research Council, 1998; Baron, 2005]. Despite these benefits, there are drawbacks associated with youth employment, including increased high-school drop-out rates with decreased overall educational attainment [National Research Council, 1998]. Furthermore, younger workers, including both adolescents (age 15–19 years) and young adults (age 20–24 years) are at higher risk for experiencing workplace injuries [Runyan and Zakocs, 2000; National Institute for Occupational Safety and Health, 2004; Salminen, 2004; Breslin and Smith, 2005; McCall et al., 2007; Holizki et al., 2008]. Younger workers may be vulnerable because of a number of factors, including lack of experience; dearth of training coincident with lack of supervision; and a lack of physical or cognitive maturity

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[Massachusetts Department of Public Health, 1998; Runyan and Zakocs, 2000; National Institute for Occupational Safety and Health, 2003; Baron, 2005].

Data from various sources have been collected and numerous studies have been undertaken to assess the burden of occupational injuries and illnesses among young workers. Recent data available from the U.S. Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (2007) database showed that 135 work-related fatalities occurred in workers younger than 20 years of age and 424 in workers 20–24 years of age [Bureau of Labor Statistics, 2006]. Data from the Survey of Occupational Injuries and Illnesses (SOII) showed that in 2007, there were nearly 36,000 cases of days away from work among workers under the age of 20 (incidence rate = 124.0 per 10,000 full-time workers), and nearly 125,000 cases among workers 20–24 years of age (incidence rate = 134.4 per 10,000) [Bureau of Labor Statistics, 2006]. Previous analyses have found that the SOII significantly underestimates the magnitude of work-related injuries and illnesses [Rosenman et al., 2006]. This is because the SOII excludes the self-employed, farms with fewer than 11 employees, private households, and federal government agencies. A study using emergency department (ED) data showed that workers aged 15–24 years were twice as likely as workers aged 55 and older to be treated in hospital ED s for nonfatal occupational illnesses and injuries [Centers for Disease Control and Prevention (CDC, 2006)]. Additionally, data from another study suggest that only 34% of occupational injuries and illnesses are treated at an ED; thus, these numbers are likely a significant undercount. [Centers for Disease Control and Prevention (CDC, 2001)].

Workers' compensation (WC) claims have been used to understand the scope and nature of injuries and illnesses to young workers. Several studies in the U.S. and Canada have used WC claims to demonstrate varying rates of injury and illness to teens and young adults (Table I) [Banco et al., 1992; Heyer et al., 1992; Belville et al., 1993; Parker et al., 1994; Brooks and Davis, 1996; Miller and Kaufman, 1998; Cooper et al., 1999; Lipscomb and Li, 2001; Breslin et al., 2003; Ehrlich et al., 2004; Horwitz and McCall, 2005; Breslin and Smith, 2006; Breslin et al., 2007; McCall et al., 2007]. Although WC claims data are an excellent source of information, they have limitations. States differ in their WC systems (e.g., scope of coverage, required reportable claims, required length of missed work before indemnity payment), so it can be difficult to compare across studies. Furthermore, there are differences in how rates of injury are calculated across studies. However, WC records remain an invaluable source for providing detailed information that can be used to characterize injuries and target prevention strategies.

Oregon law mandates that employers within the state have WC insurance benefits for their employees [Workers' compensation law, 2007]. Employers can choose one of three options for WC insurance: self-insurance, insurance through a commercial (private) company, or insurance through the state fund (now known as SAIF Corporation). In 2007, SAIF held 49% of the market share, whereas private insurers held 39% and self-insured employers and employer groups held 12%. Not all Oregon employees are required to have WC coverage (e.g., sole proprietors, private residence workers) nor are all workers captured in the WC system (e.g., federal workers, maritime workers are excluded) [Information Management Division, 2008]. By statute, any claim that results or is likely to result in missing three or more days of regularly scheduled work, hospitalization, or likely permanent disability must be reported to the Oregon

TABLE I. Examples of Previous Studies Estimating Youth Work-Related Injury Rates Based on Workers' Compensation Claims Data

Study	Study period	State	Age studied (years)	Claims included[a]	Reported injury rate
Parker et al. [1994]	1986–1987	MN	12–17	≥3 days lost	14.0 per 1,000 FTE
Banco et al. [1992]	1989	CT	14–17	All	15 per 1,000 employed
Brooks and Davis [1996]	1987–1990	MA	14–17	≥5 days lost	1.9 per 100 FTE
Belville et al. [1993]	1980–1987	NY	14–17	≥8 days lost	28.2 per 10,000 workers
Miller and Kaufman [1998]	1988–1991	WA	11–17	All	9.0 per 100 workers
McCall et al. [2007]	1990–1997	OR	16–19	≥3 days lost	134.2 per 10,000 workers
Breslin et al. [2003]	1993–2000	Ontario (CAN)	15–19	All	30.6 per 1,000 FTE
Breslin et al. [2003]	1993–2000	Ontario (CAN)	20–24	All	32.1 per 1,000 FTE
Breslin and Smith [2006]	2000	Ontario (CAN)	15–19	All	27.0 per 1,000 FTE
Breslin and Smith [2006]	2000	Ontario (CAN)	20–24	All	26.5 per 1,000 FTE
Horwitz and McCall [2005]	1998–2002	RI	15–19	All	6.6 per 100 workers
Breslin et al. [2007]	2001	Ontario (CAN)	15–24	All	3.9 per 100 FTE

FTE, full-time equivalent workers based on 2,000 hr worked/year; 100 FTE, 200,000 hr worked.

[a]Refers to states/provinces where a period of lost time is required for the claim to be reported to the WC administrative agency.

Department of Consumer and Business Services (DCBS), which administers laws in WC, occupational safety and health, insurance, and other areas.

This study increases our understanding of injuries to young workers by examining the epidemiology of occupational injuries to workers 24 years of age and younger using Oregon WC claims data from 2000 to 2007. Specifically, we examine characteristics of injuries to workers in three separate age groups: 10–18, 19–21 and 22–24 years.

METHODS

Data Sources

Disabling claims data

We used WC data from the DCBS to describe disabling injuries. In this analysis, we included only the accepted disabling claims in workers younger than 25 years of age. This was performed because reporting non-disabling claims to the DCBS is voluntary, thus, these claims may represent an incomplete and potentially biased source of data.

The disabling claims data include information needed to administer claims, such as source and nature of injury, injury event, occupation, industry, employer information, employee demographics, hospitalization status, and claim status. Nature of injury, part of body, and source of injury are coded by the DCBS using Occupational Illness and Injury Coding System (OIICS) [Bureau of Labor Statistics, 2002]. It codes industries with the North American Industry Classification System (NAICS) [U.S. Department of Management and Budget, 2002] and occupations with the 1990 Bureau of Census (BOC) occupation codes [U.S. Census Bureau, 2003].

Non-disabling claims data

Data from a commercial insurance carrier (CIC) were used to describe the non-disabling claims among workers less than 25 years of age. CICs are companies that provide WC coverage to employers for a premium. CICs collect information on all injuries that are paid out by their company.

All CICs in Oregon report accepted disabling, denied disabling, and denied non–disabling claims to the DCBS. However, they are not required to report accepted non-disabling claims. These non-disabling claims augment occupational injury and illness surveillance by providing information on workplace injury trends that may be more common, but less severe, and injuries that would not be captured otherwise. This allows us to more completely examine the range of work-related injuries to younger workers.

Employment data

In constructing injury rates, we used data from the Quality Workforce Indicators (QWI) project, which is a partnership between the Local Employment Dynamics of the U.S. Census Bureau and select states' Labor Market Information (LMI) agencies. The state LMI agencies supply key employment data collected from unemployment wage records and from businesses each quarter. The Census Bureau merges these data with current demographic information to produce employment information by selected age groups, gender, and industry division (NAICS) [U.S. Census Bureau, 2009].

ANALYSIS

Disabling Claims Only

Frequencies of disabling claims by age group, gender, nature of injury, body part, injury event, injury source, hospitalization status, summer season, weekend day, fatality status, occupation, event, and source were calculated to characterize work-related injuries to young workers in Oregon between 2000 and 2007. We also calculated overall rates of disabling injuries for each age group (14–18, 19–21, and 22–24 years) using total employment from the QWI data. Because the QWI data do not contain employment figures for workers under the age of 14, rates could only be calculated for youth over the age of 14. Because youths work fewer hours per week than older adults, using total employment may underestimate injury risk [Ruser, 1998; Calvert et al., 2003]. However, adolescents, while also working fewer hours than older adults, also have varied schedules throughout the course of a year, including weekends, summer vacations, and other holidays. Data on total hours worked, such as that available from the Bureau of Labor Statistics' Current Population Survey (CPS), may be inaccurate for younger groups depending on when the survey was administered. Other authors have used rates by employment, rather than hours worked, to reduce this potential source of bias in younger age groups [Belville et al., 1993]. Rates by industry division were also calculated for each individual age group.

Non-Disabling Claims Only

For the non-disabling claims from the CIC, we calculated frequencies by gender for each age group.

Total Claims

We combined the disabling claims from the DCBS with the non-disabling claims from the CIC and calculated overall injury rates for all claims.

All of the activities performed under our NIOSH occupational health surveillance cooperative agreement, including this study, have been reviewed and approved by the Public Health Institutional Review Board.

RESULTS

Disabling Claims only

Frequencies

In Oregon, between 2000 and 2007, there were 23,325 accepted disabling claims filed by workers 10–24 years of age; 12.5% (2,915) were made by workers 10–18 years of age, 39.0% (9,098) were made by workers 19–21 years of age, and 48.5% (11,312) were made by workers 22–24 years of age. Characteristics of these work-related injuries are shown in Table II. Approximately 69% of the claimants were male; however, females accounted for a larger percentage of the younger age groups. There were 45 accepted claims for fatal injuries in workers aged 10–24 years during this study period. The percentage of fatalities was similar for all age groups—between 0.1% and 0.2% of total claims. This is equivalent to seven fatalities among workers 10–18 years old, 13 fatalities among 19–21 yearsold, and 25 fatalities among 22–24 years old. The most common event leading to a fatality was a highway crash (n = 19, 42.2%), followed by a non-highway crash (n = 8, 17.8%). Five fatalities were caused by a worker being struck by an object or equipment (11.1%) (data not shown).

Although the most common nature of injury for all age groups was sprain or strain (49.0%), injured workers 10–18 years of age were more likely to have a laceration than 19–21 year olds or 22–24 year olds. In addition, workers 10–18 years of age were much more likely to have a burn than either 19–21 year olds or 22–24 year olds. Workers 10–18 years of age were more likely to injure both lower and upper extremities compared to the 1921 and 22–24 year olds. However, workers 10–18 years of age were less likely to injure their trunk compared with the other age groups. Among injured workers, hospitalizations were similarly distributed for both the 10–18 and 19–21 years of age groups. The distribution of claims by season (summer vs. not summer) and day of the week (weekend vs. weekdays) differed across age groups. Younger claimants were more likely to be injured in the summer and on weekends. Overall, the most commonly reported occupation group for all age groups was handlers, equipment cleaners, helpers, and laborers (22.2% of total). Injured workers 10–18 years of age were over-represented in the service occupations category and the farming, forestry, and fishing category compared with both 19–21 and 22–24 year olds. Workers 22–24 years of age had a higher percentage of occupations in the transportation sector than either the 10–18 or 19–21 year olds.

For the event leading to the injury (Table III), injured workers 10–18 years of age were more likely to suffer a fall than either 19–21 or 22–24 year olds. Both 10–18 and 19–21 year olds were more likely to be struck by or against objects or equipment than 22–24 year olds. Overexertion was more common in 22–24 year olds than in 19–21 or 10–18 year olds. Temperature extremes were more commonly experienced by those 10–18 years of age than by 19–21 or 22–24 year olds.

The most frequent source of injury for all age groups combined was "person-injured or ill worker"[1]; as age increased, the proportion of this source also increased. Of those that were injured, workers 10–18 years of age were more likely to be injured by floors or walkways compared with 19–21 and 22–24 year olds. Machines were a more common source of injury for 10–18 year olds than for those 19–21 or 22–24 year olds. Of the different types of machinery, 10–18 year olds were specifically more likely to be injured by special process machinery (27.0% of total injuries caused by machines for 10–18 year olds vs. 16.4% and 12.5% for 19–21 and 22–24 year olds, respectively). Of the special process machinery injuries to 10–18 year olds, 59% were caused by food slicers, and 12.8% were caused by food and beverage mixers and blenders (data not shown). Building materials were a more common source of injury to 22–24 and 19–21 year olds compared with those 10–18 years of age. The two categories of food products and steam, vapors, or liquids were more likely to cause injury to workers 10–18 years of age compared with the other two age groups.

Rates

Overall rates of injury by age group and gender for the total time period are presented in Table IV. By age group, the overall rate was highest for workers aged 22–24 years (140.7 per 10,000 workers) and lowest for the 14–18 year olds (70.8 per 10,000 workers). Rates of injury were also examined by gender. Males 22–24 years old had the highest rate, followed by males 19–21 years old. The rate of injury for females was lowest in the 14–18 year-old group, followed by 19–21 and 22–24 year olds.

Table V presents injury rates by industry sector for the three age groups examined in this analysis. The industry sector with the highest rate per 10,000 workers for 14–18 year olds was construction (173.0), followed by transportation and utilities (161.7) and manufacturing (126.4). For 19–21 year olds, the industry sector with the highest rate per 10,000 workers was construction (334.8),

[1] e.g., stress or strains induced by a free movement of the body or its parts, with no impact involved; awkward or sustained positions of the injured worker; motion sickness; or nervous disorders, symptoms, or illnesses

TABLE II. Characteristics of Disabling Oregon WC Claims by Age Group, 2000–2007

	Age group number (years) (column %)			
	10–18	**19–21**	**22–24**	**Total**
Gender				
Male	1,832 (62.9)	6,285 (69.1)	8,082 (71.5)	16,199 (69.4)
Female	1,083 (37.1)	2,813 (30.9)	3,230 (28.6)	7,126 (30.6)
Nature of injury				
Sprain/strain	1,211 (41.5)	4,466 (49.1)	5,744 (50.8)	11,421 (49.0)
Fracture	351 (12.0)	961 (10.6)	1,196 (10.6)	2,508 (10.8)
Laceration	377 (12.9)	868 (9.5)	832 (7.4)	2,077 (8.9)
Contusion/bruise	271 (9.3)	680 (7.5)	792 (7.0)	1,743 (7.5)
Musculoskeletal disease	47 (1.6)	235 (2.6)	362 (3.2)	644 (2.8)
Burn	133 (4.6)	215 (2.4)	218 (1.9)	566 (2.4)
Dislocation	57 (2.0)	173 (1.9)	234 (2.1)	464 (2.0)
Amputation	50 (1.7)	125 (1.4)	121 (1.1)	296 (1.3)
Carpal tunnel syndrome	4 (0.1)	46 (0.5)	96 (0.9)	146 (0.6)
All other	414 (14.2)	1,329 (14.6)	1,717 (15.2)	3,460 (14.8)
Part of body				
Back	526 (18.0)	2,103 (23.1)	2,816 (24.9)	5,445 (23.3)
Lower extremities	712 (24.4)	2,091 (23.0)	2,465 (21.8)	5,268 (22.6)
Upper extremities	514 (17.6)	1,351 (14.9)	1,707 (15.1)	3,572 (15.3)
Fingers	499 (17.1)	1,201 (13.2)	1,236 (10.9)	2,936 (12.6)
Trunk	253 (8.7)	1,018 (11.2)	1,315 (11.6)	2,586 (11.1)
Head/face/neck	132 (3.8)	283 (3.1)	398 (3.5)	793 (3.4)
Eyes	36 (1.2)	107 (1.2)	113 (1.0)	256 (1.1)
Multiple	206 (7.1)	697 (7.7)	947 (8.4)	1,850 (7.9)
All other	57 (2.0)	247 (2.7)	315 (2.8)	619 (2.7)
Hospitalization status				
Hospitalized	122 (4.2)	372 (4.1)	403 (3.6)	897 (3.9)
Not hospitalized	2,292 (78.8)	7,293 (80.3)	9,182 (81.3)	18,767 (80.6)
Unknown	495 (17.0)	1,423 (15.7)	1,715 (15.2)	3,633 (15.6)
Fatal status				
Yes	7 (0.2)	13 (0.1)	25 (0.2)	45 (0.2)
No	2,908 (99.8)	9,085 (99.9)	11,287 (99.8)	23,280 (99.8)
Season				
Summer (June–August)	1,122 (38.5)	2,742 (30.1)	3,191 (28.2)	7,055 (30.2)
Not Summer (September–May)	1,793 (61.5)	6,356 (69.9)	8,121 (71.8)	16,270 (69.8)
Day				
Weekend (Saturdya—Sunday)	646 (22.2)	1,404 (15.4)	1,639 (14.5)	3,689 (15.8)
Weekday (Monday—Friday)	2,269 (77.8)	7,694 (84.6)	9,673 (85.5)	19,636 (84.2)
Occupation group (BOC)[a]				
Handlers, equipment cleaners, helpers, and laborers	743 (25.5)	2,189 (24.1)	2,247 (19.9)	5,179 (22.2)
Service occupations, except protective and household	721 (24.7)	1,523 (16.7)	1,652 (14.6)	3,896 (16.7)
Precision production, craft, and repair	136 (4.7)	775 (8.5)	1,300 (11.5)	2,211 (9.5)
Machine operators, assemblers, and laborers	149 (5.1)	713 (7.8)	1,028 (9.1)	1,890 (8.1)
Sales occupations	179 (6.1)	539 (5.9)	548 (4.8)	1,266 (5.4)
Farming, forestry, and fishing	204 (7.0)	427 (4.7)	496 (4.4)	1,127 (4.8)
Transportation and material moving	59 (2.0)	305 (3.4)	564 (5.0)	928 (4.0)
All other occupations	168 (5.8)	763 (8.4)	1,161 (10.3)	2,092 (9.0)
Unknown/uncoded	556 (19.1)	1,864 (20.5)	2,316 (20.5)	4,736 (20.3)
Total (row percent)	2,915 (12.5)	9,098 (39.0)	11,312 (48.5)	23,325 (100)

US Census Bureau, 2003.

TABLE III. Frequency of Disabling WC claims by Age Group, Event and Source, 2000–2007

	Age group (years) number (column %)			
	10–18	19–21	22–24	Total
Event				
Overexertion	561 (19.3)	2,098 (23.1)	2,820 (24.9)	5,479 (23.5)
Struck by or against	670 (23.0)	1,961 (21.6)	2,183 (19.3)	4,814 (20.6)
Falls	532 (18.3)	1,406 (15.5)	1,725 (15.3)	3,663 (15.7)
Bodily reaction	265 (9.1)	966 (10.6)	1,265 (11.2)	2,496 (10.7)
Caught in or between	228 (7.8)	618 (6.8)	675 (6.0)	1,521 (6.5)
Repetitive motion	102 (3.5)	520 (5.7)	808 (7.1)	1,430 (6.1)
Transportation accident	159 (5.5)	458 (5.0)	546 (4.8)	1,163 (5.0)
Temperature extreme	116 (4.0)	174 (1.9)	181 (1.6)	471 (2.0)
Assault or violence	19 (0.7)	106 (1.2)	167 (1.5)	292 (1.3)
All other	263 (9.0)	791 (8.7)	942 (8.3)	1,996 (8.6)
Source				
Person-injured or ill worker[a]	372 (12.8)	1,493 (16.4)	2,094 (18.5)	3,959 (17.0)
Floors, walks, ground	459 (15.8)	1,203 (13.2)	1,493 (13.2)	3,155 (13.5)
Containers	381 (13.1)	1,073 (11.8)	1,322 (11.7)	2,776 (11.9)
Machines	289 (9.9)	758 (8.3)	845 (7.5)	1,892 (8.1)
Vehicles	251 (8.6)	702 (7.7)	831 (7.4)	1,784 (7.7)
Hand tools	179 (6.1)	562 (6.2)	600 (5.3)	1,341 (5.8)
Building materials	126 (4.3)	482 (5.3)	658 (5.8)	1,266 (5.4)
Person-other than injured or ill worker	86 (3.0)	440 (4.8)	606 (5.4)	1,132 (4.9)
Furniture, fixtures	106 (3.6)	300 (3.3)	355 (3.1)	761 (3.3)
Food products	45 (1.5)	96 (1.1)	85 (0.8)	226 (1.0)
Steam, vapors, liquids	42 (1.4)	34 (0.4)	46 (0.4)	122 (0.5)
All other	579 (19.9)	1,955 (21.5)	2,377 (21.0)	4,911 (21.1)
Total (row percent)	2,915 (12.5)	9,098 (39.0)	11,312 (48.5)	23,325 (100)

[a]Example: Stress or strains induced by a free movement of the body or its parts, with no impact involved; awkward or sustained positions of the injured worker; motion sickness; or nervous disorders, symptoms, or illnesses

followed by agriculture (317.2) and transportation and utilities (263.6). For 20–24 year olds, the industry sector with the highest rate per 10,000 workers was agriculture (342.7), followed by construction (331.9) and transportation and utilities (296.7). Industry sectors where 19–21 year olds had higher rates of injury per 10,000 workers than any other age group were manufacturing (205.7), educational and health services (111.7), public administration (85.6) and professional and business services (109.0).

In the educational and health services industry, the majority of claims for 19–21 year olds were in the industry subsector of nursing and residential care facilities (54.9%), followed by hospitals (16.7%) compared with 45.8% and 23.0%, respectively, for the same sectors in 22–24 year olds (data not shown). For 14–18 year olds, the subsector of nursing and residential care facilities was also the most common (53.2%), but teens of this age were much less likely to work in hospitals (8.3%).

Non-Disabling Claims Only

Between 2000 and 2007, there were 16,153 accepted non-disabling claims identified for workers 14–24 years of age from the CIC data; 18.3% (2,955) were from workers 14–18 years of age, 38.7% (6,244) were from workers 19–21 years of age, and 43.1% (6,954) were from workers 22–24 years of age. As with the accepted disabling WC claims data, females made up a larger proportion of the younger age groups (nearly 42% of the 14–18 year olds, and nearly 32% of the 19–21 year olds) (data not shown).

Total Claims

Figure 1 shows the rates for total claims (disabling and non-disabling) and the rates for disabling claims only. This figure demonstrates the change in overall injury rates when the CIC non-disabling claim counts are added to the disabling claims from the DCBS. For the 14–18 year olds, the rate

TABLE IV. Rate of Disabling WC Claims by Age Group and Gender, 2000–2007

Age group (years)[a]	Total employment	Total claims	Rate/10,000 (95% CI)
14–18			
Male	191,354	1,825	95.4 (91.0–99.8)
Female	218,953	1,079	49.3 (46.3–52.2)
Total	410,312	2,904	70.8 (68.2–73.4)
19–21			
Male	331,244	6,285	189.7 (185.1–194.4)
Female	355,033	2,813	79.2 (76.3–82.2)
Total	686,280	9,098	132.6 (129.9–135.3)
22–24			
Male	400,299	8,082	201.9 (197.5–206.3)
Female	403,734	3,230	80.0 (77.2–82.8)
Total	804,037	11,312	140.7 (138.1–143.3)
14–24			
Male	922,897	16,192	175.4 (172.7–178.1)
Female	977,720	7,122	72.8 (71.2–74.5)
Total	1,900,629	23,314	122.7 (121.1–124.2)

CI, confidence interval.
[a]11 workers of age less than 14 years were excluded from rate calculations.

doubled; for the 19–21 and 22–24 year olds, the rates increased around two-thirds (Fig. 1).

DISCUSSION

This study reviewed accepted, disabling injury claims and a portion of non-disabling claims in Oregon from 2000 to 2007 to describe the epidemiology of injuries to workers 10–24 years of age. Consistent with prior research, our results confirm that occupational injuries to young workers are a real and continuing problem [Runyan and Zakocs, 2000; Salminen 2004]. Our results are consistent with a similar study using Oregon data from 1990 to 1997 [McCall et al., 2007]. The findings show that there were over 23,000 accepted, disabling injuries reported to Oregon DCBS during the 8-year time frame, and demonstrated a disabling claims rate of 122.7 per 10,000 workers. When medical only data from the CIC were added to the disabling claims, the rate of claims doubled for the youngest age group (14–18 years). There were also 45 Oregon adolescents and young adult workers killed in work settings during the 8-year period of this analysis. This number is likely an undercount, since more fatalities may have occurred that would not have been eligible to receive WC (e.g., employed on small family farms). Since 2003, the Oregon Occupational Fatality Assessment Control and Evaluation program (OR-FACE) has collected case-based data on occupational fatalities in Oregon. For the 5-year period of 2003–2007, the OR-FACE program recorded 45 fatalities in workers 24 years of age and younger. Of these 45 deaths, 22 were not covered under WC: eight in workers 18 years and younger, eight in 19–21 year olds, and six in 22–24 year olds (Terry Hammond, OR-FACE program, December 16, 2008, written communication).

One of the more troubling findings was the high percentage of back injuries found among young workers. This is because back injuries are some of the most costly injuries to treat [Lipscomb et al., 2009]. Furthermore, early back injuries may increase the risk for more serious

TABLE V. Disabling WC Claims Rate by Industry and Age Group, 2000–2007*

	14–18 years		19–21 years		22–24 years	
	Rate	95% CI	Rate	95% CI	Rate	95% CI
Agriculture, forestry, fishing, and hunting	92.3	78.7–105.9	317.2	291.4–342.9	342.7	316.5–369.0
Mining	NA		186.9	57.4–316.4	200.7	87.1–314.2
Construction	173.0	149.6–196.3	334.8	314.6–355.1	331.9	314.8–339.0
Manufacturing	126.4	109.7–143.1	205.7	193.5–218.0	183.9	174.4–193.5
Wholesale and retail trade	61.2	56.4–66.1	86.4	82.2–90.7	99.9	95.2–104.6
Transportation and utilities	161.7	125.8–197.6	263.6	238.5–288.7	296.7	273.2–320.3
Information	22.5	10.7–34.3	42.1	29.5–54.7	30.1	21.8–31.5
Financial activities	12.7	6.3–19.1	24.3	18.8–29.8	26.3	21.6–30.9
Professional and business services	70.5	61.1–79.9	109.0	101.8–116.2	105.3	99.2–111.4
Educational and health services	67.2	58.2–76.1	111.7	103.8–119.6	51.4	48.3–54.6
Arts, entertainment, and recreation	48.0	37.4–58.7	59.0	47.7–70.3	57.3	46.2–68.4
Accommodation and food services	47.9	44.2–51.5	79.5	74.8–84.1	92.3	87.0–97.6
Other services (except public administration)	33.9	24.9–42.8	69.9	59.4–80.4	75.5	65.6–85.4
Public administration	56.0	38.2–73.8	85.6	67.5–103.7	77.9	64.7–91.1

*Per 10,000 workers.

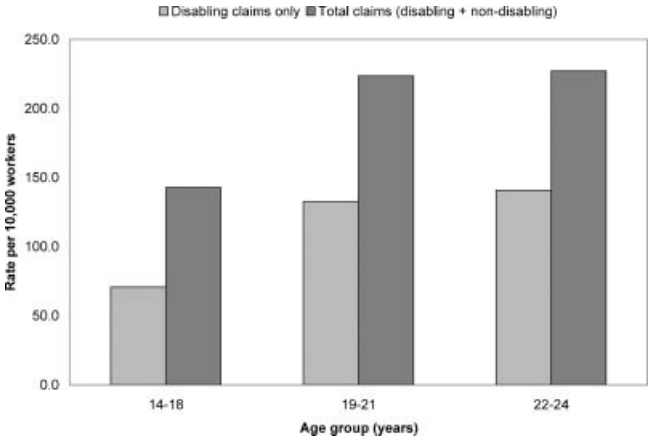

FIGURE 1. Disabling and total claims rates.

back injuries in the future [Brophy et al., 2001; Breslin et al., 2003]. This finding has important implications for prevention and policy, because reducing musculoskeletal injuries, including back injuries, early in a worker's career may reduce future permanent impairment [Breslin et al., 2003].

Claim Rates by Industry

Workers 19–21 years of age had a higher injury rate in the public administration sector than did 22–24 year-olds. This is an industry that has been shown to have a high rate of injury to younger workers [Banco et al., 1992; Miller and Kaufman, 1998]. As previously demonstrated, most of the occupations for younger workers in this industry are more likely to involve physical labor than administrative tasks, and are therefore inherently more hazardous [Miller and Kaufman, 1998]. A review of occupation descriptions in the Oregon WC claims data for this age group confirmed this finding, with firefighting occupations the most commonly reported, followed by protective service and laborers. These data imply that workers in this age group may benefit from targeted intervention strategies.

The rate of injury in the educational and health services sector for 19–21 year olds was more than double that of 22–24 year olds. However, between 2000 and 2007, this sector had a lower concentration of total employment for 19–21 year olds (9%) than in 22–24 year olds (11%) [Oregon Labor Market Information System, 2009]. This finding implies that large numbers of teens in this sector may not solely be responsible for the high rate of claims in educational and health services. We found that both 14–18 and 19–21 year olds were more likely than 22–24 year olds to be employed in nursing and residential care facilities. They were also more likely to be classified as nursing aides, orderlies, or attendants (data not shown). These data may imply a higher rate of injury to young workers directly involved in hands-on aspects of patient care (e.g., transporting, moving, or lifting) such as that experienced by certified nursing assistants (CNAs). Previous analyses by our section showed that nursing aides have a much higher rate of claims for musculoskeletal disorders than registered nurses (Oregon Occupational Public Health Program 2007, unpublished data), and this is supported by other data [Waters et al., 2006; Menzel, 2008]. The relatively high rate of injuries in 19–21 year-old group supports the idea of further research to clarify unique risks to this population, including comparison to older workers [Mardis and Pratt, 2003].

Limitations

There are some limitations to this analysis. Claims that are both filed and accepted under represent the actual incidence of work-related injuries and illnesses [Brooks and Davis, 1996; Miller and Kaufman, 1998; Horwitz and McCall, 2005]. Reasons for this undercount include lack of knowledge of WC law and worker rights among some employees, lack of a work-related consideration or diagnosis by a health care provider, or fear of employer retribution by an employee [Miller and Kaufman, 1998]. Parker et al. (1994) estimated that 2/3 of work-related injuries in 12–17 year olds were not reported to the Minnesota Department of Labor & Industries. Furthermore, an analysis of 2004 Oregon Population Survey data showed that 37% of workers injured on the job in 2003 did not file claims for workplace injuries or illnesses, which translates into 32,000 unreported cases [Information Management Division, 2005]. Furthermore, many teens may work as newspaper carriers or in-home childcare providers, but these are not occupations that are covered under state Workers' compensation law [2007] It is unknown if adults or teens are more or less likely to work jobs that are covered under WC [Miller and Kaufman, 1998]. Therefore, the injury rates calculated in this paper are likely to underestimate the true rates.

Some authors argue that calculating rates of injury by employment and not hours worked dilutes the true magnitude of work-related injuries and illnesses, because younger workers are more likely to work part-time [Brooks et al., 1993; Ruser, 1998; Breslin and Smith, 2005]. However, others argue that because of the seasonal, part-time nature of work for adolescents, rates based on monthly survey data, such as CPS, might be biased depending on when the survey was administered [Belville et al., 1993]. Regardless of the denominator choice, both methods generally identify the same high- and low-risk groups [Ruser, 1998]. We chose to use employment data, rather than monthly survey data from the CPS, as our denominator to reduce this source of bias. However, FTE can be approximated using the General Accountability Office (GAO) estimates that teens 16–17 years of age generally work 21 hr a week, 23 weeks per year, and FTE injury rates can be calculated by multiplying the rate based on the number of working

adolescents by a factor of 4 [U.S. General Accounting Office, 1991; Belville et al., 1993; Brooks and Davis, 1996]. When we apply this method, the rate per 100 FTE would be 2.8 per 100 FTE for the youngest group. For 19–21 and 22–24 year olds, if we assume they generally work full-time, their rate per 100 FTE would be 1.3 and 1.4, respectively. Using that approximation, the youngest group of workers indeed has the highest overall rate of injury. These issues illustrate the complexity of choosing denominators when calculating rates of injuries for young workers, and demonstrate the need for future research to help fill these data gaps.

Oregon law restricts working hours of 16- and 17-year olds (44 hr per week), and limits the activities for workers of this age (e.g., prohibiting 16-year olds from driving motor vehicles, and 17-year olds from using power driven saws or bakery machines) [Bureau of Labor and Industries, 2008]. However, our denominator source included 18-year olds in the youngest group—a group to which child labor laws do not apply. This fact potentially obscures the true rate of injury to the youngest workers. We found that 10–18 year olds were more likely than the other age groups to be injured by special process machinery (e.g., blenders and food slicers). Furthermore, nearly 63% of the injuries attributed to special process machinery occurred in 18-year olds. Use of these types of machinery is limited and/or prohibited in workers younger than 18 years [Bureau of Labor and Industries, 2008]. These data suggest that a shift to more hazardous job duties may occur when workers are no longer prohibited, based on age, from performing certain tasks [Banco et al., 1992; Horwitz and McCall, 2005].

Oregon law only requires that claims that result or are likely to result in three or more missed workdays be reported. This is more likely to undercount injuries to part-time workers, such as students, who may not miss workdays because of their schedules. For example, if a younger worker was injured on a Saturday (and that was his/her only scheduled workday), then missed a whole week of school, but was able to return to work for his or her next Saturday shift, the injury would not be reported. Authors using state data where all claims are required to be reported, not just those with a specific number of paid leave days, generally calculate higher rates [Brooks and Davis, 1996; Horwitz and McCall, 2005]. This is illustrated in Oregon by the increase in rates (Fig. 1) that occurred once a portion of non-disabling claims was added to the disabling data. Oregon could improve occupational surveillance by requiring that all claims resulting in an injury be reportable to the WC division, as is the requirement in other states such as Rhode Island [Horwitz and McCall, 2005]. Even without this policy change, obtaining non-disabling claims data from some CICs helps to address the undercount problems present in the current WC data and augments Oregon's occupational public health surveillance system.

Finally, occupational disease is even less likely than injury to be fully captured from WC data. Previous research demonstrated that in 1999, WC missed between 46 and 93,000 deaths and $8 to $23 billion in medical costs because of occupational disease [Leigh and Robbins, 2004]. Possible future approaches to remedy undercounting of occupational injury and disease include obtaining ED visit data, electronic medical records, or a change in the law to require reporting of all occupational injuries and illnesses in Oregon.

Prevention Efforts

Efforts to prevent work-related injuries and illnesses among young workers continue to expand at the national and state level. The National Young Worker Health and Safety Resource Center [California Resource Network, 2010] provides training, technical assistance, and resource materials to state and community groups throughout the country. Because of this, states have established partnerships and resource centers to build capacity for young worker safety and health (e.g., Massachusetts Young Worker Initiative Task Force) [Massachusetts Department of Public Health, 2003]. In Oregon, staff at the University of Oregon Labor Education & Research Center has led the effort to organize the Oregon Young Worker Health and Safety Coalition to coordinate efforts among various state and federal agencies and other young worker stakeholders to develop strategies and raise awareness of issues affecting young workers [LERC, 2008]. Current projects include providing workshops for teachers for the ''Youth @ Work: Talking Safety'' high school curriculum [National Institute for Occupational Safety and Health, 2007], providing a one page flyer with an Oregon child labor law summary on the back and tips on preventing injuries at work to school districts to include in school registration packets, and sponsoring an annual video contest among high-school students to create a Public Service Announcement that promotes worker health and safety to be shown in pre-movie commercials in select Oregon theaters.

CONCLUSIONS

This study adds to the evidence that teenagers and young adults are at risk for work-related injuries, illnesses, and fatalities. Continued surveillance of claims data, as well as examining new sources of data, is essential to monitor young worker safety and health and to help target intervention efforts. Our results by industry demonstrate that special attention should be given to older teen workers, who are not covered under child labor laws but may still lack the emotional or cognitive maturity to perform higher-risk tasks, especially in educational and health services, and certain jobs in public administration. Our findings also illustrate

the complexities of calculating injury rates for this population, and demonstrate the importance of filling existing data gaps to form a comprehensive picture of injuries to young workers.

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